Causal chains, policy trade offs and sustainability: Analysing land (mis)use in seven countries in the South

Ingrid Nesheim [a,*], Pytrik Reidsma [b], Irina Bezlepkina [c], René Verburg [c], Mohamed Arbi Abdeladhim [d], Marcel Bursztyn [e], Le Chen [c], Youssouf Cissé [f], Shuyi Feng [g], Patrick Gicheru [h], Hannes Jochen König [i], Nina Novira [j], Seema Purushothaman [k], Saulo Rodrigues-Filho [e], Mongi Sghaier [d]

[a] Centre for Development and the Environment, University of Oslo. P.O. Box 1116, Blindern, NO-0317 Oslo, Norway
[b] Plant Production Systems Group, Department of Plant Sciences, Wageningen University, P.O. Box 430, 6700 AK Wageningen, The Netherlands
[c] LEI, Part of Wageningen UR, P.O. Box 29703, 2502 LS The Hague, The Netherlands
[d] Laboratoire d'Economie et Sociétés Rurales, Institut des Régions Arides, Route de Jorf, Km 22.5, 4119 Médenine, Tunisia
[e] Center for Sustainable Development, University of Brasilia, Campus Universitário Darcy Ribeiro, Gleba A, Bloco C, 70070-914 Brasília, DF, Brazil
[f] Institut d'Economie Rurale (IER), BP 258, Rue Mohamed V, Bamako, Mali
[g] College of Public Administration, Nanjing Agricultural University, Weigang No. 1, 210095 Nanjing, PR China
[h] Kenya Agricultural Research Instituté, PO Box 14733, Nairobi, Kenya
[i] Leibniz-Centre for Agricultural Landscape Research (ZALF), Eberswalder Str. 84, 15374 Müncheberg, Germany
[j] Gadjah Mada University (GMU), Bulaksumur, Skeip Utara Jalan Kaliurang Bulaksumur, Yogyakarta 55281, Indonesia
[k] Ashoka Trust for Research in Ecology and the Environment, Royal Enclave, Srirampura, Jakkur Post, Bangalore 560 024, Karnataka, India

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ABSTRACT

The need to enhance sustainable development of land use is more urgent than ever; specifically in developing countries where poverty and land degradation are often interlinked. To promote a common understanding of land use problems by experts, stakeholders and decision makers, it is essential to understand the system characteristics, including the complex feedbacks between drivers and impacts. To enhance sustainable development, appropriate policies need to be identified. In this paper, we analysed and compared seven case studies in Kenya, Mali, Tunisia, China, India, Indonesia and Brazil, representing different biophysical and socio-economic conditions and challenges. We analysed Driver Pressure State Impact Response (DPSIR) story lines of the land use problems, policy priorities and value trade-offs as identified by stakeholders and experts in National Policy Forums. Important drivers of land use change impacting main land use problems among the case studies were economic growth, technological development, immigration and agricultural intensification, in addition to existing policies. Of the latter the most important were related to domestic support through various forms of subsidies or access to credit, land tenure polices and liberalization policies. In the policy prioritization, the value trade-offs made by the National Policy Forums emphasize the environment rather than increased economic production. It is recognized that the environment needs to be improved to maintain and improve economic production in the long term, both in agriculture and in other sectors.

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Introduction

Human actions during the last 50 years have altered ecosystems to an extent and degree unprecedented in human history. Health and wealth have on average improved, but the benefits are unequally distributed and further improvement may be limited by an insufficient supply of key ecosystem services (MEA, 2005a,b). The degradation of approximately 60 percent of land and ecosystem services cause significant harm to human well-being and represents a loss of the natural assets or wealth of a country (UNEP, 2010). Hence, the need to enhance sustainable development (SD) is more urgent than ever; specifically in developing countries where poverty and land degradation are often interlinked. It is, however, essential to understand the system characteristics, including the complex feedbacks between drivers and impacts and address this fundamental issue with appropriate policies. The successful implementation of land use polices has in the past often been hampered by the fact that we simply do not know enough about their impact on sustainable development across developing countries (Birdsall et al., 2005; Leichenko et al., 2010). There is a need to identify and analyse causal linkages between local, national, and international factors and their economic, environmental, social
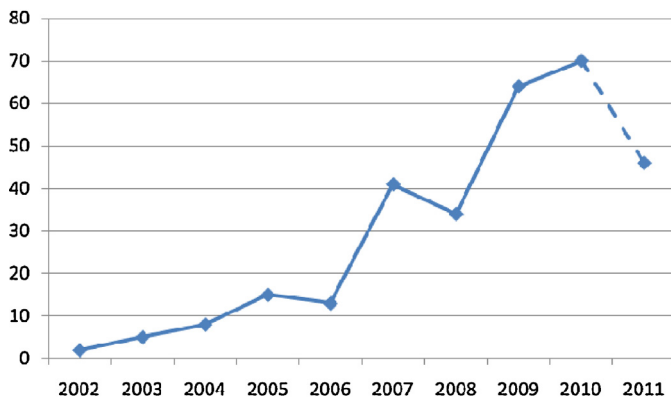
Fig. 1. Number of annual publications referring to "DPSIR" framework and "assessment" as cited in Scopus (www.scopus.com).

and institutional impacts, to promote a common understanding by experts, stakeholders and decision makers. This paper seeks to respond to this challenge, based on a comparative analysis of seven case studies from Africa, Asia and Latin America.

This study is performed within the research project LUPIS (Land Use Polices and Sustainable Development in Developing Countries), an EU funded research project with the key objective to study the impact of different land use options on sustainable development in developing countries (Reidsma et al., 2011; König et al., 2013). The analysis of causal chains and identification of policy options is part of the first phase in the impact assessment, the pre-modelling phase. It forms the basis for further quantitative assessments, but also provides important insights itself. Many tools have been developed for quantitative impact assessment (De Ridder et al., 2007), but few have focused on the first steps including the identification of the problem and the development of the policy (EC, 2009).

Seven case studies in Kenya, Mali, Tunisia, China, India, Indonesia, and Brazil have been selected to represent different biophysical and socio-economic conditions and challenges. The Driver, Pressure, State, Impact and Response (DPSIR) framework (OECD, 1993) was used as a tool to analyse drivers and impacts in the case study areas. Based on this analysis, trade-offs can be identified, and relevant policies can be selected for the promotion of sustainable development (SD). When recommending a policy to be pursued, some SD objectives are necessarily encouraged or promoted at the expense of others. Policy decisions are not only based on "factual trade-offs" between the economic, environmental and social dimensions of SD, i.e. measured impacts, but also on "value trade-offs", i.e. the importance given to the different dimensions. In this paper we aim to explore links within the DPSIR story lines, policy priorities and the value trade-offs, as indicated by stakeholders and experts in these seven case studies.

Methodology: DPSIR framework to analyse causal chains

The DPSIR framework developed in the late 1990s and proposed by the Organisation of Economic Co-operation and Development (OECD) as means of structuring indicators (OECD, 1993; Helming et al., 2008; Tscherning et al., 2012) was used to analyse the causal relationships between the various economic, environmental, social and institutional aspects within each case study. The DPSIR framework has been widely applied in Impact Assessment studies; Scopus (www.scopus.com) reveals 300 publications on "DPSIR" and "assessment" over the period 2002–2011 (Fig. 1). The approach has been popular in comparative analysis of assessment tools (Helming et al., 2011) as well as in land use change assessments (Helming and Pérez-Soba, 2011; Morris et al., 2011). Helming and Pérez-Soba (2011) write that the approach has been widely used for

jointly conceptualizing research problems and integrating disciplinary viewpoints. Tscherning et al. (2012) discuss the different positive and negative implications of the DPSIR framework with reference to research that supports policy making.

The components of the framework distinguish between driving forces of change, pressures on land use, state of the natural and socio-economic environment, and the impacts on sustainable development. The use of this conceptual framework based on causality between interacting components of social, economic and environmental systems has important benefits by providing clear and concise communication to decision makers (see also Kohsaka, 2010; Rounsevell et al., 2010). On the other hand, the same framework has been criticized for being too simplistic, ignoring non-human drivers and discursive interpretations (Rekolainen et al., 2003; Svarstad et al., 2008). In order to clarify the functionality of the drivers, we classified them into a group of *underlying drivers* including social, political, economic, demographic, technological and cultural factors, such as economic growth, technological development, international factors and climate change, and a group of *proximate drivers* which includes human actions linked to economic sectors (e.g., agriculture, forestry, industry) and policy drivers (Geist and Lambin, 2002). The distinction between underlying and proximate drivers was seen as important in order to understand which aspects are difficult to modify/change as the underlying drivers are out of control of the case study stakeholders, and which drivers can be modified i.e. proximate drivers such as existing policies, human actions such as immigration and agricultural intensification. The proximate drivers are the ones that directly influence land use change, which is represented by the *Pressure* component. We also adapted the DPSIR framework so as to cover not only the environmental dimension as in the original form of the framework (OECD, 1993), but to include also the social and economic dimension. This was performed by providing an indicator framework including indicators related to "Land Use Functions (LUFS)" within each of the three sustainable development dimensions (Paracchini et al., 2011; Reidsma et al., 2011). The *State* refers to the level of an indicator, whereas the *Impact* component refers to the change in an indicator and the importance given to this change for sustainable development.

The drivers, pressures, states and impacts, and the causal links including feedback mechanisms have been identified based on literature reviews and interaction between researchers, decision makers and civil society in science–policy dialogues. Representatives from ministries, local authorities, service staff, local researchers, NGOs and farmers were invited by the local research teams took part in these national policy fora. About 15–25 people, with researchers and decision makers dominating, participated in each dialogue. The dialogues were organized by the local research team, three times during the project period, and each session lasted from one to six days. They started with discussions on the problems in the case study area, their drivers, and the major impacts. No interpreter was needed as the different local research teams were able to speak the languages needed. Story lines and indicators were later verified in a subsequent science–policy dialogue. Interactive land use mapping tools, spreadsheets, and moderated stakeholder workshops were used, for example, in the Indonesian case study (see König et al., 2010) also, Tunisian case study (see König et al., 2012), the Indian and the Kenyan case studies (see König et al., 2013) in order to specify the regional problem, to select alternative policy instruments which aim to tackle the regional problems and to develop scenario narratives of alternative land use options. The story lines presented do not aim to be fully comprehensive; we rather present what was perceived by the stakeholders and experts as the most important mechanisms of change in each case.

Some discussions were undertaken on the definition of the different DPSIR categories among research partners (see also Maxim