TIAS Quarterly

No. 01/2015 March

The newsletter of *The Integrated Assessment Society (TIAS)*
http://www.tias-web.info

ISSN 2077-2130

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Senegal (Ulli Meissner ©)

The Society

The Integrated Assessment Society is a not-for-profit entity created to promote the community of inter-disciplinary and disciplinary scientists, analysts and practitioners who develop integrated assessment. The goals of the society are to nurture this community, to promote the development of IA and to encourage its wise application.

Integrated Assessment Defined

Integrated Assessment (IA) can be defined as the interdisciplinary process of integrating knowledge from various disciplines and stakeholder groups in order to evaluate a problem situation from a variety of perspectives and provide support for its solution. IA supports learning and decision processes and helps to identify desirable and possible options for addressing the problem. It therefore builds on two major methodological pillars: approaches to integrating knowledge about a problem domain, and understanding policy and decision making processes. IA has been developed to address issues of acid rain, climate change, land degradation, water and air quality management, forest and fisheries management and public health.

Feature

Unravelling the Dimensions of Integration in Integrated Assessment and Modelling Projects

Tony Jakeman and Serena Hamilton, both at Australian National University and Edith Cowan University

It is becoming increasingly accepted that Integrated Assessment (IA) is an essential metadiscipline to tackle "Wicked" problems such as those that often arise in the management of water resources. Such problems involve multifaceted, multi-use resource systems comprising interdependent social, economic and ecological components. They also are characterised by stakeholders with different and often conflicting goals, for example, how water is allocated for domestic use, irrigation in agriculture, and water to sustain ecosystems. Integrated Modelling is generally considered a key tool for performing the IA process as it has the capacity to deliver a systematic and transparent approach to integration. Together, integrated assessment and modelling (IAM) can help decision-makers develop policies to manage natural resources and assets in a way that delivers acceptable environmental and socioeconomic outcomes. More broadly put, effective use of IAM supports social learning by promoting a science-informed dialogue about the future.

But to go beyond using integration as a buzzword, we must continually strive to clarify the process of merging diverse knowledge, data, methods and perspectives across disciplines, sectors and other divides into one coherent framework. One requirement of such a synthesis is that when undertaking an IAM project we be attentive to which dimensions we are actually addressing, and which we are not. And indeed where do we start? Are some dimensions primary and to be looked at first before decisions are taken on addressing other dimensions? Inadequately integrating these dimensions and/or omitting important ones may result in impacts of interventions being overlooked, or the associated modelling effort being rendered irrelevant.

The ten dimensions of integration

There are several articles that have addressed the dimensions of integration and their importance, including Jønch-Clausen and Fugl (2001), Janssen (2009), van Kerkhoff (2005) and Strasser et al. (2014). A recent article by Hamilton et al. (2015) offers help in unravelling the dimensions and advice on where to start. The authors propose ten dimensions of integration (see Figure 1), grouped into three themes. The first group of dimensions represents the key drivers of integration, specifically the need to address multiple: i) issues of concern, ii) management interventions and governance arrangements, and iii) stakeholders. The next group of dimensions relate to the integration of different elements from the (iv) natural systems and (v) social systems that we are dealing with, and their vi) spatial scales and vii) temporal scales. This second grouping comprises the elements of the system to be integrated in the model, including the attributes, boundaries and states specific to each problem.

The third grouping relates to the methodological aspects of IAM, including the integration of multiple viii) disciplines, ix) methods, models, tools and data and x) sources and types of uncertainty. Methods and models selected should always take into account the context of preceding dimensions. Kelly et al. (2013), for example, offer advice on how such considerations should affect the selection of one of five common modelling platforms. The initial motivation of the paper was to encourage modellers not to just select the platform with which they are comfortable, be it Bayesian networks, agent-based models, system dynamics, knowledge-based methods or coupled complex models. Ideally one should choose the platform that best suits the job.

The tenth dimension: Uncertainty

One dimension that is not typically given holistic treatment is is uncertainty (x). It pervades all of the other dimensions, entering into the four phases of IAM: problem scoping where one must consider alternative boundaries of the scope; problem framing and alternative formulation of the problem and model; analysis and evaluation of options that should entail alternative model instances (structures, parameters etc.); and communication of multiple findings according to different assumptions. Guillaume et al. (2012) propose an uncertainty management framework containing seven iterative steps including: identifying the uncertainties, prioritising resources to address them, reducing the uncertainty, describing the uncertainty, propagating it through the model, communicating the uncertainty to model users and anticipating residual uncertainty that may be due to future conditions. They place this framework in the context of a groundwater problem involving extraction rules. But we need further application of such frameworks by the IAM community in order to identify the lessons that will allow the IAM practitioner to manage uncertainty more holistically.

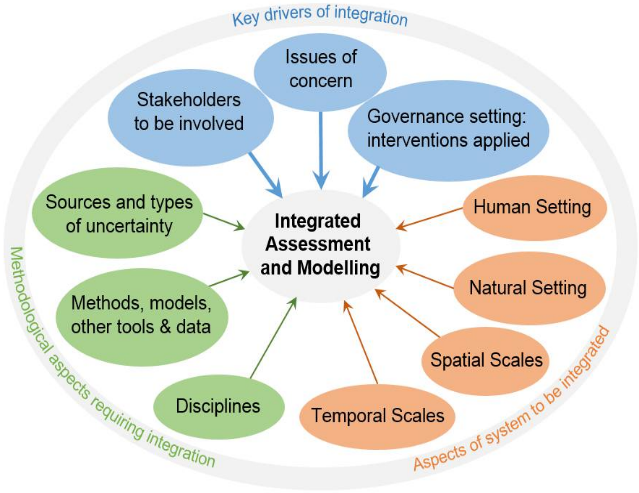

Figure 1: The ten dimensions of integration

Setting sustainable diversion limits: Murray-Darling Basin

To illustrate the potential of IAM for addressing wicked problems we briefly examine the example of water allocation in the Murray-Darling Basin (MDB), the largest perennial river system in Australia. The MDB covers some 1.06 million km^2 and supports a population of approximately 2 million people. Most of the Basin is arid or semi-arid with a relatively flat landscape. Average annual streamflow is around 11 000 GL/year, but it is highly variable, ranging from 2 500 to 40 000 GL/year. About two thirds of the water in the Basin is diverted, and 90 to 95% of this is used for irrigation. The Basin accounts for approximately 40 % of Australia's agricultural income, and therefore irrigated agriculture has generated many social and economic benefits. However flow diversion for irrigation, in addition to extensive clearance of native vegetation, has led to a drastic decline in the biophysical health of the Basin's rivers and wetlands.

The Murray-Darling Basin Authority is responsible for administering what is known as the MDB Plan. One of its associated objectives is to improve understanding of the relationship between key external drivers and social, economic and environmental outcomes. This understanding includes the scale, intensity and distribution of impacts of future climate change on Basin water resources. One of the core parts of current planning for the Basin is the setting of long term Sustainable Diversion Limits (SDLs), which are the maximum limits of human water use (including domestic, agriculture and other consumptive uses). Due to the conflicting goals of stakeholders and inadequate engagement, previous attempts to define diversion limits were not well received by all local communities. The challenging dimensional issue here is in identifying SDLs that provide not only acceptable environmental but also social and economic outcomes. Integrated models are therefore required and are being developed with stakeholders for exploring tradeoffs involved with alternative SDLs based on different socioeconomic and environmental criteria (El Sawah, 2013; Jakeman et al., 2014). The model platform being used is a coupled complex model because it allows one to deal with the dynamic and spatial complexity of the hydrological, farming system and ecological component models. The use of such integrated models can allow a more systematic and transparent comparison of alternative management scenarios, which is particularly important when the decision may be controversial.

Reducing water use for irrigation

Due to climate variability and changes to water allocations, regions dependent upon irrigation need to find a way to remain economically viable, essentially with less water. Managed Aquifer Recharge (MAR) offers one possible intervention by using surface water, when in surplus, to artificially recharge an aquifer. This water is then available for irrigation purposes during subsequent dry periods, with underground storage reducing water loss from evaporation. Preliminary studies by Arshad et al. (2013) in the Lower Namoi region in the MDB have shown that MAR intervention is hydrogeologically vand economically feasible, while Rawluk et al. (2012) have found it to be potentially socially acceptable.

Another possible adaptation for irrigators is to reduce the water lost during field irrigation. Water efficiency of typical flood irrigation of field furrows can be improved by practices such as modifying the irrigation regime including timing and volumes, converting to sprinkler irrigation systems, and deepening their dams to reduce evaporation. The degree to which these practices improve efficiency varies from farm to farm.

Building adaptations into models

Integrated modelling is needed that builds such potential adaptations into a modelling system which takes into account the social acceptability of practice changes and the effects of climate, water allocation rules and uncontrollable external factors that determine both economic outcomes for farmers and the associated ecological impacts in the river systems. There is a need to be able to identify, at a farm scale, the potential to implement MAR and change irrigation practices, and to be able to compare the costs, risks, and hydrological and economic benefits of the different options, within the MDB. This requires engagement with farmers to understand their risk profiles and willingness to make changes to their irrigation practices. It also requires a good understanding of the uncertainties associated with decisions to change practices. For this purpose Arshad et al. (2014) have developed a cost-benefit analysis that can be implemented in the farming system component of an integrated model that evaluates SDLs. It allows for ranges of uncertainty in the influencing variables to be specified. The analysis identifies the 'break-even point', being the point at which the financial benefits from changes in practices meets the returns from current practice.

To go beyond identifying critical uncertainties in such component models towards those uncertainties in an integrated model will always be challenging but much more is possible than is seen in current IAM practices. A major research gap is in establishing frameworks that allow one to examine uncertainties in all component models and then to assess how uncertainties propagate through the linkages between components. At the very least, however, we in the IAM community should be attempting in our projects to generate insights from our models that help decision makers and stakeholders appreciate the potential outcomes of different management practices and policies. Even being more confident about the magnitude and direction of changes, rather than accurate predictions, will be beneficial. While there are no correct solutions to wicked problems, IAM processes have the potential to help make informed decisions that produce better outcomes for the whole of system.

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TIAS News

In the last three months, TIAS has submitted two funding applications: (1) conference on “Securing water and food in a changing world” to the “Herrenhäuser Conference Series 2016” of the Volkswagen Foundation (result expected April 2015); and (2) collaborative team science focusing on "Enhancing Integrated Assessment for improving the understanding of socio-environmental problems and decision-making" has been submitted by the Graham Sustainability Institute, University of Michigan in collaboration with TIAS to the National Socio-Environmental Synthesis Center - SESYNC (results expected in May 2015). The result of our Summer School proposal "Concepts, frameworks and methods for the comparative analysis of water governance" (planned August 2015) submitted to the Volkswagen Foundation in November 2014 is expected in early April. The next online meeting with members of the working group on Social Impact Assessment is planned for April/May. Finally, TIAS is launching a new website which will be online soon! To learn more about any of these initiatives, contact the secretariat (info@tias-web.info).

New Publications

Rural Development: Knowledge and Expertise in Governance by Kristof van Assche & Anna-Katharina Hornidge
This book offers a unique perspective on rural development, by discussing the most influential perspectives and rendering their risks and benefits visible. The authors do not present a silver bullet. Rather, they give students, researchers, community leaders, politicians, concerned citizens and development organizations the conceptual tools to understand how things are organized now, which development path has already been taken, and how things could possibly move in a different direction.

Sustainable Economics: Context, Challenges and Opportunities for the 21st Century Practitioner, Keith Skene and Alan Murray
A handbook for undergraduate and postgraduate students, as well as practitioners, on the linkages between science and business. Takes a systems approach with specific focus on the circular economy concept, which is proceeding apace in China and gaining more traction in Europe. More information: https://gre.presswarehouse.com/Books/BookDetail.aspx?productID=412347

Review of Targets for the Sustainable Development Goals: The Science Perspective released by the International Council for Science and the International Social Science Council, provides an independent review of the 169 targets under the proposed Sustainable Development Goals (SDGs), which are set to be approved at the General Assembly of the UN in September.

The authors – more than 40 leading researchers from across the natural and social sciences – find that the SDGs offer a "major improvement" over their predecessors, the Millennium Development Goals (MDGs). However, of the 169 targets beneath the 17 draft goals, just 29% are well defined and based on the latest scientific evidence, while 54% need more work and 17% are weak or non-essential.

Many of the targets suffer from lack of integration and rely too much on vague, qualitative language rather than hard, measurable, time-bound, quantitative targets, the report finds. Authors are also concerned the goals are presented in 'silos.' The goals address challenges such as climate, food security and health in isolation from one another. Without interlinking there is a danger of conflict between different goals, most notably trade-offs between overcoming poverty and moving towards sustainability. Action to meet one target could have unintended consequences on others if they are pursued separately. Finally, the report highlights the need for an 'end-goal' to provide a big picture vision for the SDGs. Download the full report here:http://bit.ly/SDGsReport
Blog: http://bit.ly/1Cjkzdp The report was also covered in Science: "Sustainable goals from U.N. under fire".
http://bit.ly/1uPegOt

Events

Workshops and Conferences

Workshop on **'Humans, Animals and Nature: a Sustainable Relationship?'**, 9 April, 2015 in Maastricht, Netherlands. This one-day symposium is open to students, university staff and others. Registration: icisoffice@maastrichtuniversity.nl. More information on the lectures and instructors: http://www.icis.unimaas.info/wp-content/uploads/2015/03/MUST-course.pdf

Sustainable Development Goals: A water perspective. 17-18 August 2015, Bonn, Germany. Organised by the Global Water System Project with support from the German Federal Ministry of Education and Research. The conference is intended to inform and catalyse action by policymakers, non-governmental organizations, the private sector, educators, and researchers. More information:
http://www.gwsp.org/gwsp-events/sustainable-development-goals-conference-2015.html

Conference: Transformations2015 - People and the Planet in the Anthropocene. 5-7 October 2015, Stockholm, Sweden. Abstract submission (250 words) by 7 April 2015.
http://www.transformations2015.org/

Summer Schools

Oxford Summer School in Ecological Economics 2015: Policies and Innovation for a Green Economy,
30 August – 5 September, 2015 at Balliol College, Oxford.
More information:
http://www.isecoeco.org/oxford-summer-school-in-ecological-economics-2015/

MISS-ABMS 2015 - Multi-platform Inter-national Summer School on Agent-Based Modelling & Simulation for Renewable Resources Management, 17-28 August 2015 in Montpellier, France.
This summer school focuses on skills for building agent-based models for renewable resources management, and includes participatory use of models and simulation. The trainers will support the groups in designing, implementing and fine-tuning their own agent-based model.More information:
http://www.cirad.fr/content/download/9675/110522/version/1/file/MISS-ABMS+2015_flyer.pdf

Oxford Adaptation Academy. 9-28 August 2015.
http://www.climateadaptation.cc/our-work/adaptation-academy/what-we-offer/oxford-adaptation-academy

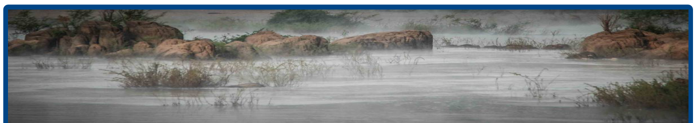
Summer school: Concepts, methods and tools to engage in participatory research and governance. 13-17 July 2015 at ISEG-Ulisboa/ SOCIUS in Lisbon, Portugal.
The course focuses on: a) stakeholder involvement in research and governance processes; b) planning and facilitating sound participatory processes; c) innovative participatory methods and tools; and, d) reflexive capacities for continuous process improvement.
More information:
http://www.lisode.com/wp-content/uploads/2015/01/Summer_School_2015_ISEG.pdf

Education Programmes

M.Sc in Sustainability Science and Policy with a unique focus on integrated sustainability assessment, Maastricht University, Netherlands.
This one-year Master's provides an intensive programme where students will acquire knowledge and skills to deal with one of the world's most relevant and complex questions: how can we balance ecological, economic, and social developments for our present and future well-being?
More information:
http://www.maastrichtuniversity.nl/web/Schools/ICIS/TargetGroup/MScSustainabilityScienceAndPolicy/ProgrammeInformation.htm

Job Openings

Two **Junior Professors positions in Sustainability Science** open at Leuphana University of Lüneburg in Germany. The Faculty of Sustainability investigates the conditions and opportunities for sustainable development. **Deadline: 06 April 2015**
More information:
http://www.leuphana.de/en/apply/open-positions/professorial-positions/eng-ansicht-professuren/datum/2015/02/25/sustainability-science-w1.html



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TIAS Quarterly is the newsletter of The Integrated Assessment Society.

ISSN: 2077-2130
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