ISSN 2316-3747

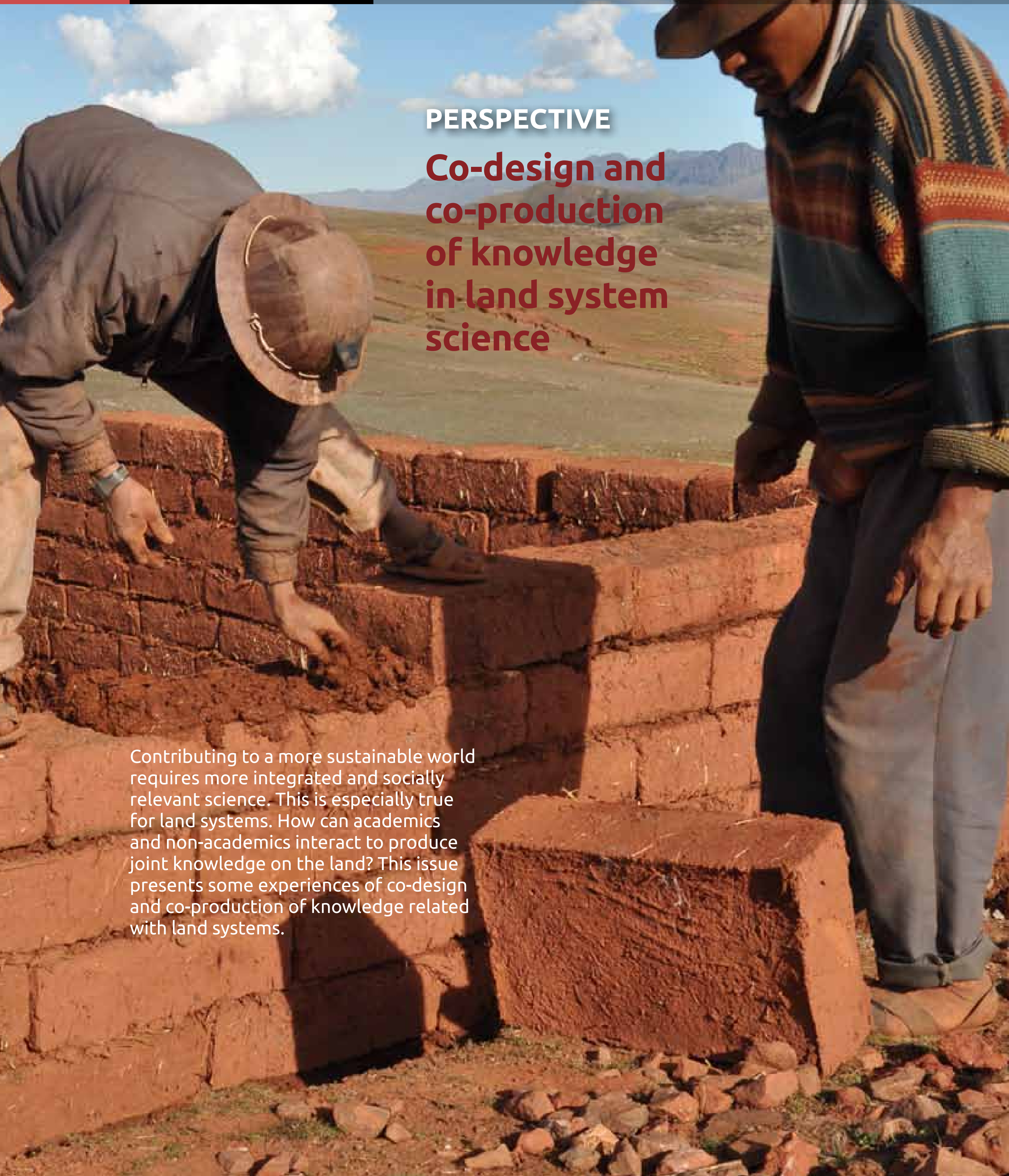
11 GLP news

NEWSLETTER OF THE GLOBAL LAND PROJECT

GLP - A joint research project of IGBP & Future Earth

Global LAND Project

ISSUE Nº 11 | APRIL 2015



PERSPECTIVE

Co-design and co-production of knowledge in land system science

Contributing to a more sustainable world requires more integrated and socially relevant science. This is especially true for land systems. How can academics and non-academics interact to produce joint knowledge on the land? This issue presents some experiences of co-design and co-production of knowledge related with land systems.

Scientific Steering Committee – SSC

Peter Verburg (Chair of GLP, 2011-2015)
Institute for Environmental Studies - VU University Amsterdam
De Boelelaan 1087 - 1081 HV Amsterdam - Netherlands
Email: peter.verburg@ivm.vu.nl

Roy Rinku Chowdburry
Department of Geography - Indiana University (IN)
Student Building 120 - 701 E. Kirkwood Ave. - Bloomington, IN 47405
United States of America
Email: rroychow@indiana.edu

Patrick Meyfroidt
SST/ELI - Earth and Life Institute (ELI) - ELIC - Earth & Climate (ELIC) - Université Catholique de Louvain (UCL)
ELIC - Place Louis Pasteur 3 bte - L4.03.08 à 1348 Louvain-la-Neuve - Belgium
Email: patrick.meyfroidt@uclouvain.be

Allison M. Thomson
Science and Research Director
Field to Market, The Alliance for Sustainable Agriculture
777 North Capitol Street, NE, Suite 803
Washington, DC 20002
Email: athomson@fieldtomarket.org

Souleymane Konaté
IUCN –Central and West Africa - University of Abobo-Adjame
UFR-SN/CRE, 02 BP 801 Abidjan 02, Côte d'Ivoire - Ivory Coast
Email: skonate2@yahoo.fr

Karlheinz Erb
Institute for Social Ecology - University of Klagenfurt
Schottenfeldgasse 29/5t - A-1070 Vienna - Austria
Email: karlheinz.erb@aau.at

Nancy Golubiewski
Land Use Carbon Analysis System (LUCAS) - Ministry for the Environment – Manatu Mo Te Taiao
23 Kate Sheppard Place, PO Box 10362, Wellington 6143 - New Zeland
Email: golubiewskiN@gmail.com

Jonathan Morgan Grove
Northern Research Station - USDA Forest Service
5200 Westland Blvd. TRC 171 - MD 21227, Baltimore - United States of America
Email: mgrove@fs.fed.us

Andreas Heinimann
Centre for Development and Environment - University of Berne
Hallerstrasse 10, 3012 Bern, Switzerland
Email: andreas.heinimann@cde.unibe.ch

Harini Nagendra
Azim Premi University - PES Institute of Technology Campus
Electronics City, Hosur Road, Bangalore - India
Email: harini.nagendra@apu.edu.in

Erle C. Ellis
Dept. of Geography & Environmental Systems - University of Maryland
1000 Hilltop Circle, Baltimore, MD 21250 - United States of America
Email: ece@umbc.edu

Lin Zhen
Institute of Geographic Science and Natural Resources Research, Chinese - Academy of Sciences
Deputy Director of Research Unit for Resource Ecology and Biomass Resources
11A Datun Road, Chaoyang District, Beijing 100101- PR China
Email: zhenl@igsnrr.ac.cn, linlinzhen@yahoo.com

Neville D. Crossman
Senior Research Scientist, Team Leader, CSIRO Ecosystem Sciences
CSIRO Ecosystem Sciences, Private Bag 2, Glen Osmond, SA, 5064 - Australia
Email: neville.crossman@csiro.au

Ole Mertz
Department of Geography and Geology, University of Copenhagen, Oster Voldgade 10, 1350 Copenhagen K. - Denmark
Email: om@geo.ku.dk

Patrick H. Hostert
Head of Geomatics Lab, Deputy Director of Geography Department
Humboldt-Universität zu Berlin, Geography Department / Geomatics Lab
Unter den Linden 6, 10099 Berlin - Germany
Email: patrick.hostert@geo.hu-berlin.de

Héctor Ricardo Grau
Instituto de Ecología Regional - Universidad Nacional de Tucumán-CONICET
Casilla de Correo 34, (4107) Yerba Buena, Tucumán - Argentina
Email: chilograu@gmail.com

11 GLP news

Coverpage

Rural builders in Waka Playa, Bolivia
Photo by Sébastien Boillat

GLP News is a newsletter of the Global Land Project

Editors:
Sébastien Boillat
Fabiano Micheletto Scarpa
Peter Verburg
Jean Pierre Henry Balbaud Ometto

International Project Office - GLP IPO

National Institute for Space Research - INPE

Earth System Science Centre - CCST

Av. dos Astronautas, 1758
CCST Building, 1st Floor, Room 22
Jd. Granja - 12227-010
São José dos Campos
São Paulo - Brazil

Office phone: +55 12 3208 7938

www.globallandproject.org

Dr. Jean Pierre Henry Balbaud Ometto
INPE Liason Researcher
Office phone: +55 12 32087903

Dr. Sébastien Boillat
Executive Officer
Office phone: +55 12 3208 7931

Dr. Fabiano Micheletto Scarpa
Project Officer
Office phone: +55 12 3208 7942

EDITORIAL

Land system science at the interface of science and society

It is likely that the 2015 will be a key year for global development and sustainability. While the target date of the Millennium Development Goals (MDGs) expires with mixed results, the UN General Assembly will meet in September this year to adopt the post-2015 development agenda. In this framework, a process to develop a set of Sustainable Development Goals (SDGs) has been launched at the United Nations Conference on Sustainable Development that took place in the city of Rio de Janeiro from 20-22 June 2012 (Rio +20), with the expectation that SDGs will become operational after 2015. A key milestone of this year will also be the 21st session of the Conference of the Parties to the UNFCCC that will happen in December in Paris, with the hope of reaching a new agreement in order to avoid the most severe consequences of anthropogenic global warming.

The sustainability research community is taking an active part in contributing to achieve these challenging goals. Successful endeavors will require the integration of natural and social sciences and the integration between science and society (Pahl-Wostl et al. 2013) in developing solutions towards a more sustainable world ensuring both the protection of natural resources as well as a just and balanced society. In other words there is a need for a new generation of interdisciplinary and transdisciplinary scientists to achieve these objectives.

As we write these lines, we are pleased to announce that GLP has now been officially endorsed by the Future Earth global research platform. Launched in June 2012 at Rio+20, Future Earth is taking a strong commitment in performing a new form of science: more integrated, more socially relevant, working in partnership with society and decision-makers. As outlined in its 2025 Vision document, Future Earth has put co-design and co-production of solutions-oriented science at the core of its methodological approach. This includes aspiring to be a globally recognized model for engaged research committed to maximizing impact, supporting interdisciplinary and transdisciplinary research, fostering science-society collaborations and sharing data (Future Earth 2014).

The Global Land Project (GLP) is in an excellent position to contribute to these ambitious aspirations. Established as a research project under the umbrella of both International Geosphere Biosphere Programme (IGBP) and International Human Dimensions Programme (IHDP), GLP has a long tradition of performing interdisciplinary research at the interface of natural and social science. GLP also highly contributed to the emergence of the promising concept of land system science, defined as a "separate, interdisciplinary, research field engaging scientists across the social, economic, geographical and natural sciences" (Verburg et al. 2013: 434).

These aspects make GLP and its components strongly interdisciplinary, but we also believe that land system science is a transdisciplinary field. Land systems, natural, rural or urban, are experienced first-hand in daily interaction by most people on earth. They are also multifunctional and reflect people's aspirations, values and power relationships. When they perform their research, land system scientists are in continuous collaboration not only with land users, but also with local, national and international political and economic decision makers. All these actors contribute to defining how we interact with the land and how we manage ecosystems and other natural resources. In turn, these interactions define our cultural identity and the political and economic structure of our societies. How we treat the Land is a reflection of ourselves.

Several concepts have emerged to define and characterize science produced in interaction with society. A well-known concept in the European context is transdisciplinarity, which has been defined as "research that addresses the knowledge demands for societal problems solving regarding complex social concerns" (Hirsch Hadorn et al. 2006: 122). Transdisciplinarity might have a different meaning in the American context, with some authors using the concept to describe collaborative science involving several disciplines, which is more similar to the concept of interdisciplinarity (Zscheischler and Rogga 2015). Another used concept is "Mode 2" knowledge production, which emphasizes the production of "socially robust" applied knowledge (Nowotny et al. 2001).

In this issue of GLP newsletter, we use a more general concept of "co-production of knowledge", which we understand as the generation of new knowledge involving both academics and non-academics in a strongly interactive way, so that "the research process requires starts forms of knowledge and expertise that cannot be supplied by the researchers alone" (Robinson and Tansey, 2006:159). Privileging this concept does not mean dismissing the others, which might be used somewhat interchangeably by researchers, including the perspectives featured in this newsletter.

Involving stakeholders in research processes is time and budget consuming and often a challenging task when their views on how to interact with the environment highly diverge. What are then, the advantages of co-producing knowledge? On the one hand, reaching sustainable development faces trade-offs and involves normative opinions and values. Scientists alone cannot provide the answer on how to reach sustainability. In this context, co-production encourages better adapted and accepted solutions, responds better to societal demands and help prevent conflicts. On the other hand, environmental systems are bounded to society as part of social-ecological systems, which are complex and characterized by uncertainties. Because there are potentially infinite variables to describe a system, choosing them is also a normative decision. Co-production can provide clues on how to deal with complexity and produce context-relevant knowledge. A key aspect is integrating local knowledge, which is often holistic, oriented at practice and generated through long-term interactions.

We are pleased to present a series of practical experiences on co-production of knowledge in the context of land system science. As a perspective article, the text written by Jonathan Morgan Grove, Rinku Roy Chowdhury and Daniel Childers, uses results from the U.S. long term ecological (LTER) network experience to elaborate a dynamic framework for linking decisions and science. LTER projects were characterized by the production of long-term data that are accessible for anyone to use, and a cyclic process of "social-ecological experiments" including several feedback loops involving scientists and stakeholders. They observed that this process could be characterized as "use-inspired basic research" (Stokes, 1997), which consist in "enhancing fundamental knowledge while also addressing a practical concern". On the basis of this observation, they show that sustainability and resilience are open-ended, continuous processes of social learning, making the distinction between basic and applied research a false dichotomy.

Information technology is the most prominent innovation of the last decades. It includes the development of computerized and networked interactive tools, which can boost co-production of knowledge on land systems. Susanne Frank and colleagues brought together a series of interactive tools for participatory landscape assessment and planning under the RegioPower platform, and tested them in four European countries. The approach proved to be especially successful to bring together economic and non-economic land and forest users to identify important ecosystem services and their relevancy. Interactive tools can also foster innovation. MS Srinivasan and colleagues from New Zealand implemented a co-innovation approach to promote efficient water use at farm scale. Farmers collected data on water use and combined weather forecasts to design solutions to improve water use. Researchers acted as "innovation brokers", enabling knowledge transfer among diverse interest groups.

In developing countries, environmental data access is often a challenge. Two contributions highlight the crucial importance of sharing environmental data. In Ivory Coast, Pauline A. Dibi Kangah and Moussa Koné show that disaggregated data on climate change impacts are extremely scarce, while farmers rely on their local knowledge to adapt to climate change. They highlight the potential to make both knowledge systems interact, which has not happened yet. In Bolivia, disaggregated environmental data exist, but have been produced by dispersed development projects that were limited in time and unequally distributed throughout the country's territory. Louca Lerch and Fernando Molina show how the implementation of a Spatial Data Infrastructure can overcome these limitations and open up wide participation to generate new knowledge.

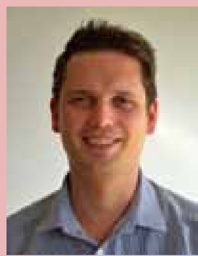
Three case studies take us into rural Southeast Asia. Christoph Görg and colleagues address the challenge of co-producing knowledge beyond the local scale. By highlighting lessons learned from the LEGATO project on irrigated rice landscapes in six countries, they established criteria of social relevance, including communication skills of researchers, a step-wise approach, adequate compensation of stakeholder for their efforts, and the need to include co-design in evaluation criteria used by donors. In Thailand and Laos, Claire Lajaunie and Serge Morand used participatory methods from land system science to perform health impact assessments at community level. Their approach enabled to find collective solutions to health hazards linked with pesticide use, as well as rodent-borne diseases, and set up standards to replicate the process. Ole Mertz and colleagues analyze the potential impacts of REDD+ in Southeast Asian landscapes characterized by the co-existence of mature and degraded forests with agriculture and other land uses. They highlight the importance of performing multi-scale monitoring of forests integrating local knowledge; combine state and community control, and take into account carbon stocks in mosaic landscapes and degraded forests.

In the same region, Aliyu Salisu Barau from Malaysia works in an urban context. He engaged academics, policy makers, civil society groups and local communities to address the implications of urban landscape fragmentation, setting socially robust bases to mitigate its negative effects. Finally, Ana Paula Dutra Aguiar from Brazil elaborated participatory scenarios on the future of Brazilian Amazon at both local and national scale. She shows us that co-production of knowledge can take a prospective approach and can be used to project future development with social consensus. She also shows that normative approaches of environmental scenarios can provide a substantial methodological contribution to co-production of knowledge on land systems.

We hope that you will enjoy as much as us traveling through this colorful collection of promising experiences of fruitful collaborations, constructive interactions and mutual learning, that make us more diverse, more human and more aware of our bonds with the Land. We wish you a good reading and we look forward to your future interactions and contributions to the GLP community.

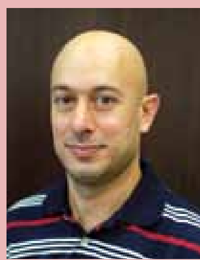
Sébastien Boillat and Fabiano Micheletto Scarpa

Sincerely,



Dr. Sébastien Boillat

Executive Officer of the IGBP/ Future Earth Global Land Project (GLP)



Dr. Fabiano Micheletto Scarpa

Project Officer of the IGBP/Future Earth Global Land Project (GLP)

References

Pahl-Wostl, Claudia, et al. 2013. Transition towards a new global change science: requirements for methodologies, methods, data and knowledge. *Environmental Science and Policy* 28: 36-47

Future Earth. 2014. Future Earth 2025 Vision. http://www.futureearth.org/sites/default/files/future-earth_10-year-vision_web.pdf; accessed on March 26th 2015.

Verburg, Peter H, Karl-Heinz Erb, Ole Mertz and Giovana Espindola. 2013. Land System Science: between global challenges and local realities. Editorial overview. *Current Opinion in Environmental Sustainability* 5: 433-437.

Hirsch Hadorn, Gertrude, David Bradley, Christian Pohl, Stephan Rist, and Urs Wiesmann. 2006. "Implications of Transdisciplinarity for Sustainability Research." *Ecological Economics* 60 (1): 119–28.

Zscheischler, Jana and Sebastian Rogga. 2015. Transdisciplinarity in land use science – A review of concepts, empirical findings and current practices. *Futures* 65: 28-44

Nowotny, Helga, Peter Scott, and Michael Gibbons. 2001. *Re-Thinking Science: Knowledge and the Public in an Age of Uncertainty.* Cambridge: Polity Press.

Robinson, John, and James Tansey. 2006. "Co-Production, Emergent Properties and Strong Interactive Social Research: The Georgia Basin Futures Project." *Science and Public Policy* 33 (2): 151–60.

Stokes, Donald E. 1997. *Pasteur's Quadrant – Basic Science and Technological Innovation.* Washington, D. C.: Brookings Institution Press.

GLP news

CONTENTS

Global LAND Project

Ole **Mertz**[1] | Maya **Pasgaard**[1] | Daniel **Müller**[2,9] | Maria **Brockhaus**[3] | Louis V. **Verchot**[3] | Zhanli **Sun**[2] | Thomas **Sikor**[4] | Meine **van Noordwijk**[5] | Cornelia **Hett**[6] | Jean-Christophe **Castella**[7] | Thilde Bech **Bruun**[8] | Dirk **Pflugmacher**[9] | Finn **Danielsen**[10]

Lessons for REDD+ from complex mosaic landscapes

The GLP endorsed research project I-REDD+ (Impacts of reducing emissions from deforestation and forest degradation and enhancement of forest carbon stocks) ended formally in December 2014. Six main lessons emerge from the research conducted mainly in Southeast Asia and they all indicate a rapidly closing window of opportunity for REDD+. This is especially the case in mosaic landscapes where many types of mature and degraded forests co-exist with agriculture and other land uses and where land use changes are occurring very rapidly.

1) Reference emission levels may not predict uncertain futures

Sudden or unanticipated changes in land systems make it challenging to establish credible reference emission levels that allow for prediction of 'business-as-usual' changes in future carbon stocks as a benchmark for compensating emission reductions. Therefore, the current approach to market-based national level REDD+ relying on performance-based payments and prediction of future carbon dynamics is highly risky and may not lead to the expected emission reductions. Payments or investments in better forest management and co-benefits may be more efficient than a mechanism based on emission reductions compared to unknown future emissions.

2) Drivers of deforestation and degradation are difficult to address

Many underlying drivers of carbon emissions from tropical land–use change originate from the global level and are beyond the control of national or sub-national institutions (e.g., demand for rubber, palm oil and other globally traded cash crops). Interventions to mitigate emissions that are an indirect result of increases in world market prices are costly and difficult to tackle by the currently proposed REDD+ interventions. Moreover, these drivers are mostly decoupled from the forestry sector and expansive land development of cash crops often co-occurs with efforts to promote REDD+ without cross-sector coordination.

3) Carbon stocks in mosaic landscapes and secondary forests may be underestimated

Large areas of forests in the tropics are secondary and still being used occasionally for cultivation. Carbon stocks in such mosaic landscapes may be larger than what has been previously assumed in allometric equations because high belowground biomass under secondary forest is not captured. Small trees in these forests often reveal large underground root and horizontal stem systems, from which they are resprouting and that are not proportional to their small aboveground stems.

4) Forest degradation must be monitored at different scales

The use of dense Landsat time series for temporal analyses of individual pixels is recommended for mosaic landscapes as it can better capture forest degradation associated with felling and regrowth of secondary forests over large areas. It has also been demonstrated that measuring sub-national and local carbon-stocks – needed for verification of broader national measurement efforts – can

[1] Department of Geosciences and Natural Resource Management, University of Copenhagen, Øster Voldgade 10, 1350 Copenhagen K, Denmark, email: om@ign.ku.dk
[2] Leibniz Institute of Agricultural Development in Transition Economies (IAMO), Theodor-Lieser-Str. 2, 06120, Halle (Saale), Germany
[3] Center for International Forestry Research, PO Box 0113 BOCBD, 16000, Bogor, Indonesia
[4] School of International Development, University of East Anglia, Norwich NR4 7TJ, United Kingdom
[5] World Agroforestry Centre (ICRAF), 16000 Bogor, Indonesia
[6] Centre for Development and Environment (CDE) NCCR, University of Bern, Hallerstrasse 10, CH-3012, Bern, Switzerland
[7] Institut de Recherche pour le Développement, UMR GRED – PO Box 5992, Vientiane, Lao PDR
[8] Department of Plant and Environmental Sciences, University of Copenhagen, Thorvaldsensvej 40, 1871, Frederiksberg, Denmark
[9] Geography Department, Humboldt-Universität zu Berlin, Unter den Linden 6, 10099, Berlin, Germany
[10] NORDECO, Skindergade 23, 1159, Copenhagen K, Denmark

include community-based measurement for enhancing feasibility, efficiency and potential equity benefits. Community members can monitor above ground carbon as accurately as professional foresters and should be considered in local REDD+ projects, but also if national REDD+ integrate sub-national approaches to monitoring. With repeated rounds of measurement, both the reliability and the cost-effectiveness of community monitoring increase.

5) Just benefit distribution needs elements of both state and community control

Benefit distribution mechanisms for REDD+ are important in relation to effectiveness, efficiency, equity and their trade-offs. From the local perspective, the combination of state and community control is considered more just, while top-down state control is more effective, but only where states commit significant resources in the form of specialized staff and operating budgets. However, state control performs badly from a justice perspective in terms of distribution, participation and recognition. Decisions about payment distribution at the local level should take into account tenure arrangements (private or collective), which affect the tolerance and perceived equity of payment methods. The risk of elite capture and harming the poorest households, who rely the most on forest resources and have limited power in local actor-networks, remains high in many potential REDD+ countries and should be addressed openly before REDD+ is implemented.

6) Locating REDD+ activities should match desirable qualities for REDD+

Desirable qualities for REDD+, both at national level and for localized interventions, include a high degree of dense forests, low population density, low level of losses from foregone opportunities, high biodiversity benefits, high poverty reduction potential and commitment to engage in REDD+. However, so far locations for REDD+ pilot activities have typically been selected on the basis of specific interests of the external implementing agencies and other powerful players – with or without the potential to reach the intended climatic, ecological and social objectives in REDD+. This is likely to remain an issue if national REDD+ has an important sub-national/nested component.

REDD+ activities on the ground in the four countries studied by I-REDD+ are still under preparation. However, there is considerable scope for co-design and co-production of new research as local Pilot REDD+ programmes are being implemented and if an international REDD+ agreement will make national REDD+ programmes get off the ground. This is especially relevant for monitoring systems, which have been set up in many areas and countries, but need to be evaluated jointly by researchers and implementing agencies once they are operational.

References

Ankersen J, Mertz O, Fensholt R, Castella JC, et al. (2015): Vietnam's forest transition in retrospect: demonstrating weaknesses in business-as-usual scenarios for REDD+. Environmental Management, http://dx.doi.org/10.1007/s00267-015-0443-y

Brofeldt S, Theilade I, Burgess ND, Danielsen F, et al. (2014). Community monitoring of carbon stocks for REDD+: Does accuracy and cost change over time? Forests 5(8): 1834–1854.

Danielsen F, Adrian T, Brofeldt S, van Noordwijk M, et al. (2013). Community monitoring for REDD+: international promises and field realities. Ecology and Society 18(3): 41.

Fox J, Castella JC, Ziegler AD (2013). Swidden, rubber and carbon: Can REDD+ work for people and the environment in Montane Mainland Southeast Asia? Global Environmental Change 29: 318-326.

Mertz O, Müller D, Sikor T, Hett C, et al. (2012). The forgotten D: challenges of addressing forest degradation in complex mosaic landscapes under REDD+. Geografisk Tidsskrift-Danish Journal of Geography 112(1): 63-76.

Müller D, Sun Z, Vongvisouk T, Pflugmacher D, et al. (2014). Regime shifts limit the predictability of land-system change. Global Environmental Change 28: 75-83

Sikor T (2013). REDD+: Justice Effects of Technical Design. Pp 46-68 in Sikor T (ed.) The Justices and Injustices of Ecosystem Services. London: Routledge.

Vongvisouk T, Broegaard RB, Mertz O, Thongmanivong S. (In review) Rush for cash crops and forest protection: neither land sparing nor land sharing. In review in Land Use Policy.

Yuen JQ, Ziegler AD, Webb EL, Ryan CM. 2013. Uncertainty in below-ground carbon biomass for major land covers in Southeast Asia. Forest Ecology and Management 310: 915–926.

See all I-REDD+ publications on http://www.i-redd.eu

Aliyu Salisu **Barau**[1]

Tools for Co-Creation of New Knowledge for Transformation to Sustainable Urban Landscapes

Abstract

Rapid urbanization undermines landscape sustainability in many developing countries. Spatially explicit models have dominated explanations on spatial and temporal patterns of urban land use change. However, as urbanization exerts pressure on landscapes through fragmentation and sprawl; researchers are challenged to explain sustainability implications of urban induced landscape change through alternative approaches. This article narrates my experience in applying a co-design strategy supported by social and decision science tools to co-create knowledge on complex socio-ecological implications of urban landscape fragmentation in Malaysia. In doing this, I engaged academics, policymakers, civil society groups, and local communities in identifying problems, effects and perceptions on landscape fragmentation. Co-design offers unlimited opportunities for achieving holistic, cross-disciplinary and decision support that can help developing countries to achieve transformation to sustainable urban landscapes.

Keywords: rapid urbanisation, co-design, co-production, sustainability

Urban landscapes are vulnerable to contemporary rapid urbanization. Unfortunately, academic discourses are lacking in consensus on criteria for defining an urban area (Bhatta, 2010; McGranahan and Satterthwaite, 2014). While academic debates continue, the disproportionate implications of urban growth intensify to all regions. Land change has become one of the most critical sustainability issues in the new urban age. For instance, some projections suggest that 60% of global urban regions would be built-up; whilst the estimated two percent annual increase in land use change is expected to induce global low-density population distribution in the next few decades (Angel et al. 2011; Seto et al. 2013). Therefore, the problem of rapid urban growth poses huge challenge to sustainability of the finite habitable landscapes. Some of the most remarkable challenges associated with unbridled urban land use change evolve through fragmentation of landscapes and urban sprawl. The effects of these processes include urban heat island, depletion and pollution of water resources, increased greenhouse emissions, biodiversity loss, social inequality and increasing poverty (Buyantuyev and Wu, 2010). However, it is difficult to offer systematic explanations on how these problems affect people and ecosystems.

In this article, I intend to share my experience of using co-design or co-production as emerging strategies for achieving a broader and in-depth understanding of problems of landscape fragmentation in Iskandar Malaysia - a special economic region established in 2007. Co-production in landscape management studies is considered an integrated research where researchers, practitioners, managers work to produce new knowledge (Ayre and Nettle, 2015). As the world faces increasing urbanization and landscape change, it is very important for scientists and policymakers to exploit the potentials of knowledge co-production in driving transformation to urban sustainability. In this context, Trencher et al. (2013) argue that universities have an important role to play in knowledge co-production for transformation to urban sustainability through partnership with relevant stakeholders in order to diffuse ideas for sustainability to the larger society. Co-construction of knowledge is also considered as trans-disciplinary process that emerges from articulation of assumptions, disagreements, and misunderstandings between different stakeholders (Mattor et al. 2014).

What is happening to urban and peri-urban landscapes in open economies like Malaysia is of interest to landscape change research community. Landscapes in the emerging economies are being exposed to global capital influx and this spurs rapid low-density development. The situation in Iskandar Malaysia represents an example of the deepening interactions between distant urban areas, which in the opinion of Liu et al. (2013) is characterized by five features: coupled human and natural systems, flows, agents, causes, and effects. It is not possible for landscape

[1] Department of Urban and Regional Planning, Universiti Teknologi Malaysia, Johor Malaysia, Malaysia, aliyubarau1@yahoo.co.uk

scientists alone to understand or explain these features without engaging stakeholders from businesses, policymakers, civil society groups, and communities. Although the conventional mapping of spatial and temporal patterns of landscape change remains indispensable, nevertheless, mapping is not sufficient for deep understanding of the present day urban growth challenges. Therefore, the critical role of knowledge co-production or co-design in achieving transformation to urban sustainability is increasingly becoming more desirable. For instance, the UN Habitat (2013) declares that urban spatial configuration has an important role to play in achieving the UN Sustainable Development Goals (SDGs). Urban spatial configuration is directly related to patterns of urban land use, proportion of public space and accessibility. One of the targets of the SDGs under the proposed Spatial Configuration Cluster is to make one-third of total urban areas into urban public space. This target also envisages achieving high density, mixed use, walkable, bikeable, and disabled accessible neighborhoods.

Most of the capital influx into Iskandar Malaysia targets the real estate sector – housing, tourism, recreation and industrial infrastructure. Such land development projects trigger fragmentation of vital ecosystems and particularly mangroves, agricultural landscapes, and forests in this wet tropical area. As a lived environment, these unfolding landscape changes also affect people in many ways. (Barau and Qureshi, 2015)

I quite believe that understanding the human dimensions of landscape fragmentation in a rapidly urbanising area requires involvement of local communities, investors, policy-makers, planners, academics, and civil soceity groups. In the course of my research, I engaged many stakeholders in co-designing my research problem and methodology (data collection). In general, my results are comprised of landscape fragmentation maps derived from GIS and landscape metrics. However, field observations, public and experts surveys were strengthened by the co-design process. My results were able to explain the role of a normative approach in achieving transformation to sustainability.

It is important to reveal how I co-designed investigating landscape fragmentation in Iskandar Malaysia. Literature has guided my theoretical framework where I was able to establish strong link between rapid urbanisation and landscape change in developing countries through the time-space telescoping theory (Marcotullio, 2003). I explored the opportunity of enagaging with senior staff of Iskandar Malaysia Regional Development Authority (IRDA), the sole authority vest with this responsibility for developing this special economic region. Through my relationship with IRDA, I was able to participate in series of meetings they organised between 2011 and 2013. These include focus group discussions and technical presentations that usually bring together stakeholders. Through these interactions, I was able to identify how new land development activities affect people and ecosystems. Subsequently, using what I learnt from these interactions, I designed an experts survey that targeted stakeholders who evaluated the region's existing sustainability strategies and offered alternative views through Delphi/Analytic Hierarchy Process (Delphi/AHP). This method is used by researchers to analyse and evaluate experts' views to achieve complex decsion-making process through dialogue, and scalable collaborative ideas (Vidal et al. 2011; Kim et al. 2013). This interactive dialogue allowed experts to sort out the best alternative ways for achieving transformation to landscape sustainability.

On the other hand, I discussed and collaborated with neighbouhood organisations on the effects of recent land development on people and ecosystems. I discussed with locals on issues relating to sampling and sustainability issues to be included for a public perception survey. I analysed the questionnaire using the Rasch model which gives the picture of public perceptions on fragmentation of landscapes along gender, place of living and age group. Rasch model is commonly used by social and medical scientists to analyse respondents perception dynamics concerning a wide range of issues (Huang et al. 2012; Kenaszchuk et al. 2013). In addition to using these research tools, while conducting the fieldwork, I listened to people and observed people and how they experience fragmented landscapes.

The GIS/landscape metrics findings revealed that within five years, urban built-up areas increased from 13% in 2006 to 24% in 2010, whilst mangroves declined by 20% in the same period (Figure 1). On the other hand, green areas, which represent protected ecosystems and coastal vegetation, witnessed some changes but particularly the coastal vegetation. By and large, the use of co-design greatly helped me achieve a broader explanation of the socio-ecological implications of landscape change. My resarch established some links between landscape fragmentation and human-wildlife conflict, land tenure change issues, gentrification, environmental human rights, declining landscape aesthetics, emergence of novel ecosystems, public safety issues, threats to cultural landscapes. Others include the crtical role of private sector and planning policy. Based on my experiences, co-design is an important strategy that can greatly facilitate researchers' capacity to reach out to policy-makers and other stakeholders in order to establish broader understanding of complex problems of landscape change in the rapidly urbanizing economies of the

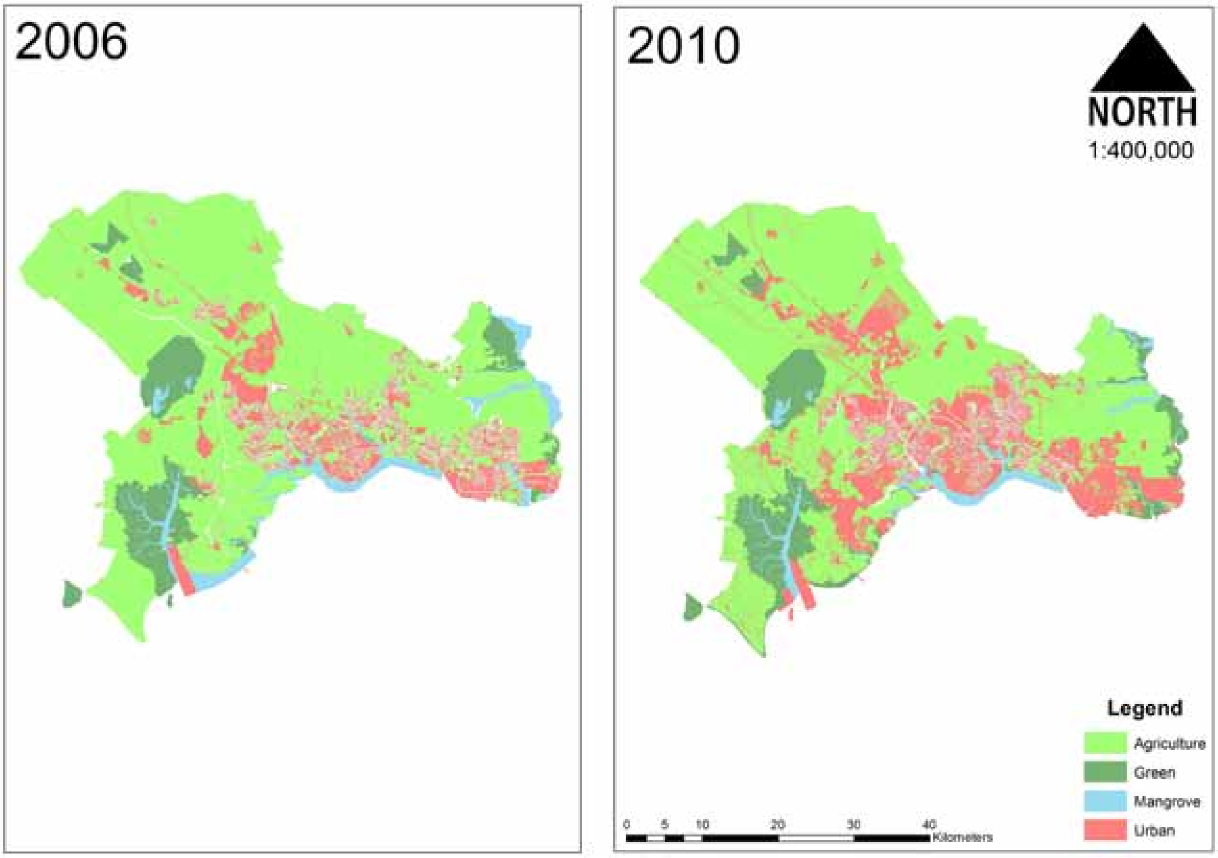


Figure 1: *Spatio-temporal patterns of landscape change in Iskandar Malaysia*

Figure 2: *Map of Iskandar Malaysia (source: IRDA)*

References

Angel, S., Parent, J., Civco, D.L., Blei, A. and Potere, D. (2011). The dimensions of global urban expansion: Estimates and projections for all countries, 2000–2050. Progress in Planning, 75(2), 53-107.

Ayre, M. and Nettle, R. (2015) Doing integration in catchment management research: Insights into a dynamic learning process. Environmental Science & Policy, 47, 18-31.

Barau, A.S. and Qureshi, S. (2015)Using agent-based modelling and landscape metrics to assess landscape fragmentation in Iskandar Malaysia. Ecological Processes DOI: 10.1186/s13717-015-0033-1

Bhatta, B. (2010). Analysis of Urban Growth and Sprawl from Remote Sensing Data. Springer, Dordrecht.

Buyantuyev, A. and Wu, J. (2010). Urban Heat Islands and Landscape Heterogeneity: Linking Spatiotemporal Variations in Surface Temperatures to Land-cover and Socioeconomic Patterns. Landscape Ecology 25:17-33.

Huang, J-H., Peng, K-H. (2012) Fuzzy Rasch model in TOPSIS: A new approach for generating fuzzy numbers to assess the competitiveness of the tourism industries in Asian countries. Tourism Management 33(2) 456-465.

Kenaszchuk, C., Wild, T.C., Rush, B.R., Urbanoski, K. (2013) Rasch model of the GAIN Substance Problem Scale among Canadian adults seeking residential and outpatient addiction treatment. Addictive Behaviors, 38 (7), 2279-2287

Kim, M., Jang, Y-C., Lee, S. (2013) Application of Delphi-AHP methods to select the priorities of WEEE for recycling in a waste management decision-making tool. Journal of Environmental Management. 128, 941-948.

Liu, J. et al. (2013). Framing sustainability in a telecoupled world. Ecology and Society 18(2): 26.

Marcotullio, P.J. (2003) Globalization, urban form and environmental conditions in Asia-Pacific cities. Urban Studies, 40: 219-247.

Mattor, K., Betsill, M., Huayhuaca, H., Huber-Stearns, H. Jedd, T., Sternlieb, F., Bixler, P., Luizza, M., and Cheng, A.S. (2014) Transdisciplinary research on environmental governance: A view from the inside. Environmental Science & Policy, 42, 90-100.

McGranahan, G. and Satterthwaite, D. (2014) Urbanisation concepts and Trends. IIED Working paper, IIED, London

Seto, K.C. Parnell, S. and Elmqvist (2013) A Global Outlook on Urbanization. In: Emqvist T. et al. (eds.), Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment. Springer, New York.

Trencher, G.P., Yarime, M., Kharrazi, A. (2013) Co-creating sustainability: cross-sector university collaborations for driving sustainable urban transformations, Journal of Cleaner Production, 50, 40-55.

UN Habitat (2013). Sustainable Cities & Human Settlements in the Sustainable Development Goals (SDGs) within the Post-2015 Development Agenda and Environment and Climate Change: Challenges, Responses and Tools. UN Habitat, Nairobi.

Vidal, L-A. Marle, F., Bocquet, J.C. (2011) Using a Delphi process and the Analytic Hierarchy Process (AHP) to evaluate the complexity of projects. Expert Systems with Applications, 38 (5), 5388-5405.

GLP International Project Office
National Institute for Space Research- INPE
Earth System Science Centre- CCST
Av. dos Astronautas, 1758
Earth System Science Center (CCST),
1st floor, room 22
Jd. Granja - 12227-010
São José dos Campos - São Paulo - Brazil
Fone: +55 12-3208 7931/7942
www.globallandproject.org

Graphic design: Luciano Urizzi, Magno Studio, Brazil

GLP is a joint research project of the International Geosphere-Biosphere Programme (IGBP) and Future Earth.

GLP International Project Office is thankful for the financial support from the National Institute for Space Research – INPE, Brazil, the Earth System Science Center (CCST) and VU University Amsterdam (VUA)