Identifying governance challenges in ecosystem services management

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Abstract

Ecosystems all around the world generate a wide range of provisioning, regulating and cultural services. Often there are trade-offs where optimizing one ecosystem service (ESS) provision reduces other ESS. Managing such trade-offs requires adapted and effective governance. Our work contributes to finding appropriate institutional mechanisms by identifying critical action situations related to the provision and appropriation of ESS. We demonstrate our approach with six forest cases in Asia, Africa and Latin America. Data have been collected by case experts working in different transdisciplinary research projects.

Our results confirm that ecosystems are managed in a complex landscape of interacting action situations. There is a tendency that ecosystem management, which provides public goods and common pool resources is under strong pressure to be transformed into one which provides a more narrow range of private goods.

Our approach enriches the ESS and SES discourses by detailing and operationalizing the linkage of ESS with human agency and governance and in this way makes the ecosystem service concept more operational for decision makers. It further provides new entry points for social-ecological system analyses.

Keywords

Ecosystem Services, Governance, Social-Ecological Systems, Forest ecosystems, Case Comparision

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Introduction

Communities all around the world make strong use of a wide range of natural resources such as land, forests, pastures and water. They benefit from ecosystem services (ESS) as aspects of ecosystems which are utilized to produce human well-being (Fischer et al. 2009). In particular poor smallholders depend on provisioning ESS such as food, fuel, grazing biomass, timber, and medicine (Sukhdev 2009). In addition, the poor are the group most vulnerable to ecosystem disservices (EDS) such as pest infestation or river flooding. Ecosystems further provide regulating and cultural ESS which are experienced by multiple beneficiaries on the local, regional and global scale (MEA 2005, Raudsepp-Hearne et al. 2010).[1] The social and ecological interactions relevant to the governance of ESS and EDS are, however, not yet sufficiently understood (Reyers et al. 2013). Different actors are still challenged to find ways of managing ecosystems which strike a balance and enhance the provisioning of ESS while limiting the occurrence of EDS.

Alternative management and governance choices at various scales lead to different constellations of actually and potentially provided ESS and EDS.[2] Often there are trade-offs where optimizing one ESS provision results in gains and losses of other ESS (Tallis et al. 2008). Insufficient knowledge about ESS-EDS interactions in combination with institutions failing to take externalities into account often results in suboptimal decisions favouring the provision of some ESS at the expense of losses of other ESS or increase of EDS (Rodriguez et al. 2006).

Natural resource governance studies often focus on a single resource used by a single user group. ESS research teaches us, however, that basically any ecosystem provides multiple potentials for generating a broad range of benefits to people (e.g. OECD 2003, MEA 2005, Maynard et al. 2015, IPBES 2015). It remains a challenge to understand and indeed manage such situations (Kosoy & Corbera 2010, Hinkel et al. 2014, Ruckelshaus et al. 2015). There are both competing and complementary ESS/ESD bundles which differently affect different stakeholders' interests (Raudsepp-Hearne et al. 2010, Maynard et al. 2015). In the logic of the ecosystem service cascade (Haines-Young and Potschin 2010, 2011) each bundle is associated with a distinct ESS transformation pathway (see conceptual background below). Which of the pathways is chosen depends on power structures, group hierarchies, and the preferences for ecosystem service benefits (ESB) in particular of influential agents (Förster et al. 2015).

[1] Following the argument of avoiding double counting we do not look specifically into supporting ESS (MEA 2005, Maynard 2015).

[2] For the remainder of this paper we will consider ESD as ESS losses and therefore talk about ESS gains or losses when addressing ESS and ESD.

Using the terminology of the social-ecological system thinking, along each pathway a number of "action situations" occurs. We distinguish: (1) provisioning action situations where beneficiaries create, maintain, or improve an ESS, and (2) appropriation action situations where actors subtract from a stock of ESS (Hinkel et al. 2014). Action situations are influenced, amongst others, by historical, cultural, and macro-level institutions. The interaction of these action situations critically affects the natural resource management (Cole et al. 2014).

The governance of provisioning and appropriation action situations is influenced by the characteristics of the ESS such as subtractability and excludability (OECD 2003). Based on these characteristics ESS can be classified as private, public and toll goods as well as common pool resources (regarding the good typology see Ostrom 2009). There is a risk that incentives for short-sighted resource-use decisions lead to suboptimal outcomes from a wider local, regional or global social welfare perspective. We call such incentive constellations social dilemmas. They are more likely when public goods and common pool resources are affected (e.g. Constanza et al. 2011) and often lead to an over-exploitation of the ecosystem service potential and/or under-investment into underlying ecosystem functions and service potentials. Identifying ESS related social dilemmas is a prerequisite for developing more effective governance mechanisms in ecosystem management.

This paper is driven by the motivation to guide stakeholders in the process of developing effective and adapted ecosystem governance frameworks. We demonstrate an approach of categorizing ESS in order to identify appropriation and provision action situations which are particular vulnerable to multi-scale social dilemmas. This creates awareness for the fact that ecosystem governance has to deal simultaneously with multiple action situations and not seldom multiple social dilemmas associated with different ESS. Our approach enriches the ESS discourse by detailing and operationalizing the linkage of ESS with human agency and governance and contributes to the still largely unresolved challenge of making the ecosystem service concept operational for decision makers (Ruckelshaus et al. 2015). It takes a step towards a better understanding why institutions in some instances fail to maintain the provision of ESS and sometimes succeed (Carpernter et al. 2009).

We apply a diagnostic procedure to forest cases in Asia, Africa and Latin America, using forests as an exemplary resource and land use type. The case data have been collected between 2010 and 2016 by research projects implemented under the Sustainable Land Management Program (Eppink et al. 2012) of the German Ministry of Education and Research (BMBF). All projects shared the effort to improve the understanding of selected socio-ecological systems and

contribute with interdisciplinary scientific approaches to sustainable land management. Cases of the following projects for the following countries are compared: INNOVATE/Brazil (www.innovate.tu-berlin.de), SuMaRiO/China (www.SuMaRiO.de), LEGATO/Philippines (www.legato-project.net), SuLaMa/Madagascar (www.sulama.de), The Future Okavango (TFO)/Namibia (www.future-okavango.org) and SASSCAL/Zambia (www.sasscal.org). In this way we demonstrate the potential of the procedure to support comparative studies.

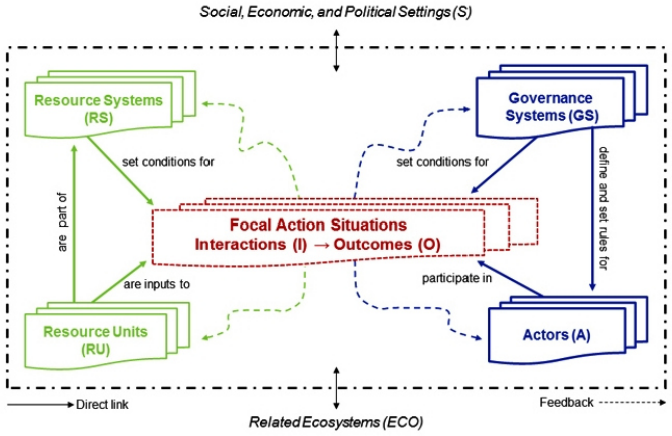
Conceptual background

Our starting point is the acknowledgement that ESS differ in their characteristics, and we use this as a vehicle to link ecosystem services to different social system dimensions (Fisher et al. 2009). We classify ESS into private, public and toll goods as well as common pool resources based on their characteristics of excludability and subtractability (Ostrom 2009). This is a clearly defined classification system which supports our understanding of the conditions under which specific institutions can prevent ESS degradation (Carpenter et al. 2009). To be effective, institutional frameworks need to be developed which best fit to different types of ESS (Fisher et al. 2009) being simultaneously aware of the potential co-production of different kinds of ESS. This follows the logic of Ostrom (2007) who emphasizes that natural resource governance has to be adapted to the social-ecological system (SES) context. For instance, private goods can usually be well handled within markets as one can easily exclude somebody from their enjoyment. This is not the case for public goods and common pool resources. The difficulty to exclude from its benefits offers incentives in the provision action situation for beneficiaries to free-ride on the investment of others. Economic theory predicts that this leads to an under-provision of the ESS. Individual benefits are spread amongst a large number of beneficiaries for many public good ESS. Transaction costs prevent markets to provide efficient incentives to ensure the maintained provision of these public ESS and state-based institutions are often considered to be an appropriate response. In the case of common pool resources (CPR) this challenge is combined with the risk that even if the ESS is provided it is prone to overuse. Groups benefiting from the resource have to find rules how to distribute the ESS and associated benefits.

No governance regime is per se superior to the other and there are no panaceas to prevent social dilemmas (Coase 1960, Williamson 2000, Ostrom 2007). This is a critical finding of new institutional economics. Governance solutions need to be adapted to specific social and ecological conditions. The SES framework (McGinnis & Ostrom 2014, Figure 1) is an

attempt to highlight the complexity of social-ecological systems which needs to be taken into account in governance decisions. Scholars following the SES logic are often challenged by setting the system boundaries and defining the so called first tier variables, namely the Resource System, the Resource Units, the Governance System and the Actors (Hinkel et al. 2014). We propose to take the identification of critical action situations – which are in the center of the SES framework - as a starting point for searching for adapted governance solutions. Acknowledging that ecosystems provide multiple ESS with multiple action situations.

Figure 1: The SES framework in its version of McGinnis & Ostrom 2014



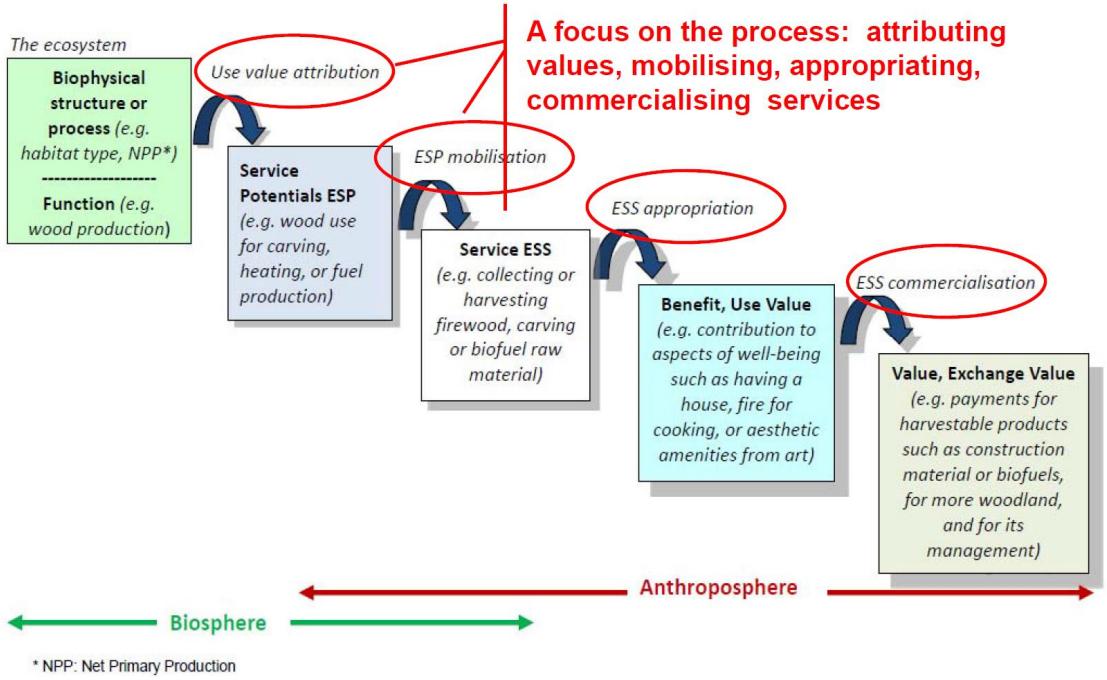
We apply this logic to:

1) create awareness that it might be necessary to conduct multiple SES assessments for finding best suited ecosystem governance solutions as ecosystems provide, under most management systems, multiple ESS of different classes;
2) create awareness that ecosystem governance needs to take into account interactions between action situations and incorporate multiple institutional mechanisms simultaneously. So far action situations are studied mainly in isolation (Cole et al. 2014);
3) identify which action situations are vulnerable to inefficiencies and require special attention in terms of ecosystem governance arrangements; and
4) structure the assessment of actors within the provision and appropriation action situations. The classification allows to focus on actors within vulnerable action situations.

We acknowledge that in particular appropriation action situations can be understood as a transformative process from ecosystem functions to actual benefits for people (Spangenberg et al. 2014b). The 'cascade model' of ecosystem service generation and valuation as originally presented by Haines-Young and Potschin (2010, 2011) highlights the manifold steps which

eventually link the biophysical aspects/biodiversity with human well-being. Spangenberg et al. (2014a) modified the cascade by including, in particular, societal processes and the role of stakeholders (Figure 2). This modification allowed to link the ESS transformation processes to provision and appropriation action situations which are in the center of institutional analyses. Important is the emphasis on people's efforts to improve ESS provision motivated by the benefits they expect to receive. This view could be conceptualized as adaptive management or adaptive governance (Cosens et al. 2014).

Figure 2: The ecosystem service cascade including also social processes (Spangenberg et al. 2014a)



Research Approach

For the purpose of this paper we have collected expert opinions on different dimensions of ecosystem services and their governance from transdisciplinary project teams. Data collection was structured using an open accessible diagnostic procedure (cmap.icrisat.ac.in/ges). The diagnostic procedure contains a sequence of questions which help to clarify, for a particular case, the steps in the ESS transformation process. It further facilitates the ESS classification and identification of actors in the action situations. The procedure is not simply a questionnaire. Questions emerge from previous answers. Taking hypothetical management pathways (scenarios) into account broadens the scope of the governance analysis.

The information on ESS characteristics have been analysed in a descriptive way using visualizations. The current state of ESS in the studied cases was compared with likely development scenarios showing how resource use changes would affect different types of goods. The scenarios were defined by the case experts as plausible and likely development pathways. Their perceptions are based on yearlong work in the region and consultations with other project partners. Still, the judgements are subjective which should be kept in mind when interpreting the results.

Results

The Kavango case

The case of The Future Okavango project refers to the Namibian Kavango East and West regions. The research area is located in the North-East of Namibia sharing the middle section of the river with Angola (Mendelsohn 2009). Although a significant proportion of the Okavango basin is still covered with primary forest of different types (Revermann & Finckh 2013) more than 70 percent of the riverine vegetation has been lost over the last decades (RoN 2004). The need for agricultural land is the main driver of deforestation (Proepper et al. 2010). There are clear trade-offs between using land under forest or as agricultural fields. Figure 3 shows that in particular public good ESS (difficult exclusion/low competition) are reduced as a consequence of deforestation. A wide range of ESS, in particular regulating and cultural ESS, fall into this group.

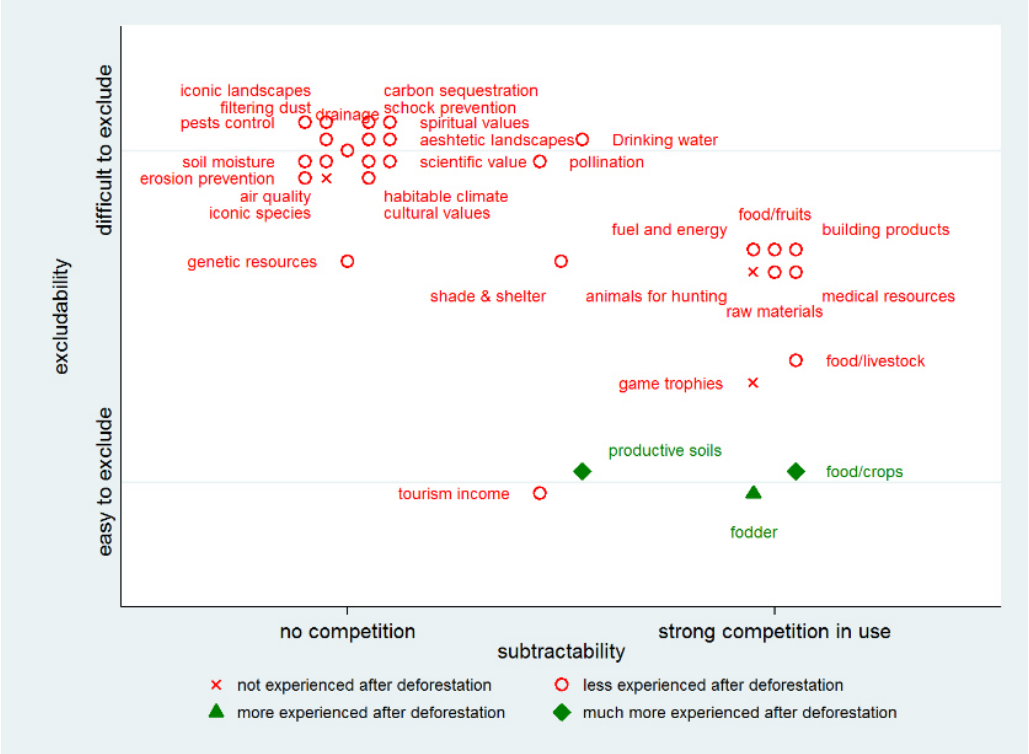
Also Common Pool ESS (difficult exclusion/high competition) are diminished due to deforestation. In this case also provisioning ESS enjoyed by local communities are affected such as firewood, construction wood, fruits, medicinal plants, thatch grass, or game meat (RoN 2004, Barnes et al. 2009). At the same time, the land use transformation towards agriculture favours a limited number of provisioning private good ESS (easy exclusion/high competition).

The private goods and common pool resources are thereby mainly enjoyed on the local scale while beneficiaries of public goods are scattered across different scales. Institutions on a national to global scale are required to provide effective incentives for local land users to consider these ESS adequately in their decision making.

We further observed that multiple actor groups and organizations make efforts to maintain the provision of collective ESS. Most beneficiaries' contributions to the provision of ESS are actually avoided actions (e.g. reduce pesticide use, do not pollute, do not cut trees). Even the

contributions of governance actors are focused on these avoided actions, making and enforcing rules which regulate the harmful actions.

Figure 3: Changes in ESS provision in TFO Deforestation Scenario by good typology



The LEGATO case

The project LEGATO analysed the combined generation of provisioning, regulating and cultural ecosystem services in irrigated rice agriculture and their importance for the local population in seven regions in the Philippines and Vietnam (Settele et al. 2015) and applied ecological engineering to future-proof it against global change and environmental pollution challenges.

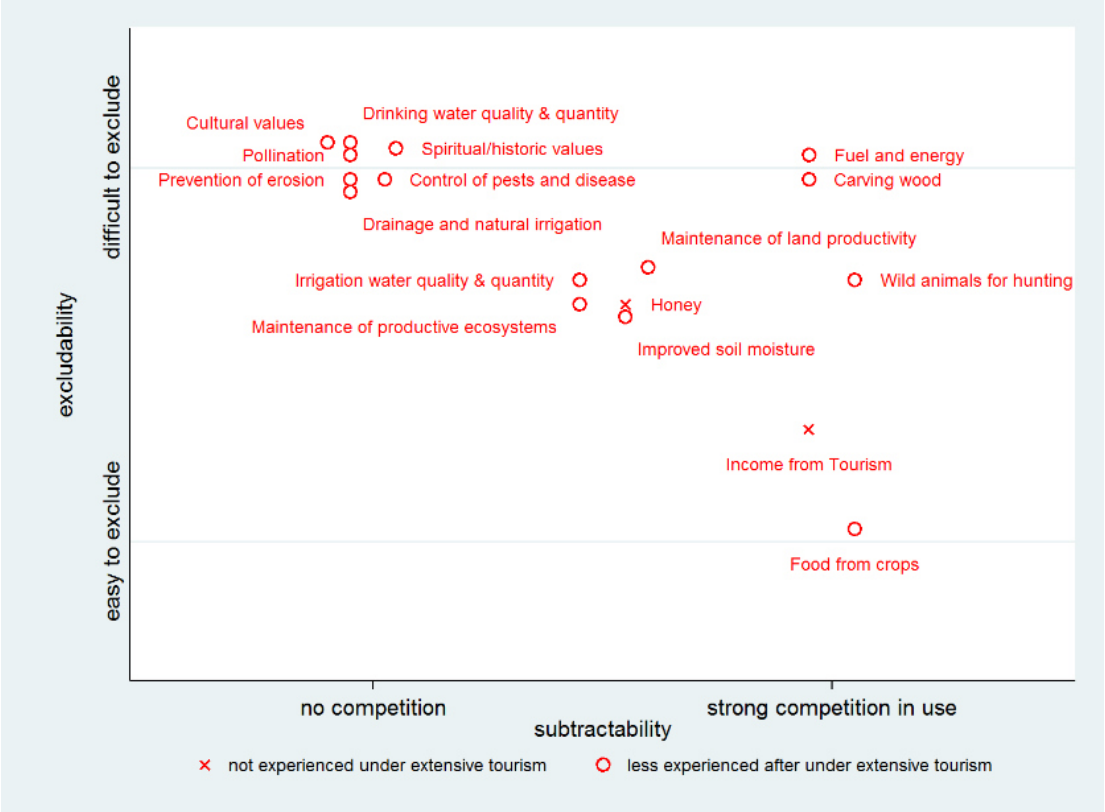
In LEGATO's project area in Banaue/Philippines forests are largely owned by family clans and under this tenure system forests have been managed relatively sustainably. In contrast, state forests have been for a long time managed ineffectively which is improving only recently. At the same time, the pressure on forests increases in particular due to unsustainable hunting as well as logging for firewood, carving and construction. The LEGATO case experts formulated an unsustainable tourism development pathway as contrast to the current state.

Currently selected tree species are extracted almost uncontrolled for large-scale carving souvenir production, disturbing biodiversity, opening up the forest and leading to destruction

in the vicinity. Infrastructure development especially in terms of roads has increased tourist numbers which also increases the demand for souvenirs. Local experienced hunters report that target species become rare; they are not extinct yet but bigger effort is needed to track them.

In the scenario (Figure 5), tourism is expanding uncontrolled, doing havoc to the landscape by inappropriate construction. In particular low price tourists are attracted which spend little money in the region, staying for just one or a few days. The slowly increasing profits from tourism are insufficiently shared with local residents. Only low qualified jobs are offered to them e.g. as tricycle drivers, guides for hiking or jeep tours or service work in hotels or restaurants. This stimulates social tensions between them and outside investors and tourism operators. Farmers remain poor, hardworking people with low reputation. Young people see no economic basis for their future in rice farming and leave the fields, either to other jobs, or emigrate outside the region. Their departure accelerates the erosion of the local culture, as the transfer of tradition is interrupted.

Figure 5: Changes in ESS provision in LEGATO ??? Scenario by good typology



The unsustainable tourism development negatively affects multiple ESS as it is putting high stress on the regions renewable resources – especially water and wood. Irrigation and drinking water are privatised and become expensive reducing local residents' access due to their limited

purchasing power. Hotels' demand for food leads to soaring prices, further reducing the purchasing power and thus the standard of living of local residents without better paid jobs. Waste remains in the region, causing additional problems with badly managed waste heaps and pest problems. The growing tourist numbers enlarge the market for souvenirs. Wood carving flourishes, and wood is extracted from the local forests. After the most suitable tree species become rare, supply partly affects more remote areas, partly less suitable species are used, inducing severe damage near the villages and widespread forest degradation. This reduces the forest ecosystem services, in particular the water retention, and leads to a less reliable supply of irrigation water. This in turn not only affects the harvests, but also the stability of the terraces which have to remain wet all year long for their stabilisation.

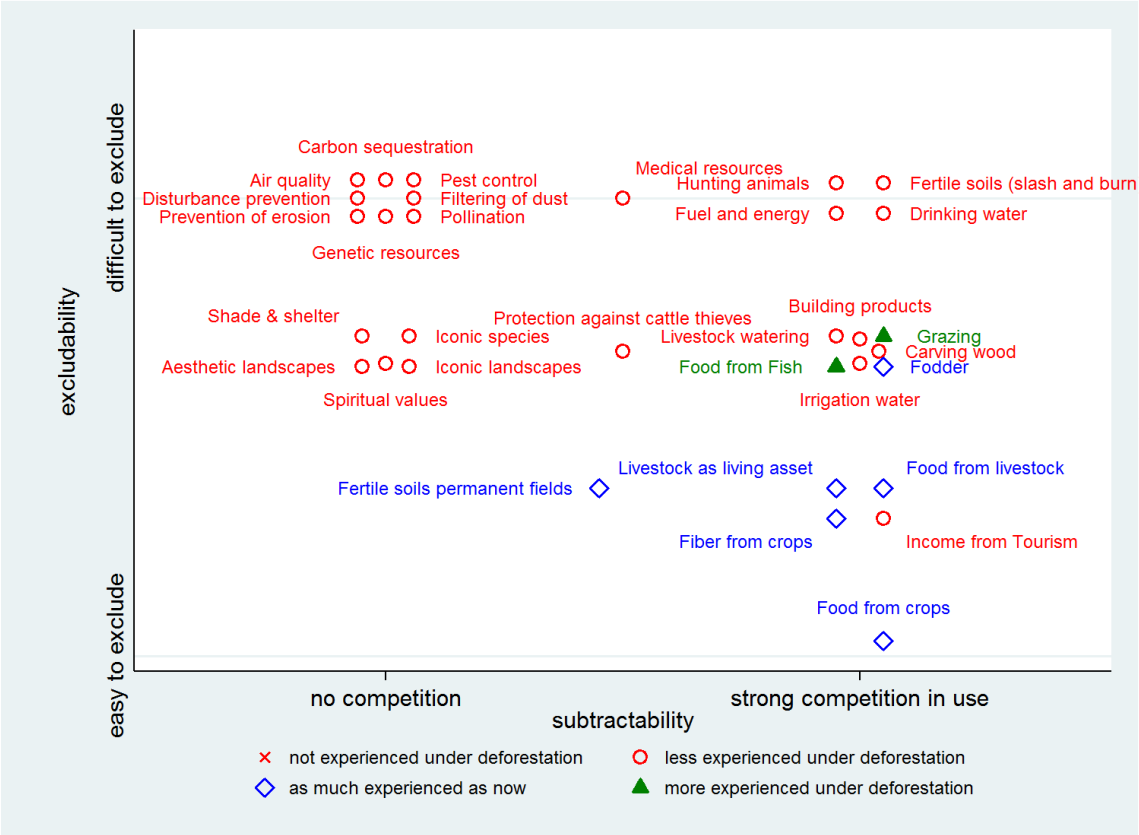
As a result, terraces either collapse due to decreasing stability, or fall idle due to emigration of younger peasants. Secondary forest grows on those terraces which have not collapsed. From a certain level of on, tourism to the (former) UNESCO World Heritage terraces will collapse as well, in particular when the landscape changes have led to the loss of the UNESCO approval, and immigrants will have to leave as their business is no longer viable. Locals are left back with all their former sources of income devastated.

The SuLaMa case

The SuLaMa project investigated sustainable land use alternatives on the Mahafaly Plateau in Southwestern Madagascar. The region faces the challenge of reconciling biodiversity conservation with sustainable land management. Economic development is extremely low and land use is dominated by pastoralism and agriculture on marginal land. The local population depends to a large degree on natural resources especially during lean times. Non-sustainable land use activities such as slash-and-burn, charcoal production and overgrazing have led to a forest loss of 45% during the last four decades resulting in a landscape mosaic consisting of savannah, agricultural land, increasingly fragmented forest patches and degraded sites (Brinkmann et al., 2014). In the low-input/low-output cropping system manure fertilisation is not common, no pesticides are used and soil treatments are performed manually. Apart from permanent agricultural fields close to villages, slash-and-burn agriculture inside the natural forest is widespread and leads to a rapid loss of forest cover. The unfavourable soil conditions as well as the harsh climate (low and erratic rainfall, high frequency of droughts, strong winds and passing of cyclones) in combination with crop pests (mostly locust plagues) and diseases lead to an extremely challenging environment for the cultivation of crops. As a consequence, agriculture is often not sufficient to guarantee food security for smallholder households

(Noromiarilanto et al., 2016). The local population therefore relies on food from natural forests as fall-back resources for human nutrition, especially during times of crop failures. Natural forests also provide basic goods for housing, firewood and medicinal plants (Neudert et al., 2015) and are important for local traditions and customs, which are linked with natural forests, plants and animals ("sense of place", graveyards, taboos) and are essential components of the Malagasy culture. Besides cropping, livestock plays a key role for people's livelihoods. The very extensive animal husbandry system is susceptible to several constraints including seasonal water and forage shortages, as well as livestock diseases, and thus bears risks of loss for herd owners. These circumstances are also tightened by the expansion of cropland in the region, which leads to a rising potential for conflict between livestock keepers and crop farmers. During the recent years of political instability (since the coup d'état in 2009), cattle rustling strongly increased and the forest also served as protection against cattle thieves, adding a new component to the forest's ecosystem service.

Figure 6: Changes in ESS provision in SuLaMa Deforestation Scenario by good typology



The main drivers for the decline of ESS are population growth (leading to a high demand in agricultural land), low economic/market value of forest ESS and an increasing variability of precipitation and aridity which diminishes the production of food and the availability of water

in the region. As a likely development scenario, SuLaMa experts assumed that these main drivers are not tackled in the immediate future and that deforestation is ongoing at high rates, resulting in a landscape mosaic which in comparison to the above-described status quo comprises considerably less natural forest area and much more agricultural land and grazing areas, which are of increasingly lower productivity and eventually abandoned. ESS from the landscape mosaic under the likely development scenario are compared to ESS from the status quo landscape in Figure 6.

Similar to the cases of the Future Okavango project, mainly Public Good ESS and Common Pool ESS would be reduced under the likely development scenario: with very few exceptions which, however do not compensate the losses. The scenario assumes no significant intensification which is likely given the current political instability and resulting investment climate. As a result, with current land use practices the accelerating deforestation at the cost of forest ESS would at best stabilise but not increase cultivation related Private Good ESS.

The SuMaRiO case

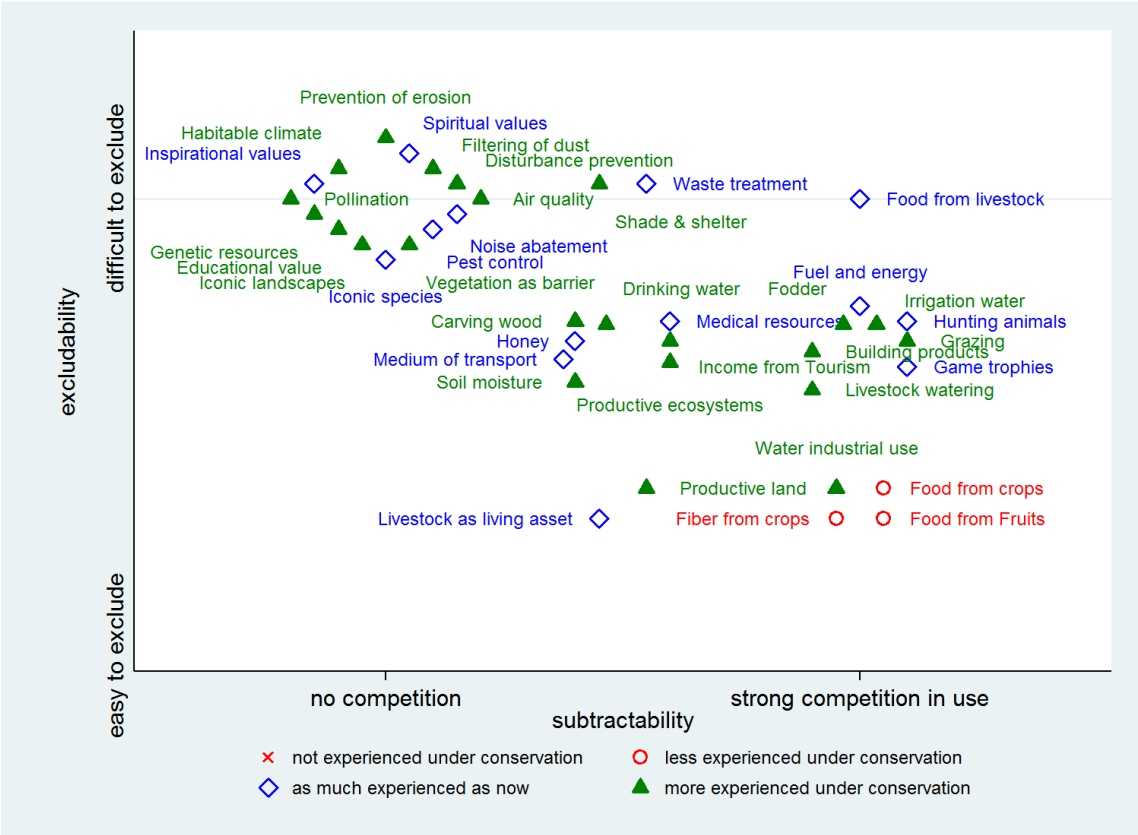
The SuMaRio SuMaRiO project researches land and related water use challenges within the Tarim River Basin in China. The arid region is extremely vulnerable. It is, globally, the most remote area from the oceans; hence rainfall is extremely rare and low and does not exceed 50 mm per year. Thus, all kind of economic activities, especially agriculture, industry and the domestic sector and urban life, as well as the natural ecosystems depend on the river water as major water source. The Tarim River, which is the largest river of the Tarim Basin, is fed from snowmelt and glacier-melt in the mountains. The water discharge into the Tarim River has been increasing over the last decade (Feike et al., 2015). However, global climate change is likely going to alter prognoses forecast a shrinking water supply in the futurewithin this century. Due to strong extension of irrigated agriculture in oases along the rivers since the 1950s river flows have strongly decreased, leading to a degradation of floodplain vegetation, while agricultural soils have become unusable due to salinization. There is a clear trade-off between generating income from irrigation agriculture, mainly cotton, at the cost of Ecosystem Functions (ESF) and Ecosystem Services (ESS) provided by the natural ecosystems.

The continuously increasing human population of the Aksu-Tarim Region exerts increasing pressure on the natural resources including surface and groundwater quantity and quality, riparian forests, and soil quality. Positive price developments for various agricultural crops motivate the local farming communities to expand their agricultural activities to generate more income. In consequence, direct degradation of the riparian ecosystems via clearing and indirect

degradation via water shortage are increasing. While the authorities are aware of the unsustainability lack of sustainability of current land and water use the efforts in effectively controlling the expansion of agricultural land use and water use expansion are insufficient.

Starting from this strongly disturbed ecosystem status quo, the SuMaRiO case expert formulated a rehabilitation scenario (Figure 7). In order to maintain or even improve the expansion and vitality of natural riparian ecosystems and its functions the land and water use for agricultural production may be reduced. This requires several efforts, which include a more

Figure 7: Changes in ESS provision in SuMaRiO Rehabilitation Scenario by good typology



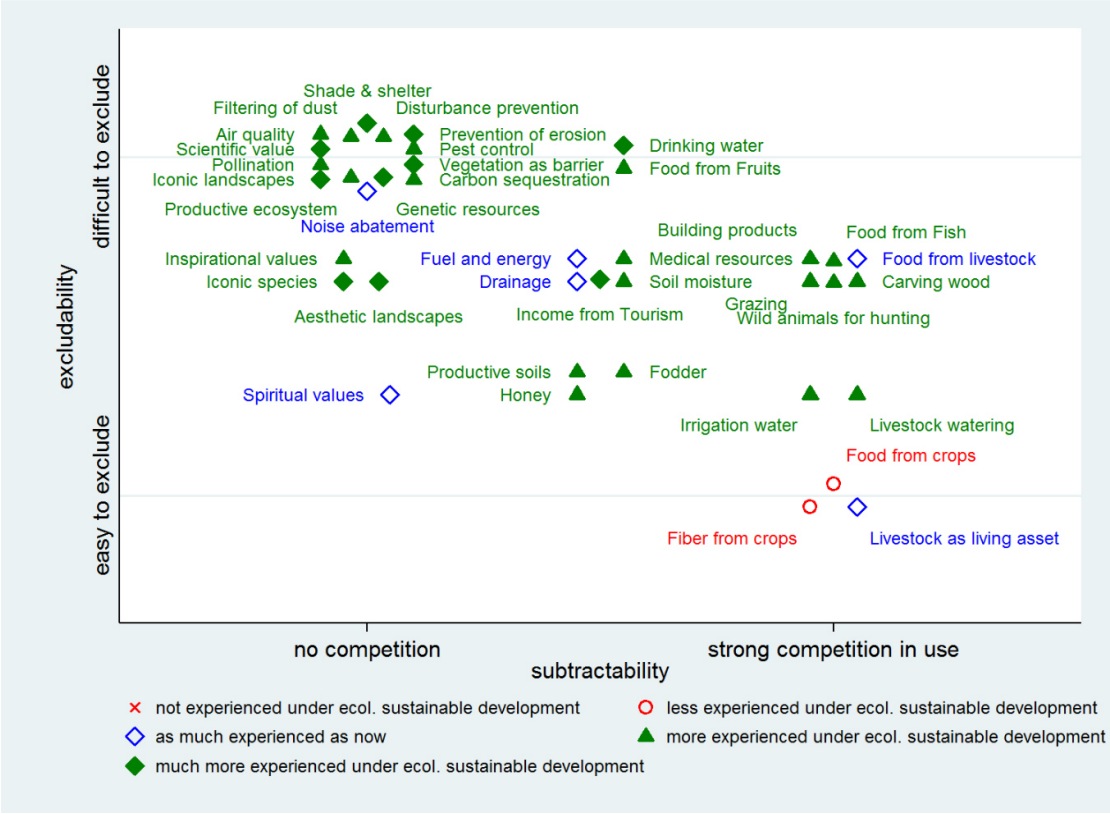
efficient use of water in crop production, a reduction of land area used for crop production, effective water pricing and a strict enforcement of laws and regulations for land and water management. It is unlikely that a substantial improvement of the ecosystem can be achieved without compromising on current crop yields and respective returns generated from agricultural production (Feike & Henseler, 2017). The social and economic sustainability of the region would therefore strongly depend on the development of alternative sources of income.

The INNOVATE case

The INNOVATE project aimed at defining land and water management options that are ecosystem-friendly and economically viable, in particular by cycling of resources between aquatic and terrestrial systems in a watershed in Brazil, partly located in its Northeast region. Scientists looked at farming and fishing in a semi-arid reservoir region affected by involuntary resettlement due to dam creation about 30 years ago. A second focus was on the whole river basin, which is huge (630,000 km^2) and spans over several states of Brazil. Reservoir management, historically focused on hydroelectricity generation, is a contested key factor since it determines the availability and options of water use in particular in the semi-arid portion of the watershed. A participatory governance of water resources is emerging (stipulated by law), though, is challenged by the socio-economic, political, ecological, and cultural heterogeneity of the basin (Siegmund-Schultze et al. 2015).

The ecosystem management is challenged by unclear responsibilities. Many concrete land use decisions are typically taken on the municipal level but the planning and implementing capacity of the responsible municipal government organizations is low (Rodorff et al. 2015). Existing

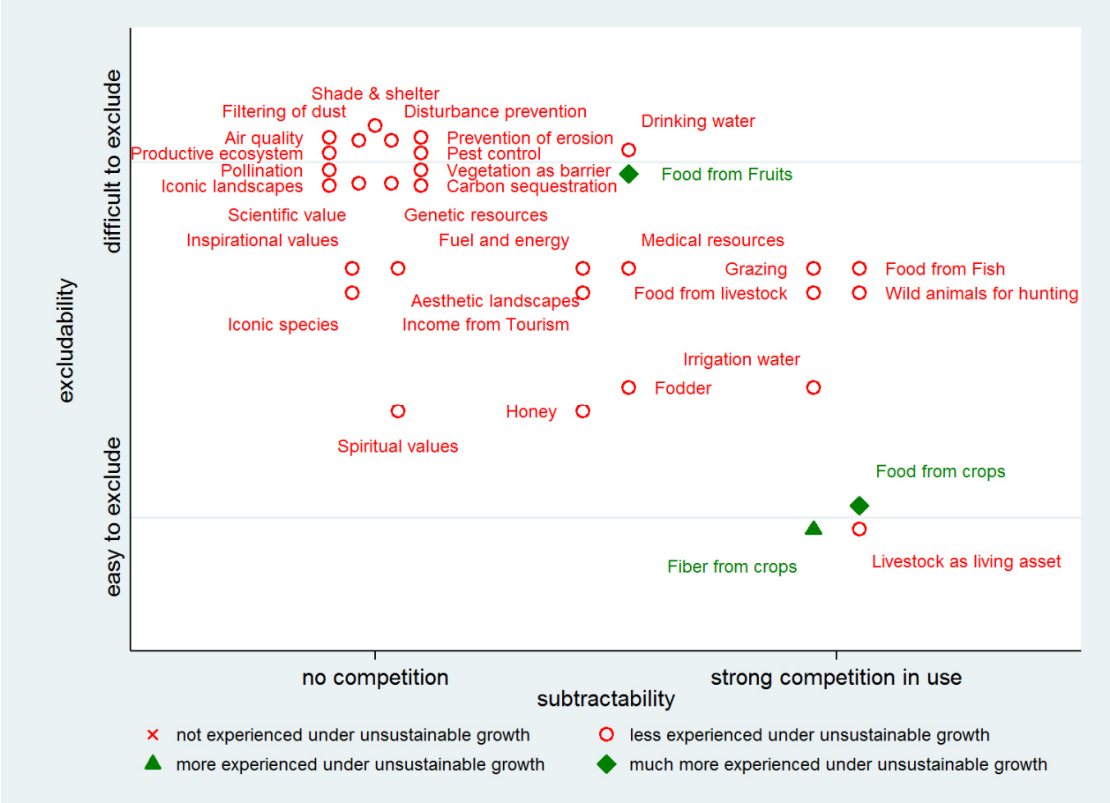
Figure 8: Changes in ESS provision in INNOVATE sustainable development scenario by good typology



regulations for natural resource management are poorly enforced. This results in uncoordinated individual decisions which often do not take unintended consequences into account.

Under the 'Unsustainable Development Scenario' (Figure 8), public policies for income generation trigger further deforestation and encroachment of Caatinga area. The establishment of public irrigation schemes increases the vegetation cover in the semi-arid region as long as the necessary water is available. Salinization of soils occurs where drainage systems of irrigation water are insufficient. Water bodies are threatened by high input of pesticides, herbicides and chemical fertilizers by the drainage water. During prolonged droughts, which are predicted to become more frequent with climate change, the temporarily unused or underused crop plots will suffer high evaporation losses from the uncovered soils. The livelihoods of farmers are at risk when droughts persist over several consecutive years. Other areas might be used for new built environment, such as streets and housing, worsening the options for groundwater recharge. The fragmentation of Caatinga forest further impedes the genetic exchange and threatens the existence of specific faunal and floral species.

Figure 9: Changes in ESS provision in INNOVATE unsustainable development scenario by good typology



Under the 'Sustainable Development Scenario' (Figure 9), environmental policies, such as the Brazilian Forest Code, are consistently implemented and enforced. Environmental education is integrated and mainstreamed in the curricula. Sustainable management practices are effectively promoted by different actors, allowing the Caatinga forest to recover. Sources and river banks will be reforested and preserved, what improves water quality and availability in the semi-arid region in the long term. A sustainable management of Caatinga forest for productive purposes is generally rather space-intensive, allowing only few people to make their livings from this natural resource. Therefore, alternative income generation options are promoted in order to decrease the dependency of the still growing population from natural resources.

Discussion

Mapping ESS according to the typology of goods provided a visualization of critical governance challenges for our cases. The pictures emerging differ substantially and help to understand what kind of governance interventions would be required to encourage sustainable land management.

It is not surprising and still remarkable that comparing forest cases in so different parts of the world reveals so similar patterns. Typically there is a trade-off between few cultivation related Private ESS and diverse forest related Public and Common pool ESS. To a certain extent, the acceleration of deforestation is the result of ineffectively governed locally enjoyed common pool resources such as grazing, timber or wild fruits. Nevertheless, cost benefit calculations indicate that even in the medium run the per-hectare subsistence and cash income received from the forest is lower than the one from agriculture. Looking at it very unemotionally, the communities are likely to be better off when managing the land as agricultural fields rather than forests. This provides strong incentives for deforestation as observed in the TFO and INNOVATE worst case scenarios. It makes it difficult to motivate local land users to support rehabilitation measures as described in the INNOVATE reforestation and the SuMaRiO scenarios. In the latter case not much forest is left to be sustainably managed. Rehabilitating ecosystems in order to re-establish their capacity to provide diverse regulating ESS would have to be based either on sever expropriation of farmers and/or massive compensations. The SuLaMa and LEGATO scenarios draw an even gloomier picture. There are no real trade-offs and one wonders why there are question marks related to avoiding these pathway? Here the land resources are degraded without having at least increasing provision of certain ESS. In the Madagascar case this can be explained with severe poverty and political instability, in the LEGATO case with short-sighted economic rationales. In addition, in the latter case, the

government wants to maintain control over resources and payment flows. As a result it seems to be more likely that a lose-lose scenario comes true where outside tourism operators exploit the region with low cost unsustainable tourism services.

Still, better managing the Common Pool ESS could put extra weight on the sustainable side of the scale. Institutions need ensure a secure distribution of benefit flows to individual local residents. Well defined resource rights are in many cases an important instrument to achieve this. This can also contribute to heal common market distortions. In the TFO case, market prices for timber are extremely low due to still low resource scarcity in combination with a quasi-open-access situation for wood extraction. Regulations in the wood market could provide extra incentives for more sustainable forest management.

Given the general pattern, it is also worth to pay stronger attention to the forest related Public Good ESS. They are enjoyed by a wider range of beneficiaries at a larger or higher scale. Incentive mechanisms or regulations would be needed to incorporate the value of such benefits into local decision making. Payments for ecosystem services can be incentives for adopting sustainable land use systems. Carbon credits are one mechanism but our illustrations show that there are many more Public Good ESS which have global value – though local land managers cannot capitalise on them.

All the above mentioned institutional mechanisms are well known. The ESS perspective tells us, however, that in many cases none of them would solve the problem in isolation. It is rather necessary to find integrated governance solutions which take into account the nature of different ESS.

Conclusion

The classification of ESS can guide ESS assessments by pointing at the main trade-offs to compare with each other. The structured approach can help to better understand how alternative decisions affect ESS and who may be winners and losers (Ruckelshaus et al. 2015). Based on this understanding a more focused ESS assessment and evaluation can be undertaken providing information which are most urgently needed by stakeholders to make better informed decisions.

This paper does not address the question how to solve governance challenges. This would be the next step of analyses and is beyond the scope of this paper. Nevertheless, often solutions are searched for without a good understanding of the actual challenge. We believe that the ESS classification and mapping can contributes to better ecosystem service related policy making. We propose a SES perspective for the next analytical step. The case specific mapping of

provisioning and appropriating action situations can lead into an identification process of action situations which most urgently require system compatible governance solutions. These action situations can be analysed first separately in search for most adapted governance mechanisms. In a next step, we recommend an assessment of the interaction between action situations related to diverse ESS. This approach also helps to link the SES thinking to the acknowledgement of multi-functionality of ecosystems. The approach also shifts the focus of SES analyses from current use practices towards the potential benefits ecosystems could provide.

The next logical step of the analyses would be to identify the beneficiaries, providing actors and provision actions related to specific ESS. Our diagnostic online tool actually facilitates this step, even though this question was not subject to this paper. Such lists can help for instance to identify actors who benefit but make little contributions. In addition, stakeholders take or do not take actions which have an impact on the ecosystem services' productive capacity even if they do not intend to do so. These can be actions which are unrelated to the initial main focus of a particular study but which in fact are relevant from an ESS governance perspective. The procedure also helps identifying such stakeholders and actions.

It should be kept in mind that our deliberations are based on subjective judgements – showing tendencies and a way of diagnosing specific situations. We see the potential to use this multi-stakeholder co-creation processes supporting the development of case specific institutional innovations. Revealing externalities resulting from social dilemmas and identifying so far "uninvolved" beneficiaries can detect untapped willingness to pay potentials and motivate governance actors to provide incentives for more sustainable development pathways. For this paper only well-informed case experts classified ESS and interpreted the emerging pictures. For instance in the context of an innovation system the approach could be used to reveal different stakeholders' mental models on ESS and initiate social learning.

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