United Nations
Educational, Scientific and
Cultural Organization

From
the People
of Japan

Office of the Science Advisor
Prime Minister's Office

Malaysian Industry-Government Group
for High Technology

Regional/Thematic Symposium on
Broadening the Application of the Sustainability Science Approach
in Support of the 2030 Agenda for Sustainable Development:
A Focus on Regional Experiences
and Inputs for the Development of Sustainability Science Policy Guidelines

Kuala Lumpur - Malaysia
19 - 21 December 2016

Report[1]

The Office of the Science Advisor to the Prime Minister and the Malaysian Industry-Government Group for High Technology (MIGHT) hosted the Second Regional/Thematic Symposium on Sustainability Science, held in Kuala Lumpur, Malaysia at the Berjaya Times Square Hotel, from 19 to 21 December 2016. This symposium was the second in a series in the context of a project generously supported by the Government of Japan on "Broadening the Application of the Sustainability Science Approach".

The 3-day symposium focused on presentations and discussions on how to apply a sustainability science approach in UNESCO's five regions. It involved the identification of particular regional characteristics, priorities, needs and gaps, and to incorporate such specific features into the planned guidelines on the application of sustainability science. The annotated outline of the draft guidelines on sustainability science was the main result of this symposium (see Annex). In parallel, the relevance of the Sustainable Development Goals (SDGs) and the 2030 Agenda for Sustainable Development was also highlighted in the symposium as a transversal matrix for guiding.

The programme started with an opening session, attended by Professor Zakri Abdul Hamid, Science Advisor to the Prime Minister of Malaysia; Mr Kazuo Akiyama, Senior Analyst for Policy Information, Ministry of Education, Culture, Sports, Science and Technology (Japan/MEXT) and Mr Irakli Khodeli, Programme Specialist, UNESCO Office in Jakarta and representative of the UNESCO Social and Human Sciences Sector.

The symposium, organized in five plenary sessions, focused on two main criteria: the thematic and regional criteria, to reflect the regional characteristics of UNESCO's five regions, with one plenary session on the academic aspect of the transdisciplinarity in research and education. It also ended with another plenary session on next steps regarding the elaboration of guidelines on sustainability science and the project's implementation.

Twenty-three presentations were given, representing academia and practitioners, best

[1] Prepared by Dr Christine A. Iskandar, UNESCO

practices/case studies from UNESCO's five regions. Three breakout groups were held to outline the draft guidelines on sustainability science covering the following pillars: Principles of sustainability science, guidelines for research and for education. A web knowledge platform of the project was also presented.

A joint Steering Committee (SC) and its Sub-Drafting Committee (DC) meetings were held during the symposium on 20 December 2016. There was very good media coverage with a press conference organized. A good number of multimedia materials had been produced out of the symposium (individual video interviews, one dynamic video, group photos and symposium photos) which are disseminated on the project's website.

UNESCO's five regions were represented by various multistakeholders and multidisciplinary experts covering several target audiences namely: academia, think tanks, practitioners and governments, the private sector, NGOs and media from more than 10 countries including: Brazil, Barbados, USA, Norway, Portugal, Egypt, Jordan, Kenya, Japan and Malaysia. The meeting consisted of the balanced presence of regional experts in natural, social and human sciences as well as education representing UNESCO's five regions with the Steering and Sub-Drafting Committee members were present.

More than 30 of the experts who came from UNESCO's five regions represented 24 partner organizations from Africa (2), Arab States (2), Asia and the Pacific (12), Europe and North America (5), and Latin America and the Caribbean (2). Several female experts from Latin America and the Caribbean as well as Asia and the Pacific attended the symposium and presented case studies from their respective areas of expertise which is of relevance to sustainability science and also to their regions.

From the presentations of the many case studies the following main points emerged:

- The process of sustainability science requires time, needs consistencies and coherence.
- There is a need to involve indigenous and local knowledge in sustainability science.
- Understanding the legislation of each region for an effective implementation is a need.
- Achieving a unified standard understanding of sustainability science is essential.
- Create an enabling environment for Science, Technology and Innovation – STI, through including STI in sustainable development plans.
- Promote educating students in four specific disciplines - science, technology, engineering and mathematics (STEM) in an interdisciplinary and applied approach.
- Engage in expanding knowledge and data sharing at the regional and international levels e.g. the "Open Data in a Big Data World" international accord provides an opportunity by ICSU, IAP, TWAS and ISSC.
- Make use of the expertise of Arab scientists in the diaspora but not before embarking on the creation of an enabling conducive environment for STI and entrepreneurship.
- Adoption of a transdisciplinary approach in rebuilding the knowledge base should help Arab countries better address development challenges within the SDGs and 2030 Agenda.
- Research infrastructure investments to enable genuine interdisciplinary and transdisciplinary work.
- Evaluations of measures that take care of the realities of inter-/transdisciplinarity should be more concrete.
- Cross-disciplinary immersion through problem/case/theme focused field schools and research schools.
- Research and educational policy initiatives and investments that bridge sectors and reinforce connections should be truly integrative in ambition and scope.
- Sustainable science strategies should be built as part within governance strategies.
- Education, participative experiments, science based narratives and dilemmas debate should be promoted as comprehensive packages such as the UNESCO work on education for SDGs.
- Sustainable science should be based on an integrated framework including mid-long term humanities' dilemmas.

The following sections present a brief overview of the insights that emerged from the presentations, case studies and discussions.

Achieving transdisciplinarity in research and education, and the role of science and knowledge in attaining sustainability: An introduction

The adoption of the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDG) that, contrary to the MDGs, have universal applicability could represent a break-through for sustainability science. Agenda 2030 encourages all states to "conduct regular and inclusive reviews of progress at the national and sub-national levels, which are country-led and country-driven".

Sustainability science can develop to be the most useful instrument to achieve this. Yet, it will require greater acceptance and understanding by decision-makers and other stakeholders, as well as guidelines for the implementation of sustainability science and its transdisciplinary approach, including directions on how to prepare demands, how to evaluate proposals, and how to ensure interaction between academics and the rest of society.

Sustainability science is a transdisciplinary research agenda that points the way toward a sustainable society:

- Approach the problem of sustainability at three levels of ''system''- global, social, and human; and
- All three systems are crucial to the coexistence of human beings and the environment, the current crisis of sustainability can be analyzed in terms of the breakdown of these systems and the linkages among them.
- It is transdisciplinary, in that it goes beyond an integrated interdisciplinary approach by including different stakeholders, e.g. knowledge producers and users, also in parts being value based.

A sustainable society must be achieved via the SDGs. In other words, sustainability science and SDGs shall be aligned and integrated on different dimensions. The global leadership in sustainability science education in Kashiwa campus, University of Tokyo is based on:

- A clear view of the complexity and severity of global issues, while having a positive outlook for the future;
- A comprehensive perspective on the complex relationships between humans and nature as a social ecological system;
- The ability to integrate the findings of specialized research to formulate solutions to complex problems;
- The ability to coordinate and integrate the opinions of different stakeholders; and
- Strong leadership in prompting transformations towards sustainable societies in the international community.

The International Social Science Council (ISSC), established in 1952, is the primary international body focusing on the social, behavioral and economic science and consists of 67 members, with a diversified portfolio of activities such as world social science report, forums, prizes and fellows, research programs, networks and capacity building program.

The explanations on the mono-, multi-, inter- and trans- research should combine the non-academic circles. An approach to knowledge production has to be beyond discipline, problem solving, process oriented co-creation and participatory approach and focused on six sets of questions: complexity, consequences, interpretation, change, decision-making and responsibility. The call for more transdisciplinary research on sustainability has focused sharply on the social sciences; Social science knowledge is indispensable knowledge but what can social science contribute? Transformation to sustainability is a need to:

- Accelerate social transformations to a just and sustainable world;
- Advance the social science contribution to sustainability research; and

- Develop a global knowledge network and resource base on social transformations.

Lessons learned include:
- Importance of co-design, and involving all stakeholders from the beginning;
- Importance of building Transdisciplinary Discipline (TD) skills;
- Transdisciplinary Discipline (TD) research takes time; and
- The need for indicators for valuing and evaluating Transdisciplinary Discipline (TD) research.

A recently published book [2] by the Comparative Research Programme (CROP) describes sustainability science as "a special case of transdisciplinarity"; also pointing out that the whole approach has its roots in the environmental sciences. Although this is a practical way to summarise what sustainability science is all about, the problem is that there is not necessarily a common agreement on what transdisciplinarity actually entails.

For research funders sustainability science and transdisciplinarity represent some particular challenges. Both concepts are relatively new and insufficiently understood by "the establishment", including the immense knowledge producing complex which includes the research communities, policymakers, industry and advocates of various causes, often referred to as civil society.

The emergence of a completely new science – sustainability science – represents an additional challenge in this context. Despite having been approved as part of UNESCO Medium-Term Strategy by all Member States, there is a surprising lack of understanding of what sustainability science really entails in many countries. In some, as in Norway, there is not even a generally accepted translation of "sustainability science", despite Norway being the birthplace of the "mother" of the sustainable development concept, by former Norwegian Prime Minister Gro Harlem Brundtland.

Without a proper understanding and translation of "sustainability science", the concept cannot become part of the general debate of society at large and makes it impossible to build the necessary alliances between academics, policymakers and civil society.

Some possible routes to follow include:
- Looking at the achievements of Future Earth, which was created during Rio+20 and has adopted a sustainability science type approach since its inception;
- Learning from the cooperation of funding institution under the Belmont Forum umbrella where national funders put together joint demands on a global level in a sort of “global co-fund model”;
- Studying relevant guidelines and procedures developed by various organs such as the Handbook of Transdisciplinary Research developed by the Swiss Academy of Sciences; and
- Following and possibly assisting the ICSU/ISSC merger process that can lead to further integration of the natural, social and human sciences, which is fully within the spirit of sustainability Science.

The most urgent mission, however, is to define a sustainability science research agenda based on a transdisciplinary approach, a process that will require a joint effort involving policymakers, academia, think tanks, research councils, industry, civil society and funders.

What kind of knowledge is needed to inform the 2030 Agenda for Sustainable Development? How can natural and social sciences engage in a dialogue with each other as well as with other relevant knowledge such as indigenous and local traditional knowledge in producing the required knowledge basis? Can co-design of research questions based on the involvement of multiple stakeholders be scaled-up from local realities to address national and international challenges? How can the education sector adapt to promote inter- and transdisciplinarity? In addition, what are

[2] Cimadamore, A. D., M. B. Mittelmark, G. M. Lie, and F. P. G. Ottemöller (2016), *Development and Sustainability,* London: Zed Books

the new institutional settings that might be required for mainstreaming knowledge on sustainability issues?

Following Schneidewind et al. (2016) in their contribution to the recently published book "Sustainability science: An introduction", policy shapes fundamental political paradigms that provide orientation to the science system (e.g. either in the direction of 'science as a driver for strengthening competitiveness', 'academic autonomy' or the like). Thus, funding policy is a central starting point for political steering efforts. Through the allocation of financial means to specific research programs and institutions, the overall topical and methodological focus can be influenced. Established scientific institutions can be influenced by new directing mechanisms like indicator-based steering, target agreements, appointing advisory boards or steering committees, etc.

European Union has funded only few transnational projects that explicitly aim to foster the sustainability science. An exception to be found in the Community Research and Development Information Service (CORDIS) is the VISION RD4SD project – VISION Research and Development for Sustainable Development – supported by the European Commission 7th Framework Program. This project focused on research policy and a dialogue among European science policy makers, science policy administrators and those funding policy makers and administrations in general who demand and need solutions from RD4SD, as well as the scientists, on how to harness RD4SD with the tools and possible actions available to them.

To recapitulate; disciplinarity is working within one area of expertise, i. e. silo in language and meaning. Multidisciplinarity is sitting under one thematic umbrella but loose cooperation of disciplines for knowledge exchange. Interdisciplinarity, cross-disciplinary boundaries with common goal setting, integrated knowledge and theory, and stronger disciplines. Transdisciplinarity will combine academic and non-academic knowledge and stakeholders.

Leuphana University of Lüneburg is one example of a university with education in sustainability science both in specialized and interdisciplinary approaches. The Complementary Studies – a compulsory part in every Bachelor student's curriculum – follows the "classical" scientific areas social sciences/he may choose, humanities, and natural sciences, but also introduces students to inter- and transdisciplinary perspectives. The disciplines are characterized by approaches that are divided into method-, practice- and mediality-oriented modules. The Complementary Studies complement and complete their the Major / Minor and is designed to take students out of their own disciplinary "comfort zone"– by adding other prospects to their own disciplinary perspective, engaging them in scientific topics outside their subject area and related thinking cultures, and by inviting them to communicate across disciplinary boundaries and to engage in new entry points and approaches.

When looking at higher education for sustainable development in general, two meaningful occasions are of particular educational significance, no matter what field of study students are exposed to. The one at the beginning of their study is the simultaneous exposure of freshmen to the "scientific world" and the sustainability idea – and getting to understand what they have to do with each other. The other, not necessarily connected with the former, is to become acquainted with sustainability science methodology in order to deal with complexity and make use of transdisciplinarity. Consequently, implementing sustainability science in (higher) education has to cope with the following key challenges:

- How to identify intervention points and develop strategies to enable fundamental transformation processes in socio-environmental / socio-technical systems?
- What are the underlying epistemological assumptions that sustainability research is based on?
- How can analytical-descriptive knowledge about global interrelations and context-specific, solution-oriented research be made mutually utilizable?
- How can central competencies for shaping a sustainable society be communicated and imparted effectively? and

- How can mutual learning processes between science and other social groups of actors be realized to foster sustainable development?

For universities as traditional social institutions in knowledge production and distribution the complex and multi-faceted problems of unsustainability constitute a challenge in research, both in terms of fundamental situational analyses and with respect to the search for appropriate solutions. Commitment to the guiding principles of sustainable development also entails rethinking of teaching and learning towards a problem-oriented balance of specialized expertise versus inter- and transdisciplinarity. Not to mention the organizational management of the universities themselves. In other words, systemic and integrated approaches are needed.

Sustainability in Asia and the Pacific: Conserving natural resources and promoting higher education

The Malaysian experience in sustainability science was mentioned by numerous successful case studies:

Universiti Malaysia Terengganu (UMT) is located in the East Coast of Malaysia. It aspires to be the country's leading and globally respected marine-focused university. Current initiatives by UMT relates to the sustainability science in coastal reserves and marine blue growth. Problems and opportunities are interconnected and must be addressed in an integrated manner through Science Policy Interface facilitation and effective implementation. Integration must occur across the terrestrial and marine domains; transdisciplinary differing needs over time; and marine Spatial Planning as well as balancing between the need for development and environmental protection.

Universiti Sains Malaysia (USM) is established as the second university in the country in 1969. USM is one of the Public Research Intensive Universities recognized by the Ministry of Higher Education of Malaysia (MOHE) in 2007 and the first university in the country to be selected by the Malaysian government to participate in the Accelerated Programme for Excellence (APEX), a fast-track programme that helps tertiary institutions to achieve world-class status.

USM's journey in sustainability began in the year 2000 with the Kampus Sejahtera programme. In addition, since then, sustainability has become one of its main agendas in striving towards excellence. USM had introduced a course for the undergraduates called WSU101 – Sustainability, issues, challenges and prospects: This is an elective course offered since 2011 in the main campus. Since then, the course has become a popular course, attracting more than 500 students every semester over three campuses.

What is unique about this course is that it is multidisciplinary in nature. In this course, students are introduced to sustainability through lectures on sustainability which covers the area of water, energy, health, agriculture and food, biodiversity, production and consumption, population and poverty, as well as climate change and disaster risk management. Students are also asked to carry out sustainability projects in groups and asked to highlight their projects to the university community in a sustainability exhibition.

The Master in Sustainable Development Practice is also a unique master's program that is multidisciplinary in nature. It exposes students to four thematic areas, which are natural sciences, social sciences, health sciences and management. The aim is to train leaders who would be able to manage the current global challenges that are transdisciplinary in nature. It is a result of a collaboration of more than 30 Universities around the world working in a global network. Students are required to complete 14 courses, in which 12 are core courses and two elective courses. Elective courses are: food security, applications of environmental science, sustainable cities and communities, and corporate social responsibility and green business. Students are also required to complete a 3 months' field training attachment with organizations involved in sustainability and also

required to complete a short dissertation on the sustainability projects they were involved in during their field training.

Universiti Kebangsaan Malaysia (UKM) is one of five public research universities, recognized by MOHE in Malaysia with solid role and responsibilities in advancing transdiscipline research and education via living lab models among others. UKM also collaborates with various stakeholders in driving the STEM agenda as well as supporting the UN's Sustainable Development Solution Network, Malaysia Chapter. UKM has garnered various achievements and awards locally and internationally through its outstanding research breakthroughs, driven by dedicated experts that are equally recognized.

Langkawi Research Center in Universiti Kebangsaan Malaysia (UKM) is one of UKM's living lab and the driver of integrated and multidisciplinarity towards achieving sustainable eco-tourism development. This center has been instrumental in Langkawi Geopark's achievement to attain UNESCO's highly coveted Geopark's status.

Pulau Banding Foundation is a science-based non-profit and non-political organization, with the aim of promoting research and eco-tourism through the sustainable development of the rainforest ecosystem of the Belum-Temengor Rainforest Complex.

Malaysia CSO Alliance on SDG: In support of the 2030 Agenda 2030 for Sustainable Development, Civil societies have come together to form the SDG CSO Alliance in Malaysia to ensure coherence and coordination of their contributions.

Ministry of Higher Education (MOHE) of Malaysia was set up with a vision of High Quality Tertiary Education, Excellent Individual, and Prosperous Nation; followed by the mission to sustain the higher education ecosystem in order to develop and enhance individual potential and fulfill the Malaysian's aspiration.

UNESCO Jakarta Office highlighted the knowledge and experiences gained through the application of sustainability science in various demonstration sites around the region – in Cambodia, Indonesia, Malaysia, Pakistan and the Philippines, to name a few beneficiary countries. Although focusing on different communities and a wide range of environmental issues, these projects have had one common goal – to produce pragmatic, applicable and accessible models of intervention and policy recommendations for governments based on the principles of sustainability science.

The pilot projects funded through the generous support of the Japanese, Malaysian and Indonesian governments through the funds-in-trust arrangements, have given a chance to turn this principle into action. Implemented in collaboration with the national stakeholders in their respective regions, the pilot projects have demonstrated that "putting people first" is the best way to address the environmental problems caused by unsustainable economic practices.

This means listening to people, gaining nuanced knowledge of the problems they face, and identifying their root causes. It also means coming up with solutions that address the environmental issues, and at the same time tackle the social and economic causes that might have led to the environmental degradation. It also means doing this through sustained consultation with the local community, the policymakers, the civil society and the academic establishment.

One of the major lessons learnt is that policies designed with the best scientific evidence-base may still fail if they do not meet a number of people-centered criteria. Bringing scientific expertise to policymaking to roll back the environmental degradation caused by human activity is a need. Paying an equal attention to lifting people from poverty and empowering them to become agents of positive change is essential.

Lessons have also learned in appreciating the distinctive nature of complexity at the heart of most of the socio-environmental challenges. The complexity is not about the variety from simple to the

more complicated, but to dissolve the complex into more “manageable” bits for easier solutions. The innovative transdisciplinary approaches, co-designed with the participation of local communities and stakeholders, allow the complexity to be turned from a threat into a resource.
UNESCO is in a position to work with people at the forefront of policy innovation to change the perception and the use of complexity by Member States. In other words, there is a need to embrace complexity, and bring to bear UNESCO’s own complex mandate and multidisciplinary expertise in an integrated manner to build the capability of policymakers for complex thinking.

This is also the most effective way to assist with the realization of the 2030 Agenda. Innovative transdisciplinary methodologies that take advantage of complexity can contribute to new, higher performing forms of governance that are of direct relevance to the achievement of the SDGs.

The critical question we are facing today is how to reinforce and disseminate the sustainability science methodologies and how to introduce them into national policies. How do we address the persistent gap that prevents the producers of useful knowledge within the scientific community from transferring this knowledge to its potential users within the government?

The evidence and knowledge acquired through the sustainability science pilot projects will be integrated into the MOST School on Sustainability Science, to be delivered for Indonesian policymakers and researchers in Padang, Sumatra on 1-3 February 2017. It will also become part of a similar MOST School organized in South Africa by Harare Office of UNESCO on 14-17 February 2017, as a model of South-South cooperation.

One additional good example is the recently launched World Social Science Report 2016: Challenging Inequalities, Pathways to a Just World. It represents a personal bridge between sustainability science and the discourse on inequalities. However, there are also solid thematic connections between the report and the symposium. The report brings out and clarifies the negative connections between inequality and sustainability. It concludes that unchecked inequality could expose the sustainability of economies, societies and communities, and unless we address this urgently, inequalities will make the crosscutting ambition of the SDGs leaving no one behind by 2030 will be an empty slogan.

There are several key messages derived from the report that reflect fundamental principles behind sustainability science. For instance, that reducing inequalities is essential for success in other global and national priorities such as environmental sustainability, conflict resolution and migration; or that citizen and community participation – a fundamental feature of sustainability science design – is opening up space for innovative policy solutions that can inspire inclusive policy innovation, including in the area of environmental sustainability.

Human development and environmental sustainability in the Arab States

Capacity needs in the Arab States require:

- Setting developmental policies and intervention strategies;
- Full understanding of sustainable system implications;
- Application of the current state of scientific knowledge in the complex to achieve both short-term continuity and long term ecological integrity;
- Better understanding of the links between social, economic and biophysical systems;
- Selecting intellectual leaders from academia, government, and industry to provide guidance for future R&D and collaborative initiatives that offer pragmatic pathways toward sustainability;
- Analyzing root unsustainability newcomers in the current economic system, e.g. applying growth as key to solve political, social problems and advance society's well-being;
- Study of the role of technology in aggravating unsustainable social practices and solving the problems they create;
- Merging current institutional status by coordination and collaboration between ministries and acting coherence of public policies; and

- Configuring knowledge to acquire comprehensive view of sustainability complex and interconnected issues. This is needed as a response to the requirements of academia, industry and government.

In recent years, many Arab countries, namely Qatar, Tunisia, Morocco, Lebanon, Jordan, Yemen, Syria, UAE and Sudan have formulated new national development strategies, visions and plans based on their national circumstances and priorities in addressing sustainable development objectives at varying degrees:

- Qatar has two key strategic planning documents, National Vision 2030 (2009) and National Development Strategy 2011-16 (2011). The National Vision defines trends that reflect the aspirations, objectives and culture of the people of Qatar. Its main goal is to transform Qatar into an advanced country by 2030, capable of sustaining its own development and providing high standard of living for future generations. It addresses four main development pillars: human, social, economic and environmental.
- Algeria set a Five-Year Development Plan (2010-14) and an Environmental Action Plan for (2001-2011). The Development plan aims to diversify the country's economy in six major axes, i.e., human development, basic infrastructure, public service improvement, economic development, unemployment control, R&D and novel technologies. With the assistance of the World Bank, Algeria finalized its national sustainable development strategy in 2001.
- Egypt has a Strategic Framework for Economic and Social Development 2012 - 2022 based on 10 challenges in three phases. Recent efforts are clearly linked with annual plans and budget allocations; however, the vision has not been implemented.
- United Arab Emirates put Vision 2021 in place.
- Jordan is currently in the process of developing a national vision to 2030.
- Syria outlined the elements of its comprehensive environmental strategy from 1992, including annual plans, a five-year development plan, and prospective twenty-year plans. Such planning was done on a consultative basis.

Divergences, main challenges and constraints discovered:

- Recent establishment programs and/or restructuring lacking satisfying experience;
- Feeble political strengthen for environmental agencies;
- Limited institutional mandate;
- Restricted available budgets;
- Insufficient use of policy analysis to determine the most effective instruments;
- Lack of selection criteria for identifying the best policies;
- Limited human technical capacity;
- Inadequate monitoring of environmental conditions;
- Lack of a proper definition of sustainable development and its indicators;
- Absence of systematic means to allocate secure and monitor funding;
- Arab countries are at varying development levels: Oil producing countries with high per capita income levels; Other Arab countries rely on foreign aid; High income disparities within Arab countries; and
- There are common challenges: e.g. water resources, energy inputs, food security, employment, and migration.

What can Arab scientists do:

- Despite a discourse advocating Arab economic integration and cooperation in science and technology, lost opportunities are many and still being witnessed till today;
- Despite the civil war / turmoil / political instability in several Arab countries, scientists and policy professionals have a duty to explore how they can contribute to meeting the Sustainability challenge b*y* promoting human well-being while preserving the natural environment for future generations;
- STI proved instrumental in many countries in enabling sustainable development and promoting resilience; and
- Inaction should not be an option in spite of the odds.

Looking Forward:

- Embarking on the path of sustainable development requires an understanding of prevailing sociopolitical, economic and environmental conditions which are also prerequisites for any future plans to advance sustainability science;
- By virtue of modern social media, Arab youth are more connected to the world than ever before. They are also better educated than ever before. Arab Governments are yet to act on this potential. There is a clear need to have an enabling infrastructure;
- The SDGs and 2030 Agenda should be an opportunity for advancing sustainability science;
- Rebuilding using a "business-as usual-scenario" will not achieve SDGs by 2030; and
- A transdisciplinary approach can be so prudent considering the much-needed efforts to reconstruct physical and human infrastructure in several Arab countries as it assumes a holistic and inclusive research methodology.

Enabling environment for STI:

- Achieving SDGs and meeting targets in 2030 Agenda will not be possible without a conducive STI environment e.g. SDGs (9, 17, 6, 11, 13 & 15): Prudent science policies should be developed addressing, inter alia: Science advice to governments, good governance, monitoring, youth science education and development; and
- Commitment to application of promulgated policies and implementation to address national and international issues like:
    - Climate change;
    - Disaster risk reduction;
    - Data sharing;
    - Management of natural resources; and
    - International scientific cooperation

Transdisciplinarity approach for Arab States:

- Transdisciplinary research approach is more needed than ever considering the political instability in the Arab states since:
    - Traditional methods will not achieve SDGs and 2030 Agenda;
    - Increasingly realized in some Arab establishments, that solid progress only occurred when a holistic approach was pursued; concurrently accounting for institutional, regulatory, human resource;
    - Advocates inclusiveness which is so much needed in post-war reconstruction, recovery and reconciliation; and
    - Transdisciplinarity can start by scientists working with communities with the priority of development needs: applied research for expanding sanitation to marginal communities.

Transdisciplinarity and solution-oriented research for interconnected challenges in Africa

Two successful case studies from Africa on sustainable urban development in Kenya and sustainability science research field in Ghana were highlighted, with the objective to replicate such successful experiences in other regions.

The goals of sustainable urbanization, social sustainability, would be through appropriate sustainability science policy on:

- Mainstreaming sustainability science in curricula at all levels;
- Encouraging and supporting transdisciplinary research;
- Providing needed resources to sustainability science education and research;
- Urban and regional planning schools should review their curriculum - make it more responsive to the complex issues;
- Embracing more participatory urban and regional planning;
- Retooling teaching methodologies - e.g. the ESDA-SUD;
- Reducing the gap between theory and practice; and
- Promotion of action-oriented research involving many perspectives, stakeholders and muti-levels.

Transdisciplinary problematics and problematizing transdisciplinarity in Europe and North America

Sustainable science strategies should be built as part of governance strategies. Education, participative experiments, science based narratives and dilemmas debates should be promoted as comprehensive "packages". Sustainable science should be based on an integrated framework involving mid-long term humanities dilemmas and short-term natural and social problems.

Resources: A list of examples of transferable projects should be made available (WHC). Education: At school level, at least one discipline or area of studies in all pre-university education should bring together human, social, natural and hard sciences, discussing dilemmas. Communication: A list of keywords should be agreed, defined and translated into different languages, cultures and disciplines. Research: Funding of science and society projects should consider projects focused in involving people in the making of science (participative science).

The review of the Leuphana University Lüneburg in becoming a 'sustainable university' highlighted several critical landmarks for the institutionalization of an academic sustainability culture. Among others: strong internal promoters, integration of sustainability into the university's principles, academic dialogue and active participation of the academic community, support by university's management board, sustainability centers and initiatives for research, and the creation of national and international networks that stabilize the external visibility of the university profile and support in its turn the internal commitment to sustainability.

In the past years, Leuphana University has been given several awards for its various sustainability activities:

- International Awards for Innovative Practices in Higher Education in 2011;
- International Sustainable Campus Award (Category Leadership) in 2010;
- The energy efficient and sustainable concept for the new central building has been selected as one of the German exhibits for the Shanghai World Exhibition 2010;
- UNESCO Chair "Higher Education for Sustainable Development" in 2005 to Prof. Michelsen, Institute for Environmental and Sustainability Communication;
- Award of 13 projects for the UN Decade of Education for Sustainable Development (Leuphana University is the most successful German university);
- Leuphana University was winner of the German's former federal president's (Horst Köhler) initiative "365 Landmarks in the Land of Ideas" six times in a row from 2008-2016;
- Award of the Institute for Environmental and Sustainability Communication by the Altner Combecher Foundation for Ecology and Peace; and
- Award-winner in the category Knowledge of the science magazine Zeit Wissen and the initiative "Mut zur Nachhaltigkeit (Encouraging Sustainability)" as best practice project that contribute in a significant way to sustainable development in 2013.

With regard to higher education, sustainable development has been integrated in the form of a general studies mandatory component for all Bachelor students and different degree programmes. These achievements came stepwise, took many years, and are an expression the ongoing cultural change that was sought. In retrospect, they reflect the hierarchy of learning as a starting point (c.f. Sterling/Thomas, 2007):

- *Awareness* of sustainable development, as well as the range of views of interpretations of sustainable development and the implications for these differences;
- *Process* - encourages to begin to question (and analyze) how the principles of sustainable development can be made to work;
- *Integration* - beginning to use the principles of sustainable development extensively in assignments and other class-work linking to real world issues in the community; and
- *Transformative* - without direction, students operate as critically reflective practitioners of sustainable development.

What do we need:

- Research infrastructure investments to enable; genuine interdisciplinary and transdisciplinary work;
- Science policy initiatives that recognize and work to remediate the structural limitations that impede integrated knowledge production;
- Evaluation measures that take the realities of inter-/transdisciplinarity seriously
- Cross-disciplinary immersion through problem-/case-/theme-focused field schools and research schools; and
- Research and educational policy initiatives and investments that bridge sectors and reinforce connections truly integrative in ambition and scope.

Scientific and technological advances for sustainability in Latin America and the Caribbean

Priorites, needs and gaps in the application of sustainability science in latin America and the Caribbean:

- Treatment of cultural heritage through the concept of cultural environment, creating an integrated treatment of landscapes and different ways of life that are related to each other, including archeological contexts;
- Integrate ancestral knowledge to scientific knowledge (concept of collective intelligence) to establish sustainable models of territory management (promoting a meeting of sciences);
- Development of every research project as a project of learning and education;
- Elaboration of cultural heritage management plans aiming at the integration and the handling of cultural heritage included in the research programs after the scientists leave the area; and
- Establishment of collaborative governance practices.

Making the case for Applying Transdisciplinary Assessment in Climate Change Adaptation Planning in SIDS:

- Even in the absence of anthropogenic climate change, SIDS are highly exposed to climate sensitive-hazards: floods, droughts, hurricanes and storm surges;
- Global climate change will amplify existing hazards and trigger new challenges:
  - Drowning and injury: floods, hurricanes
  - Freshwater shortages: drought and changed spatial distribution of rainfall
  - Infrastructural damage and losses: sea level rise, hurricanes and storm surge
  - Crop failure and effect on nutrition: rain-fed and irrigated cultivation
  - Reduced abundance and diversity of living and non-living marine resources
  - Adverse consequences on tourism: direct & in direct
  - Global climate change has potential to undermine achievement of the SIDS agenda for sustainability: SDGs, SIDS-POA and Samoa Pathway.
- Adaptation planning will require a wide range of interventions:
  - Financial/fiscal, technological, administrative
  - Broad knowledge base: integration of local experiences, physical, social sciences and stakeholder engagement
  - Consensus on adaptation choices/solutions: socio-cultural, economic, financial, political and environmental acceptability
  - Agreement on process: goals, methods & tools; shared language (risk, uncertainty, vulnerability); rules of engagement
- Transdisciplinary Assessment: knowledge integration should be solution-oriented to inform decision-making and policy intervention which should be focused on knowledge advancement for its own basic value.

Mapping Sustainability Science and Other Sustainability Initiatives at Elsevier

As one-off outside academia stakeholder attending, Elsevier was invited to present recent work done by them in the areas of sustainability. Elsevier is global provider of information solutions in science, technology, and health, and contributes to sustainability in partnership with global research and health communities. Elsevier is currently working on a number of projects to increase

the company's contributions to sustainable development – from research publishing portfolios and analytics capabilities to building research capacity in developing countries and advancing diversity in science.

To support the execution of the United Nations (UN) sustainable development agenda, the company produced the *Sustainability Science in a Global Landscape* report[3] in collaboration with SciDev.Net, launched in concomitance with the UN Summit in September 2015. The analysis reveals the current state of science behind the Sustainable Development Goals (SDGs) by focusing on the six essential themes: "planet", "people", "prosperity", "dignity", "justice" and "partnership".

Sustainability science often involves researchers from different disciplines working together towards common goals. Therefore, it cannot be appropriately defined via a selection of journal/conference categories, which is why in the report an iterative and adaptable approach was chosen. First representative keywords from the literature were identified with subject experts. Then the corpora of papers retrieved by keyword searches for each theme was examined, together with the experts further refining the keywords until the subject experts agreed that the corpora were a good representation of each theme. These processes, in some respects, also illustrate the challenge of defining sustainability science with respect to its contributions from underlying disciplines.

The search was made using Elsevier's database Scopus of peer-reviewed literature, which covers more than 62 million documents published in over 22,500 journals, book series and conference proceedings by some 6,000 publishers on (https://www.elsevier.com/solutions/scopus) for more information on coverage. The final search criteria are openly available in the report.

What emerged from this report was a comprehensive picture of global sustainability science, one of the findings of policy relevance was for instance that high-income countries account for 76 % of all research, and low-income countries 2 %. 71 % of the scholarly output coming from low-income countries is a result of collaboration with high-income countries. In terms of "North-South" partnership, this indicates a strong need for further support of capacity building together with high-income countries, such as in the North Americas, Europe, or South East Asia.

Further analysis of the Asia Pacific region in particular shows strong growth of sustainability science. China is the global number three (after the United States and the United Kingdom) in terms of scholarly output, with a compound annual growth rate (CAGR) of around 20% in 2010-2014. Over the same period, Malaysia's scholarly output has being growing at 28% annually, albeit from a much smaller base.

Moving beyond this report, in support of SDG 5 on Gender Equality, Elsevier has developed a methodology to identify the gender of scholarly authors, which is otherwise not captured in bibliometric databases. The methodology was initially presented with an analysis of the German research landscape[4]. With this methodology, Elsevier has been able to look at scholarly output and impact, collaboration, mobility, or interdisciplinarity through a gender lens.

This has been further extended to a global context, covering 12 geographies and 27 subject areas over a 20-year time in a forthcoming report to be released in March 2017[5]. Elsevier's efforts towards SDG 5 and the gender aspects of other SDGs goes further beyond analytics. As Elsevier publishes 17% of the world's STM (science, technology, medicine) articles and 29% of the world's most highly cited papers, the company sees as a responsibility to also promote gender balance in publishing. They have established an internal working group to ensure that Elsevier produces the most robust research possible in the most inclusive way, for instance looking at policies for editorial

[3] *Sustainability Science in a Global Landscape,* available at https://www.elsevier.com/research-intelligence/resource-library/sustainability-2015

[4] *Mapping Gender in the German Research Arena*, available from https://www.elsevier.com/research-intelligence/research-initiatives/gender-2015

[5] https://www.elsevier.com/promo/research-intelligence/global-gender

boards and conferences arranged by the companies. Furthermore, Elsevier Foundation's New Scholars program[6] supports family-friendly policies around skills training, dual career issues, and professional visibility. Finally, Elsevier is the first information solution companies to have attained the first level of EDGE (Economic Dividends for Gender Equality) certification[7], the leading global standard for gender equality in the workplace.

The company is also actively seeking partnerships as well as supporting capacity building, which supports SDG 17 on partnerships. For instance, Elsevier participates in the global Research4Life programme, through which scholarly publishers provide free or low cost access to publications to specific low-income countries on (http://www.research4life.org/criteria/). As a community effort, Elsevier is in the process of launching a sustainability resource center to support the community effort, this center being similar to those earlier launched on tropical diseases, such as Ebola and the Zika virus.

Finally, Elsevier has a long-term commitment to the publication, preservation, and dissemination of research, and see this as an essential contribution to the information eco-system. The hope is that it will help researchers in academia, government or industry, civil society organizations, policy makers, and other stakeholders to tackle the common sustainability challenges.

This example from an industry stakeholder also illustrates the point of industry- and private foundations contributions to the SDGs, notable examples of the latter besides the Elsevier Foundation mentioned, are for instance Melinda and Bill Gates Foundation, the Chan-Zuckerberg Foundation and the Soros Foundation.

Three Breakout Groups on: Principles of sustainability science, guidelines for research and guidelines for education

Below are the recommendations suggested in the breakout groups and the concluding plenary session on the elaboration of an annotated outline of Draft Guidelines on Sustainability Science:

- General
  - Condition of success : involvement of non-academic stakeholders and ownership
  - Indicators, how to monitor and evaluate
  - Development of large skill: communication and facilitation
  - Policy implementation in- country and between countries
  - Funding: how we would be able to spend dedicated funds
  - Capacity to do sustainability science: Political inequality
  - Operate between skills
  - Training on transdisciplinary approaches
  - Communication skills

- Principles
  - Basis: SDGs are a fundamental framework for sustainability science and diversity is a keyword.
    - Focus on processes rather in targets alone, encompassing explicit statement of understanding, including non-scientific knowledge processes;
    - Requires problem solving and dilemma facing complementary and integrated agendas. Sustainability science implies a convergent effort of human and social sciences, humanities and arts. It also implies policies and implementation;
    - Breaking the silos between natural and social sciences and the humanities;
    - Breaking the silos between knowledge, policies and implementation;
    - Breaking the silos across problems/solutions and purposes/meanings;

[6] *The Elsevier Foundation programs* are found at: http://www.elsevierfoundation.org/
[7] See further http://www.edge-cert.org/certification/levels-of-certification/

        - Funding of sustainability science both on TD and fundamental research;
        - Communication is a core component.
    - Tools: Need to fully use existing tools.
        - Co-design, co-production and co-management is a basic reference for sustainability science;
        - There is a need to clarify concepts. Instead of sustainability science as a science, mention it as a field of studies;
        - Instead of capacity building use knowledge building;
        - Territories are a privileged dimension for integrative approaches to sustainability.
    - Transition: The 2030 Agenda should be considered like a transition agenda in such converging effort.
        - There is a need for a more integrated agenda on natural, social sciences and humanities, while deepening the disciplinary research as well;
        - International programmes, such as MOST, Man and Biosphere or Geoparks, UNESCO Chairs should keep their specificities but being articulated through transversal applied projects.
    - Sustainability science should be understood as sustainability knowledge and practice.
        - Sustainability is to be considered in an integrated dimension and not in sectors, thus requiring, in each sector, a global understanding of processes;
        - STEM is the opposite of sustainability science.
            - In communication, we need a sexy acronym for what we aim at: science, humanities, policies and context based implementation for SD (ex: STEM)
            - In Malaysia, the target is 60% of STEM, but only 18% have it because they do not integrate.

- Where are we now
    - Trends: We were not effective with MDG and are not so effective in delivering results, in terms of the SDGs
        - The SDG agenda is a good reference;
        - There is a consensus on certain issues (on sustainable science, on transformative knowledge, on context and scales, inclusive endeavor to bridge silos);
        - Sustainability faces some global challenges but also very specific, contextual ones, driven by physical constraints and cultural understandings;
        - Solutions are not enough.
    - Methods:
        - Apart from stakeholders, considering individuals is also very important;
        - Researchers are engaged, but governments and people have insufficient trust on established institutions.
    - Further difficulties:
        - Job prospects impose a threat onto universities, and it is crucial to stress that one important dimension of higher education is to foster reasoning and critical capacities; fundamental to face the challenges of contemporary societies if peace is to be seeked;
        - One major problem is that planning is based on stakeholders claims, made by the government and not considering the sustainability of the projects. So planning should take into account knowledge and participation, as well as transformation in the process;
        - Ownership of solutions is fundamental, while current innovations have so far augmented global inequalities.

- Identify gaps
    - Disciplinary

        - Being overcomed, but more is required, and funding strategies should foster this, while reinforcing funding in fundamental sciences and humanities;
        - Assessment criteria of projects need to consider this.
    - Societal
        - Between knowledge, policies and implementations;
        - Across social segments, or based on gender, age, etc.
    - Regional
        - Among countries and regions.
    - Skills needed – capacity development
        - Global, holistic, visions in all disciplinary education;
        - Integrative approaches leadership at different scales;
        - Territories' integrative transdisciplinary frameworks;
        - Ethics in technology;
        - Indicators and criteria of impact measurement:
            - Numbers of participants;
            - Comments of participants;
            - Other types of targets (numbers of students, etc.);
            - Primarily: to what extent sustainability science has been taken into consideration in decisions;
            - In addition: how the impacts of sustainable solutions have been inspirational for others.

- Which approaches:
    - Territories based strategies require both cultural diverse convergent visions and technical solutions, using all available tools from sciences, humanities and arts.
    - Countries should design their own specific transition agendas, for SDGs with sustainability science.
    - Attempt to combine different existing UNESCO tools in integrated sustainability science project: Man and Biosphere, Geoparks, MOST, etc.

Web Knowledge Platform of the Sustainability Science Project

A dedicated web knowledge platform on the sustainability science project (https://en.unesco.org/sustainability-science) was created to ensure long-term dissemination of the project's activities and outcomes as well as to preserve its sustainability.

The webpage contains the following information:

- Purpose, rationale and implementation of the project;
- Policy guidelines on research and education;
- Report, programme, presentations and proceedings of the three symposia;
- A fundamental bibliography and references related to sustainability science;
- Multimedia contents (photos and video interviews), news, project's events and relevant links are also assured.

A platform of a community of interest and other relevant stakeholders, as well as a network of relevant organizations was suggested to be developed. Further interactions related to this community could be added later on.

During the symposium, a series of video interviews were organized with participants to explore what people say and think about sustainability science, their experiences and perceptions, what they would like to learn or share. These video interviews will be diffused as well as a dynamic video for the symposium on the webpage.

Annex

Annotated Outline of the Draft UNESCO Guidelines on Sustainability Science

Purpose

Sustainability Science aims at mobilising and generating the necessary knowledge to define and achieve sustainability in concrete contexts. In this project, the purpose is linked more specifically to generating the knowledge necessary to achieve the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDGs). Science can help to operationalize the Agenda.

Principles of Sustainability Science

- Fosters knowledge that is context-based and linked to the implementation.
- Mobilises relevant non-academic knowledge (e.g. indigenous knowledge).
- Based on the principles of co-design, co-production and co-delivery with non-academic stakeholders and is therefore largely process driven.
- Aims at breaking the 'silos' between several spheres: established disciplines (ID); between academia and society (TD and indigenous knowledge); between knowledge and implementation.
- Transdisciplinary research is the approach for how to generate that knowledge.

Guidelines for Researchers

- Disciplinary and Transdisciplinary Research
    - Strengthening the link between transdisciplinary thinking and research.
    - Encouraging the specialized scientific fields to include transdisciplinary approaches.
    - Promoting the universal recognition of sustainability as a credible academic discipline.
    - Including not only natural and social aspects, but also cultural aspects in sustainability research.
    - Establishing ground rules so that sustainability science will not lose credibility.
- Involvement of Multistakeholders
    - Collaborating with private sectors, local communities and central/local governments.
    - Considering IPCC, IPBES, Future Earth examples of transdisciplinary research.
    - Promoting collaboration between scientists from developing and developed countries in order to fill the gap in knowledge generation.
    - Keeping the academic standard even when involving non-academics.
- Recognition
    - Ensuring the genuine recognition of everyone involved in sustainability research.
    - Bringing self-ownership to all through co-publications and communicating of works.
    - Promoting strategic communication systems in the process of sustainability science.
- Diversifying Research Funding Sources
    - Exploring innovative funding sources such as multitude funding.
    - Diversification of funding sources from international organizations, governments and private sectors.
    - Strengthening the funding mechanisms from international and national organizations, such as World Bank, Global Environmental Facilities (GEF), Belmont Forum and ODA agencies in each country.
- Revisiting Funding Criteria
    - Measuring how sustainability research could make an impact on society complex problems.
    - Using SDGs approach in sustainability research proposal.
- Role of Academic Communities
    - Requesting academic societies to play an umbrella role to encourage a transdisciplinary research agenda.
    - Engagement of individual academic disciplines in promoting sustainability science.
- Involving Education in Research
    - Considering that education is a significant component of sustainability science.
    - Encouraging students to take a holistic approach even from undergraduate level.
    - Nurturing young scientist as future leaders in designing and implementing sustainability science for transforming society toward sustainability.

Guidelines for Education

- Higher educational institutions
    - Increase and improve capacity-building needs.
    - Sustainability science should be included in PhD studies.
    - The work in silos culture to be changed.
    - Changes in the reward systems towards a balance between research and teaching.
    - Sustainability science curricula for higher education.
    - Sharing best practices in sustainability science by the universities.
    - Establishment of partnerships and international collaborations in sustainability science (network).
    - Creation of community of interest in the web knowledge platform of the project.
- Researchers/Teachers
    - Connection between researchers and educators.
    - Young researcher training should be exposed to sustainability science thinking.
    - Further sustainability science education for established researchers
- Governments
    - Accreditation (implementation of new curricula)
    - Enabling environment for the university (funding)
- Society/Local communities
    - Curricula and transversal research training and job market
    - Increase linkages between industry, community and academia – to have the mechanism in long term