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The co-evolution of renewable resources and informal institutions and its implications for government policy design

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Introduction

Many case studies have shown that local communities are capable of managing natural renewable resources like fish, forests or grazing lands in a sustainable and profitable way by making informal agreements on the managing strategies. Unfortunately there are counterexamples in which communities fail to do so: Resources are depleted far too quickly leading to devastating ecological and economic consequences, a result that is often referred to as a *Tragedy of the Commons*.

Key questions

- Do rules and norms evolve randomly or are they determined by environmental factors?
- How are social norms transmitted over time?
- Can we explain why norms sometimes suddenly collapse?
- How resilient are certain norms against internal and external influences?
- Under what circumstances is the implementation of legal law complementary to social norms and when does it substitute them, leading to an inferior result?
- Which institutional setting promotes or undermines cooperation?
- Is it possible to corroborate theoretical findings in a laboratory setting?

An interdisciplinary approach is needed to avoid a tunnel vision and acquire the best research tools

Various disciplines are trying to solve these questions (Figure 1). Most of them cannot be answered in isolation, making an interdisciplinary approach necessary. We have especially benefited from synergies that arose from integrating the fields of economics and biology.

Synergies on theoretical foundations:

The economic science can greatly benefit from biological insights in modeling and analyzing (i) dynamic systems, (ii) out-of-equilibrium situations, (iii) the evolution of continuous strategies, (iv) individual based simulations to compliment analytical findings, and (v) find optimal strategies in changing environments.

The biological science can benefit from economics in understanding (i) the role of risk and discounting in decision making, (ii) the human dimension of resource management, and especially (iii) how choices are made, and (iv) how private incentives can undermine ecosystem preservation attempts, but also (v) how optimal resource management depends on specific costs and benefits.

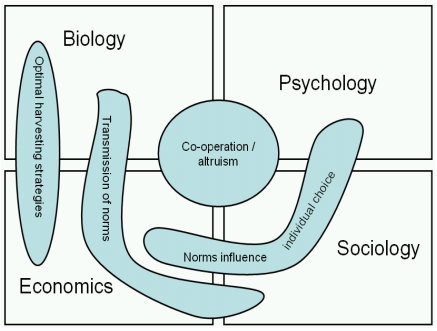

Figure 1. Insights from several disciplines are needed to get a comprehensive picture

An interdisciplinary approach gives most insights and delivers the best policy recommendations

Economists and biologists work hard to find solution to manage our ecosystems in a sustainable way. The best results will be obtained when state of the art insights from both disciplines will be used in bio-economic models. This requires true collaboration on an eye-to-eye level. This can be very difficult, due to a "Tower of Babel"-effect, but such a cross-pollination will most likely lead to scientific insights and management advise that are more correct, robust, and useful.

Key findings

- Social sanctions can be a powerful tool for overcoming social dilemmas, even when the individuals are unaware about what behavior would be best for society. (Richter, Brännström, Dieckmann; in prep., see figure 2)
- Only peer-to-peer rewards are not a powerful tool for overcoming social dilemmas because rewards divert the focus away from cooperation in a social dilemma situation. (Stoop, van Soest and Vyrastekova, Forthcoming in Handbook on experimental economics and the environment, see figure 3)
- When markets are imperfect, and individuals face constraints, technological improvements can induce a catastrophic shift from cooperation to non-cooperation (Richter, Grasman, van Soest; in prep., see figure 4)
- Policies that are overlooking the signaling character of morally good or bad behavior can lead to counter-intended results (Richter & van Soest, under review)
- Fisheries management that is based on oversimplified models may lead to undesired biological and institutional repercussions. Interdisciplinary research that incorporates biological and social complexity can prevent this. (Eikeset, Richter, Dankel, Diekert, Stenseth; in prep.)
- Fishermen in a field experiment deplete a stock of rainbow trout when no rules of law are present. Fishing activity does not respond to levels of the resource stock (Stoop, Noussair and van Soest; in prep., see figure 5)

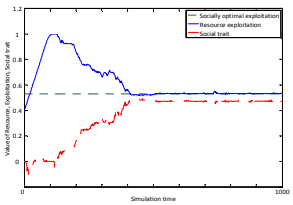

Figure 2 . Social sanctions (red line) overcome effectively a social dilemma and ensure sustainable exploitation (blue line). Sanctions and exploitation evolve endogenously from a continuum of strategies.

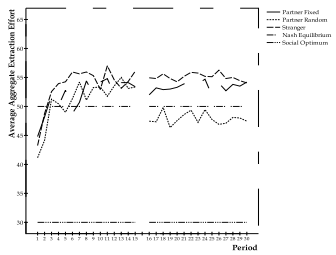

Figure 3. Subjects in an experiment extract resources in the same way as do subjects who have the possibility to reward and counter-reward each other.

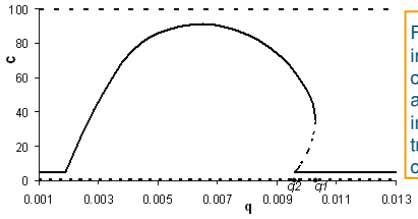

Figure 4. When individuals face constraints, technological advancement (an increase in q) can trigger a collapse of cooperation (C).

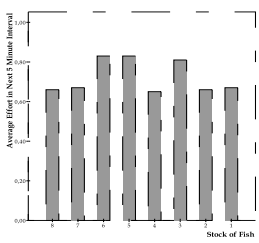

Figure 4. Fishing effort of fishermen in a field experiment is similar for each level of the resource stock, even if the stock is dangerously low.