INSIGHT #5 SOCIAL-ECOLOGICAL TRAPS

Interaction between social and ecological feedbacks can lock systems into unsustainable pathways, creating social-ecological traps

Social phenomena such as poverty, economic opportunities and identity can interact with ecosystem dynamics in mutually reinforcing ways, generating vulnerable pathways of development and undesirable states highly resilient to change. We call them social-ecological traps.

Human actions affect feedbacks and drivers in social-ecological systems, which may lead to regime shifts (Insight #2). Such changes alter ecosystem capacity to generate services on which human wellbeing depends, which in turn trigger societal responses. Recognition of such interactions reveals that the dynamics of social and ecological systems are inextricably linked.

Actors and institutions interact with ecological dynamics and lock development into a vulnerable pathway without recognizing it. In other cases, interactions reinforce the resilience of an already undesirable social-ecological state. These situations can be conceptualized as social-ecological traps.

A social-ecological trap describes a situation where social and ecological feedbacks mutually reinforce each other and maintain or push a social-ecological system towards an undesirable state. Social-ecological traps are hard to escape. Piecemeal, incremental change will not be sufficient to break out of such traps.

Social-ecological traps are related to but differ from poverty and rigidity traps that have primarily been described as a social phenomenon detached from ecosystems and how their dynamics feed into, are shaped by and affect social processes (but see Carpenter and Brock 2008).

Social-ecological traps are further related to studies of the pathology of natural resource management (e.g. Holling and Meffe 1996, Huitric 2005, Sterner et al. 2006) as well as sunk costs in the context of the collapse of complex societies (Janssen and Scheffer 2004, Costanza et al. 2007).

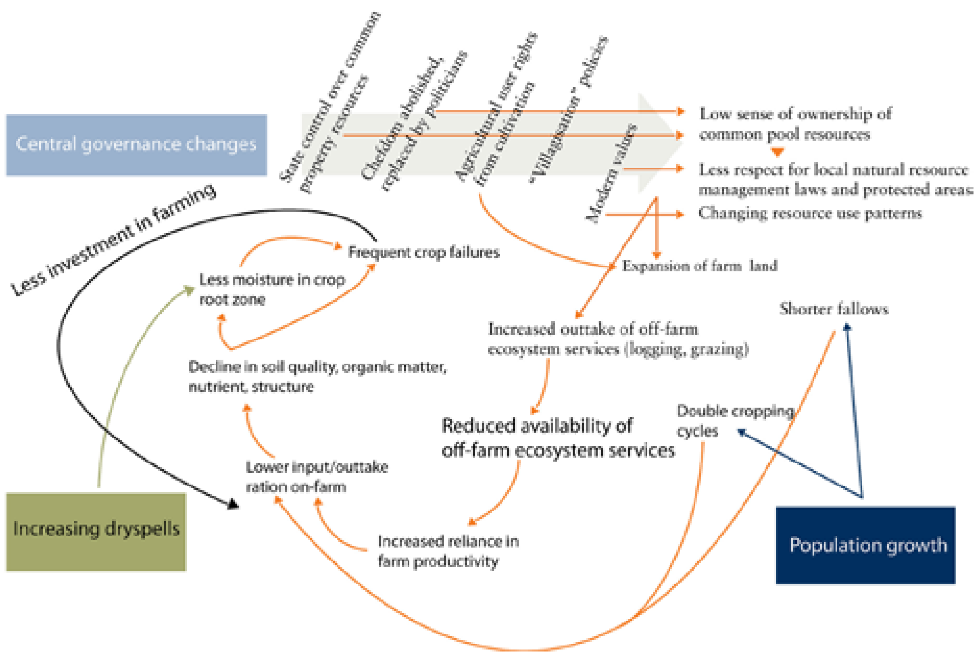

FIG. 1. A social-ecological trap: Interactions between three external drivers and a set of social and ecological key variables in a semi-arid agro-ecosystem. The outcome is a feedback process that locks the system to a development trajectory where off-farm ecosystem services are being degraded, while agricultural yields remain low and people remain poor (Enfors 2009).

KEY FINDINGS:

Poverty can create social-ecological traps
Persistent poverty can contribute to social-ecological traps. In the absence of alternative income sources, declining revenues from a resource aggravates poverty (Cinner 2011) as the poor may be least able to change their livelihood (Cinner et al. 2009). For example, the challenging hydro-climate causes frequent crop failures in semi-arid tropical farming systems (Enfors 2009). To cope with the recurring drought-induced crises, small-holder farmers are forced to deplete their accumulated capital every couple of years, making it difficult for them to build up any substantial buffer (Enfors and Gordon 2008). The frequent droughts, in combination with the lack of capital, reduce the farmers' willingness and capacity to invest in soil and nutrient management on their farms. In absence of alternative livelihood sources, the result is a trajectory defined by declining agro-ecological productivity and increasing poverty among the farmers.

Social-ecological traps can be driven by economic opportunities and aggravated by masking effects
Opportunities for financial gains can drive social-ecological systems towards an increasingly impoverished and vulnerable state. Due to the lucrative value of a natural resource, stakeholders and managers overlook risks of unexpected sudden decline and associated social-ecological consequences (Steneck et al. 2011). Communities with profitable markets and government support are less willing to consider changing livelihood if resources decline (Daw et al. 2012). This kind of traps are often camouflaged by technological advancements, exploitation of species at lower trophic levels, subsidies and trade (Berkes et al. 2006, Crépin 2007, Huitric 2005, Thyresson et al. 2011). But short-term economic opportunities and masking effects impede or prevent long-term commitments to reverse social-ecological degradation (Deutsch et al. 2007, Nyström et al. in press). For example, subsidised technological development in the European fisheries has produced overcapacity, creating political pressure for short-term decision-making and unsustainable quotas. This is reinforced by a low transparency in the decision-making process (Österblom et al. 2011).

Identifying key actor groups can be critical to understand social-ecological traps
Certain mediating groups between social and ecological components of a system can play particularly important roles in creating or maintaining social-ecological traps. An example is local fish traders who provide credit to small-scale fishers in East Africa. This helps the fishers in the short term by supporting them through lean fishing periods. However, through the credits fishers become tied to the traders, locking them into a trajectory of debt and preventing them from switching livelihood (Crona et al. 2010). This threatens to undermine the long-term sustainability of the fishery, creating a social-ecological trap.

Lag-effects can reinforce social-ecological traps
Many key ecosystem processes are inherently slow and only visible by lag-effects. For example, overfishing of herbivores on coral reefs can lead to reefs becoming overgrown by macroalgae. As the algae become increasingly abundant, a range of competitive mechanisms will strengthen their dominance (Norström et al. 2009, Nyström et al. in press). If suppression of corals continue it will after 5-10 years lead to a degradation of habitat complexity and a subsequent loss of habitat for herbivorous fish (Graham et al. 2007). This implies that: a) fewer herbivores will be available for keeping the algae in check, which reinforces their dominance even further, and b) the value of reefs as fishing grounds will progressively decline. If local users aim to optimize long-term revenues from fisheries and are unaware of these slow processes, their management will reinforce rather than break the undesirable feedbacks, increasing the risk of creating a social-ecological trap (Crépin 2007) impacting livelihood and wellbeing (Cinner et al. 2011).

Ecosystem illiteracy and strong identity can push people into social-ecological traps

Resource management institutions can perform in a socially and economically desirable manner, but be illiterate about the broader ecosystem and its dynamics. This may lock people in vulnerable social–ecological dynamics (Steneck et al. 2011).

Belief systems and strong identity may reinforce such dynamics and push people deep into a social-ecological trap. For instance, the identityof farmers in the Murray Darling Basin in Australia is so deeply embedded in the culture and the region is currently struggling with severe salinization problems (Walker et al. 2009). The possibilities and risks of social-ecological states moving away from or into traps have profound implications for the stewardship of ecosystem services (Chapin et al. 2010). A sustained flow of ecosystem services may be desirable for some but undesirable for others (Daw et al. 2011). At the global scale, humanity may be locked in a technological innovation pathway that, far from serving our needs, reinforces development in directions directly opposed to sustainability (Westley et al. 2011).

Lobster fishery in the Gulf of Maine (US) – a gilded trap

Steneck et al. (2011) describe a social-ecological trap where an ecologically destructive but financially lucrative lobster fishery has put the coastal fisheries in the Gulf of Maine at great risk.

Centuries of unsustainable fishing have gradually left only lower trophic species such as the lobster, which now thrives as their former predators (e.g. Atlantic cod) have been extirpated from the Gulf. Lobsters contribute to more than 80% of Maine's landed values. Over-capitalization of the fishing fleet and low economic and ecological diversity has made the Maine fishery highly vulnerable to unforeseen ecological and socioeconomic events.

In Eastern Long Island Sound, situated some 200km south of the Gulf of Maine, lobsters were recently infected by a shell disease resulting in a 72% population decline. There are now concerns that the disease could spread and infect the lobsters in the Gulf of Maine, severely impacting lobster fishery and fishery-related activities - and subsequently a substantial part of the Maine economy.

The social-ecological system is further vulnerable to global market trends where fluctuations in the market value of lobsters could have significant impacts on the income and wellbeing of Maine fishers. Despite these risks managers, policy makers, and fishers consider the lucrative lobster fishery to be a success. Breaking out of this social-ecological development pathway requires improved governance structures with an integrated social-ecological management approach that diversifies local ecosystems, societies, and economies.

Lobster boats in the Gulf of Maine: a strong dependency on lobster fishing has rendered the ecosystem highly simplified with the consequence that the gulf is fragile for diseases. This may leave the Maine fishing community in a desperate situation. Photo: R. Kleine/C.C 2.0

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