Institutional Economics for Sustaining Biodiversity

Abstract

Sustaining biodiversity requires economizing at multiple levels of social analysis. The multiplicity refers to social and ecological system attributes and needs to be reflected by a diversity of institutions at multiple scales. This paper identifies key attributes of social and ecological systems which need to be taken into account in order to design institutions for sustaining biodiversity. Design principles are suggested to achieve systems match and different governance regimes for sustaining biodiversity are discussed. The message of this paper is that social and institutional diversity is required for governing biological diversity. The crucial point is that with increasing institutional diversity we are able to better economize on the multiple dimensions related to the sustainable use of biodiversity.

Keywords: Biodiversity, Institutions, Governance, Multiple Economizing, Socio-ecological systems

> A businessman would not consider a firm to have solved its problems of production and to have achieved viability if he saw that it was rapidly consuming its capital. How then could we overlook this vital fact when it comes to that very big firm the economy of Spaceship Earth and, in particular, the economies of its rich passengers?
>
> (Schumacher, 1973)

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Introduction

The attempt to apply economics for sustaining biodiversity can profit from drawing on concepts provided by institutional economists. The nature of biodiversity requires economics to extend its conventional field of economizing resource allocation to that of other institutional levels. The core question this paper attempts to address is how institutional diversity matches biodiversity. In order to answer this question I draw on the framework of social and ecological systems introduced by Gatzweiler and Hagedorn (2002) and they go back to the model of Hererra et al (1976, p.24) who emphasized that sustainability "must be based on the creation of a society intrinsically compatible with its environments." Schumacher (1973), states that an economic theory that does not account for the many goods and services provided by biodiversity is believed to be the cause of environmental deterioration. Including multiple levels of economizing for sustaining biodiversity goes hand-in-hand with the endeavour of designing institutional diversity for sustaining biological diversity.

Many research efforts study the optimal allocation of land use for nature and agriculture. Here, the segregation and aggregation debate plays an important role. The essence of the debate is to find the optimal distribution of land for conservation and for agricultural production (Tomich et al. 1995). The challenge is to find a balance between income generation and nature protection. Often areas of land or forest are reserved for biodiversity conservation and restricted for human use. Or farmers are forced to shift from the cultivation of traditional/endangered species to the cultivation of modern/improved species because of price changes. This approach separates land use systems with mainly habitat, information and regulation functions from systems with mainly production functions and it relates to the age-old dichotomy of man as opposed to nature and the mechanistic worldview of an "optimal balance". Such analytic approaches are fine within their micro-cosmos restricted by assumptions which make it possible to study a small segment of reality. In order to achieve feasible options for biodiversity conservation it is necessary to understand the human dimensions of change in social and ecological systems.

Apart from a change in the biophysical sphere, appropriate change in the social sphere is required. Human actions need to be motivated and/or restricted according to sets of operational rules and regulations which are interlinked with rules at other levels of decision making for the sustainable use of biodiversity. In addition the ways people make decisions and learn to adapt to new situations in resource allocation needs to be understood (Riesekamp, 2003). The view of humans as rational, calculative, self-interested decision makers balancing costs and benefits does not take into account that people make mistakes, are not perfectly informed about their choices and constrained from choosing and deciding freely. Choices can be restricted, e.g., by poverty and asymmetric power relations.

We are far from understanding the functioning and complex interactions of many ecosystems and even further away from an optimal institutional design for the sustainable use of biodiversity. Defining the term biodiversity represents a first hurdle. Any definition of biodiversity cannot deny the multiple natures of the environmental goods and services provided by biodiversity. Common pool and public good characteristics, such as specific aspects of biodiversity are not able to be managed in a sustainable fashion if economizing for these goods and services remains at the level of efficient resource allocation.

Institutions and Biodiversity - Dimensions of Complexity

Concepts of Biodiversity – Linking Ecosystems and Human Systems

What is biodiversity and what do we want to sustain when "conserving biodiversity"? Rennolls (2004) correctly notes that "if different stakeholders at a particular time/location are talking about different types of biodiversity, without defining what they mean, then clearly there is no basis for meaningful communication, comparison of results, sharing of data, or meaningful monitoring of changes." Three concepts of biodiversity are distinguished in the following. They can be characterized by different degrees of inclusiveness of the human dimension. Sustainable solutions for biodiversity conservation and use need to include the complexity of ecological and social system and the linkages between them.

A **first concept** stresses the variability of ecological systems at different scales. This concept of biodiversity encompasses all species of plants, animals, and micro-organisms, the genetic variability within these species, and the ecosystems and ecological functions that they form and which sustain them. Usually this concept of biodiversity excludes the human actors and the rules they design to regulate how they act upon the non-human ecosystem. Pagiola and Kellenberg, (1997) provide a definition of biodiversity which is built on a similar concept by stating that biodiversity can be measured at three different levels:

- landscape diversity which is the variation in the assemblages of habitats across the earth's surface
- ecosystem diversity which describes the variation in the assemblages of species
- species diversity which refers to the variety of different species; and
- genetic diversity which refers to genetic variability within a species.

A **second concept** which can be identified describes biodiversity in conjunction with different dimensions of human systems. The approach extends biodiversity to the realm of human systems without explicitly including or understanding the linkages between both systems. The concept of "sustainable use of biodiversity" typically embraces four dimensions: the socio-cultural, economical, political and the ecological dimension. Although each dimension is regarded important to achieve sustainable outcomes, their linkages are not included into the concept. In traditional indigenous societies these dimensions are interwoven and can hardly be separated:

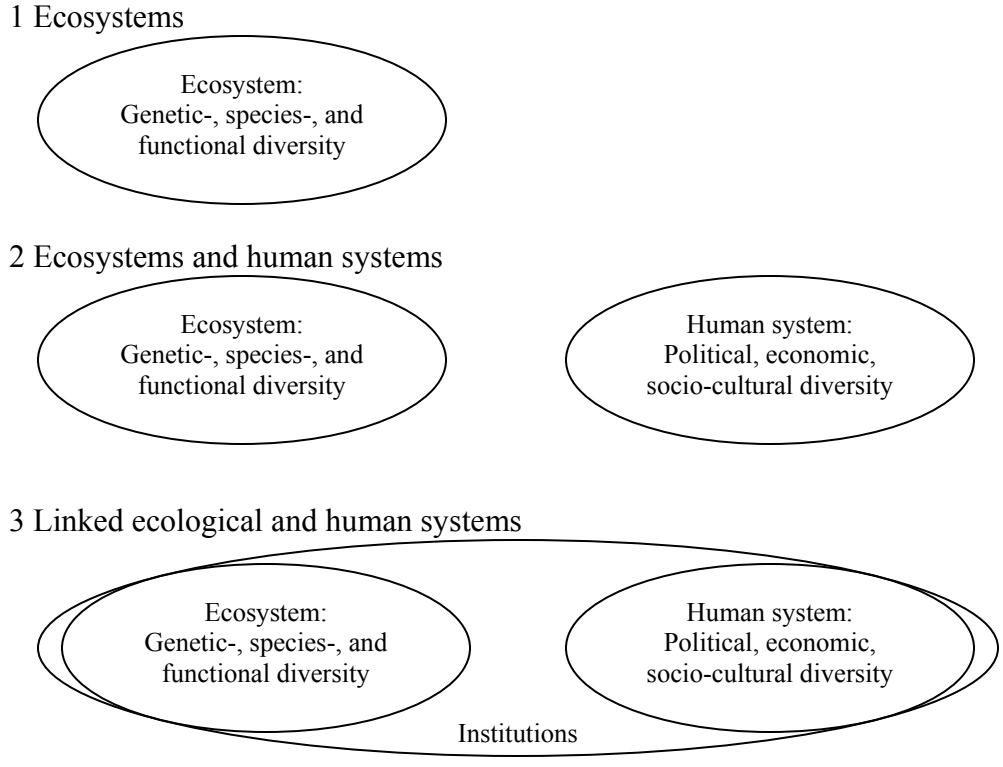
- The **social and cultural** dimension refers to the fact that the costs and benefits from conserving and/or destroying biodiversity need to be fairly distributed among different members of society. Socio-cultural dimensions refer on the organization of social and cultural aspect of society without necessarily including the linkages to ecosystems.
- The **economic** dimension also refers to the efficient economic organization within the human system. Various efficiency indicators are applicable, depending on which aspect of biodiversity management we are looking at. Although interactions between both systems occur, both systems are not linked by a set of rules and regulations. "Efficient interaction" can result in efficient exploitation of nature by the human actor. Although the economic organization of the human system may be efficient, externatlities are produced and the organization of the linkage between both systems is neglected.
- The **political** dimension refers to governance, the policy process, environmental legislation and implementation (Gatzweiler and Hagedorn 2004: 14). Depending on how democratic the political system is in which people live, their opportunities

for participation in environmental (and other) decision making processes will vary.

- **Ecological** dimensions of sustainable use of biodiversity refer to the goods and services provided by the ecosystem (De Groot 1997) and the resilience of the ecosystem. Especially with regards to biodiversity, the irreversibility of species extinction needs to be considered.

Agriculture is located at the interface of social and ecological systems. Pagiola & Kellenberg (1997) developed a framework for the study of the interrelationships between agriculture and biodiversity, recognizing that "changes in the level of biodiversity translate into losses or gains to society through changes in the level of services provided by biodiversity". Further they note that "…The incentive structure under which farmers make decisions about land use is influenced by agricultural and non-agricultural policies, and institutions." Although Pagiola and Kellenberg recognize the relationship between ecological and human systems and institutions are part of their framework, they are do not identify institutions as linking both systems.

Figure 1: Mutual dependence of ecological and social systems



A **third concept** of biodiversity includes institutions as linking element between ecological and social systems. The inclusion of institutional variables in the concept of biodiversity recognizes institutions as essential regulation mechanism at the interface between ecological and human systems (Gatzweiler and Hagedorn, 2002). This concept therefore includes issues of poverty alleviation and sharing the benefits from biodiversity equally. It stresses not only the importance of biodiversity for survival but includes the demand for a certain quality of life. Decision VI/21 of the Convention on Biological Diversity (CBD) notes, that "The rural poor, are often expected to bear much of the cost of maintaining biodiversity, for example in the form of foregone benefits of land conversion when areas are set aside for the protection of unique or threatened ecosystems or species. Unless they are fully involved in decision-making and benefit-sharing, it is unlikely that long-term solutions to the problem of biodiversity loss can be found. In developing mechanisms to ensure such involvement, it is vital that issues of gender and social structure are properly addressed. Already, there is a growing number of rural communities, especially in developing countries, who have begun to address their poverty issues through innovative approaches to the sustainable use of their biological resources, demonstrating their effectiveness. In this context, it should be ensured that such initiatives are promoted, communicated and supported, as they represent practical means to address the three objectives of the Convention[1]"

This quotation points to the fact that biodiversity conservation is strongly linked to the mutual dependence of social and ecological systems. Accordingly, in the following chapter build on the socio-ecological framework proposed by Gatzweiler and Hagedorn (2003) and the conceptual framework proposed by Costanza et al (1994) and Young et al. (1999: 51) which identifies variables necessary take into account in order to design "institutions of sustainability. Ostrom (1994) provides a comprehensive framework (the Institutional Analysis and Development framework) which was developed at the Workshop in Policy Analysis and Political Theory. The framework identifies actors who are involved in specific actions (management practices), such as the cultivation of a forest

[1] The objectives are: Conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies

or piece of land. The farmer's activities are regulated by a set of norms, rules and governance structures. These institutions depend on the biophysical characteristics of the environmental goods and services. If they are well managed, lead to a reasonable quality of life (outcomes).

Diversity of Actors' Attributes

Apart from the ecosystem attributes, institutional change depends on the characteristics and objectives of the actors involved in those transactions. This is not only true for individual actors whose values, interests and resources to exert influence (power) are very different, but also for groups of individuals like communities using organisations and networks to shape institutions according to their objectives. Poteete and Ostrom (2001), Ostrom (1998, 1994a: 33-36), Hagedorn et al. (2002) and Edwards and Steins (1998) have discussed actor's and community characteristics which affect the organization and coordination capabilities of people. By categorizing different user groups and characteristics of actors, the analyst can identify how the members of a group:

- perceive the physical nature and value of the common pool resource system
- gain access to different levels of decision making with respect to allocation and management of the resource
- interact with their own and amongst other user groups
- adopt strategies
- respond to particular outcomes on the common pool resource system

Selsky and Creahan (1996: 355) distinguish different levels of user groups which are categorized according to their commitment to the sustainable use of the resource. *Primary appropriators* have a shared set of values, norms and goals. They may share the same geographic area and seek to develop adequate institutions for the sustainable appropriation of the critical resource. *Secondary appropriators* have an instrumental interest in the appropriation of resources from the common pool. However, usually in terms of exchange value and they hold no "intrinsic interest" in the sustainable use of the system over a long time period. *Tertiary appropriators* have an instrumental interest in the consumption of the resource units but are neither concerned with the direct appropriation nor with the sustainability of the resource stock. In this categorization there is an implicit assumption of the existence of a market for resource units in which consumers have no interest in the origin of the resource units or in the management of the

resource system. This is obviously not always the case. The examples of Fair Trade and eco-labeling show that consumers can be interested in the origins of the product and that this knowledge can make a difference in sustainable resource management.

Hagedorn et al. (2002) distinguish categories of actors at different levels of society (such as policy makers, voters, and producers) and provide a comprehensive list of actor attributes which potentially effect a common pool and public resource management situation:

- Values, worldviews and belief systems of the actors and their particular attitudes and perceptions are relevant to their readiness to collaborate with other actors and to comply with rules and policy measures. If farmers are purely self-interested, they can still be motivated toward environmental goals by economic incentives. But if they are convinced that biodiversity conservation is an objective worthwhile to work for, they will be prepared to be systematically involved in such activities. Their values influence how situations are viewed which require collective decisions and action.
- Actors' reputations, reliability and trustworthiness. These attributes relate to how actors are evaluated by other actors and which are decisive factors for the credibility of their commitments.
- Resources for influencing the policy process. This refers to time resources and capacities to collect information, access to networks and bargaining power, which are necessary to establish and maintain relationships and to achieve acceptance of own interests. Also resources for the establishment of mechanisms for interest representation in decision-making processes in which land users cannot participate directly. Resources are required for delegating the enforcement of their political demands to political entrepreneurs.
- Actors' ability to communicate and exchange knowledge and information. Such actors can more easily find common rules (Ostrom, 1999) or learn for innovation. Information and knowledge, and capacities for acquiring and processing, retaining and using knowledge and information represents an important resource. Asymmetric information of actors, well known from the principal-agent theory, is a widespread phenomenon.
- The "actor's method of action selection" (Ostrom, 1998: 70). These persons can be assumed to be maximizing *homines oeconomici*, as constrained maximizers with bounded rationality, or fallible learners who make mistakes but are able to learn from them. For explorative and innovative tasks like forming institutions dealing with new problems which arise from changes in agricultural technology and structures, the latter two assumptions seem to be appropriate.
- Culture. The social environment and embeddedness of actors also affect their behavior. "…. When all appropriators of a common-pool resource share a common set of values and interact within a complex set of arrangements, there is a much greater probability that they will develop adequate rules and norms to manage resources. If keeping one's word is important in such a community, the

need for costly monitoring and sanctioning mechanisms is reduced." (Ostrom, 1998: 71).

Property Rights and Properties of Biodiversity

Biodiversity needs to be understood as an assemblage of a variety of different biological resources with different characteristics at different levels of analysis. Complexity, heterogeneity and variability are attributes which essentially contribute to the resilience of social and ecological systems – the ability of a system to restore itself after external disturbances. The variety of goods and services provided by a tropical forest ecosystem may serve as an example for property rights and properties of biodiversity which have some key characteristics:

- Non-Universality: Biological resources can have private good (e.g. timber, fruit, medicines), as well as common pool and public good characteristics (beauty, water purification, CO2 sequestration, climate regulation)
- Imperfect exclusivity/substractability: Benefits and costs accrue to the owner and others. Efforts to exclude others from the benefits of biodiversity are usually too costly to make exclusion feasible. Actors who are not entitled to use the goods or services (or have limited entitlements) are free riding or behave opportunistically which can result in the depletion of biodiversity resources or undesirable environmental damages. Those resources which are non substractable (e.g., scenic view) cannot be depleted by additional use intensity.
- Imperfect transferability: Property can be transferred from one owner to another in case of private property. Other goods and services cannot be transferred or only at high cost.
- Imperfect enforceability: Property is usually only protected from involuntary seizure if it is private property. The enforcement of property rights and entitlements for common pool resources and public goods is much more difficult.
- Rivalry: In case of common pool resources more than one user appropriates the resource and reduces the potential benefits for another user. In case of public goods and services (e.g. Carbon sequestration, climate regulation or beauty) rivalry is less of a problem.
- Heterogeneity, variability and complexity are typical attributes of biodiversity. Groups of resource users "are linked to each other and to multiple resources that occur across multiple scales through multi-level governance arrangements" (Jansson et al.
- Uncertainty. Farmers often do not know whether certain environmental occurrences will affect them or not. Diversity is an essential strategy for survival, e.g. by the distribution of risk. A drop in agricultural diversity increases the risk of crop failure by pathogens. This rule is usually known to farmers. Therefore, if farmers choose management alternatives with low biodiversity or those which decrease diversity, it can be assumed that there goals have changed. Instead of long term risk minimization they have now switched to short term survival

> strategies. The portfolio of institutional arrangements in an uncertain and biodiverse world needs to be larger than that in a more certain world. The presence of possible surprises requires institutions and policies which are changing as social and ecological systems evolve and knowledge advances.

Matching Social and Ecological Systems

Given the premise of sustainability, it is the inherent dependency of social and ecological systems and the characteristics of both system components which make it necessary for social and ecological systems to match. Institutions play an important role in matching both systems. They are the social representation of nature by means of order of human actions and interactions with nature. As reflectors of the salience of nature in society, values, norms and belief systems play an important role. Based on these informal institutions the institutional environment (including property rights and legislation) as well as the governance structures are built. Ideally the different institutional levels are congruent, relate to each other and therefore, "match". This institutional match can refer to institutions at multiple levels which are ordered according to levels of decision making. Ostrom et al. (1994: 47) suggest the operational, collective choice and constitutional levels of analysis. Alternatively, institutional match can refer to the levels of social analysis proposed by Williamson (2000).

Williamson distinguishes the social embeddedness level (1), where the norms, customs, traditions, and other informal rules are located. The institutional environment level (2), where formal rules (constitutions, laws, property rights)" are located, including "… the executive, legislative, judicial, and bureaucratic functions of government as well as the distribution of powers across different levels of government (federalism). (…) Going beyond the rules of the game (property) to include the play of the game (contract) …" identifies the third level of analysis (3), that of the institutions of governance. The link between level two and three results from the fact that the definition and enforcement of property rights is costly. The need to "craft order" by (transaction) cost efficient structures is a further requirement for sustainability apart from the need for specific rules. The fourth level of analysis is the level of the neoclassical "optimality apparatus". "The firm, for this purpose, is typically described as a production function. Adjustments to prices and output occur more or less continuously." Williamson (ibid) mainly neglects feedbacks between theses levels, refers however to their links: "The solid arrows that

connect a higher with a lower level signify that the higher level imposes constraints on the level immediately below. The reverse arrows that connect lower with higher levels are dashed and signal feedback. Although in the fullness of time, the system is fully interconnected."

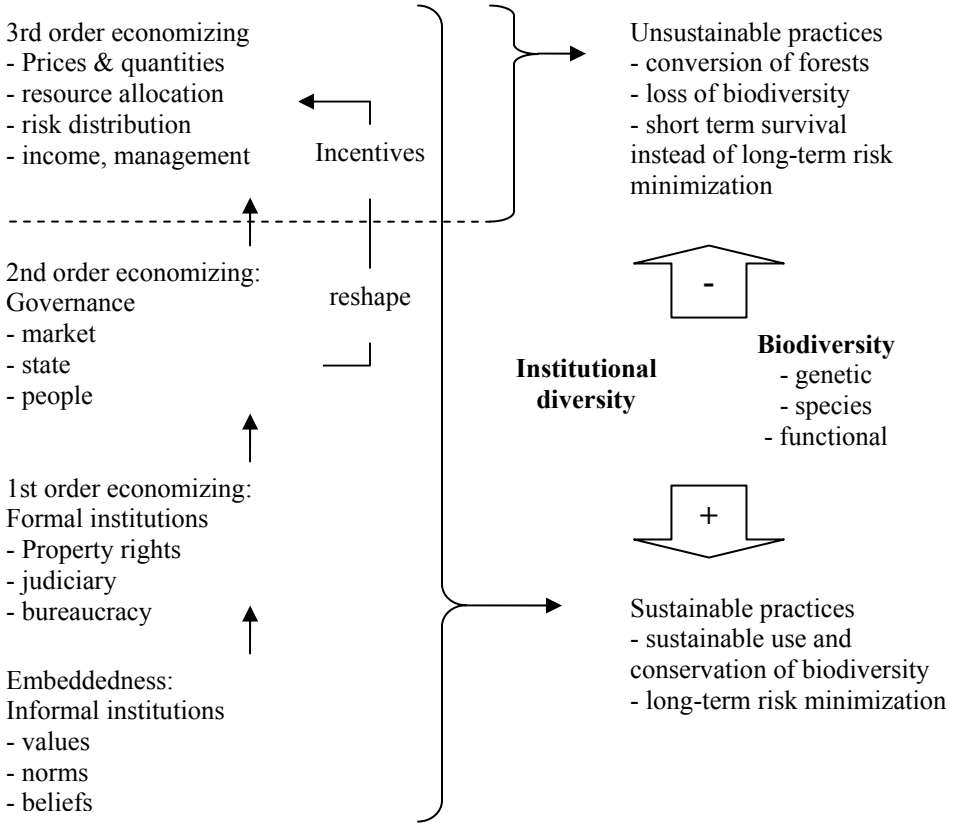
In reality an ideal match between all levels of analysis rarely occurs, especially in the field of biodiversity conservation. Here we can often witness a gap between, e.g., de facto rules and de jure rules, between informal and formal institutions, between operational, collective choice and constitutional choice rules, or between the rules of optimality (prices and quantity for resource allocation) and governance. From the economists' perspective we see the mismatch between what is valued and what can be calculated in terms of optimality or efficiency. As third order economizing is insufficiently connected to second and first order economizing (Figure 2), external disturbances (e.g. a downwards shift in coffee prizes) have drastic impacts on the ecological as well as on the socio-economic system. As a consequence of relying merely on one level of economizing, the resilience of both, the ecological and economic systems suffers.

The continuous change of institutions at Williamson's level three correlates with the high discount rates and short term decision making strategies of farmers exposed to severe poverty. Poverty, power and institutional asymmetries force farmers to engage in ecologically and economically suboptimal practices. They behave in response to the changes of prices. The "higher" levels of analysis, such as institutional arrangements and governance or values, are of subsequent importance and become irrelevant for decision-making. Accordingly, medium to long term risk minimization by managing biodiversity is replaced by short term survival strategies.

Figure 2 illustrates the difficulties in matching ecological (biodiversity) and social systems (income). The creation and conservation of biological diversity is economically also a strategy to reduce uncertainty (e.g., risk of pathogens). Accordingly a drop of biodiversity would increase the income risk for farmers. If farmers start choosing biodiversity decreasing alternatives (e.g. by deforestation), their goal is no longer long-term risk minimization, but short term survival. Or, differently put: they have no other

choice than between the bad and the worst. Surviving the next day is more important than valuing biodiversity.

Figure 2: Economizing for Sustainable Use of Biodiversity



Designing socio-ecological system match

How should the multi-dimensional and multi-scale nature of biodiversity be governed to promote sustainability? This question refers to the question of designing socio-ecoligical systems match and leads us back to the question of what exactly we aim to sustain. When dealing with biodiversity in ecological systems and social systems, we are dealing with systems which are dynamic and change through time. Change is a characteristic of both systems and therefore stasis is only a temporary desirable condition of both systems. Therefore, "although by definition persistent, institutions for sustainability constantly evolve" (Dovers, 2001). Biodiversity conservation is an issue located "in the social and economic realm" and therefore "depends on constant change in the social and economic

institutions and not in their preservation" (Bromley 2003). Ostrom (1998) gives a similar clue: "Biological processes occur at small, medium, as well as large scale. Consequently, governance arrangements to regulate biological complexity also need to be organized at multiple scales and linked effectively together. The importance of nested institutional arrangements with quasi-autonomous units operating at very small up through very large scales is stressed." Janssen et al. (2003: 11) speak about the same phenomenon when stating that "institutions affect the spatial and temporal distribution of pressure on the ecological system. …examples are pastoral systems that have adapted … to their regional disturbance regimes."

These clues, however, do little more than asserting that social and ecological systems have similar dynamic characteristics and leave open the question of which scales should be linked to what, how and by whom. Just because ecological systems are organized by temporal and spatial principles of multiple scale this does not mean that social systems need to be designed accordingly. The past mistakes in ecosystem management which have led to biodiversity loss are a result of the failure to engage in multiple economizing on sustainable biodiversity use. As a result merely 3rd order economizing had been applied to nature and either the market or the state was seen as possible governance option to regulate the allocation/preservation of biodiversity. Multiple economizing however induces institutional diversity and institutional diversity in turn is more likely to maintain ecological and social system resilience.

Because of the need for diversity in the social, institutional and ecological realm there can be no single-solution to the question of designing socio-ecological system match. Young (2002: 80) comes to the conclusion that "there are no simple antidotes to these forces[2] leading to the persistence of mismatches between ecosystem properties and institutional attributes." However, what can be identified for socio-ecological systems' match are strategies and design principles. One strategy is to allow for diversity of institutional arrangements and governance regimes. A second strategy is creating feedback and response mechanisms. Young (ibid) mentions systems of implementation review (SIR) that monitor the status of ecosystems and the performance of resource regimes. A third approach is to build flexibility into resource regimes. An example "are

[2] These "forces" refer to the social and ecological systems' characteristics.

the rules of the ozon regime allowing for changes in phase-out schedules for certain types of chemicals without ratification by individual members states" (Young 2002: 81). Finally Young mentions the precautionary principle, which intends to "respond to problems arising from imperfect information and institutional constraints by erring on the side of safety; that is by building in margins of safety to ensure that exploited components of ecosystems are not pushed beyond the limits of sustainability."

In order to achieve systems match related to the management of common pool resources, Ostrom (1992) proposes seven design principles - features that contribute to maintaining the institution and its resources, and gaining the user loyalty for the rules in use:

- Boundaries of the resource and the individuals with access rights must be clearly defined;
- Proportional equivalence between benefits and costs: principles governing resource use, and required contributions of labor, material or money, suit the local situation;
- Collective-choice arrangements allow those with access rights to participate in modifying the rules;
- Monitoring helps to control common property appropriation;
- Appropriators who violate the rules face graduated sanctions;
- Conflict resolution mechanisms exist; and
- External government authorities recognize minimal rights to self-organize.

Binning (2000:), who seeks the question of how to conserve biodiversity in New Zealand, identifies six institutional design principles for biodiversity planning and program delivery at a regional scale[3]. In contrast to Ostrom's more general design principles which have evolved from the analysis of irrigation systems, in-shore fisheries and groundwater basins from the local perspective, Binning identifies design principles in a country where a given broader institutional and political environment aims at directing efforts and resources to biodiversity conservation goals. The reliance on self governance is therefore less important and a mix and integration of different types of governance increases in importance:

- Clear definition of roles and responsibilities. These refer to 1) decision making, 2) provision of expertise and 3) the delivery of resource management programs by governmental bodies and the non-governmental sector.

[3] These design principles refer to institutions and governance arrangements.

- Maintenance of outcome-based legislative framework which should establish clear minimum standards for the maintenance of biodiversity.
- Delegation and development of action based regional strategies. Core elements of a regional biodiversity strategy are: 1) the establishment of a coordinating body which is given responsibility for the overall coordination and development of the strategy. The coordinating body needs not to be a part of government or perform statutory functions. It may be an advisory board of relevant experts and stakeholders. 2) A formal memorandum of understanding (MoU) between agencies with statutory responsibilities and other parties with a role in delivering the regional action plan. Tensions in the land use planning responsibilities of statutory agencies will be resolved through the MoU.
- Integrated land use plans. All statutory land use planning should be integrated into a single coordinated land use planning framework. Critical for biodiversity planning is mapping of the distribution of indigenous biodiversity within the region on the basis of agreed ecological communities across all land tenures. Key threats to biodiversity and appropriate management responses need to be identified.
- An implementation program needs to be developed which is consistent with priorities identified in the planning phase.
- Funding and resourcing partnership agreement. All tiers of government will agree resources for the strategy with a minimum five year commitment to the implementation program.
- Accountability criteria. Regions are given flexibility in achieving defined outcomes. Outcomes must be measured and accountability procedures put in place.

Governing Biodiversity by Institutional Diversity

Let's start with disillusioning the idea of a best way for the governance of biodiversity. This view is supported by a recent article from Dietz, Ostrom and Stern (2003: 1907) who argue that because of the variation among common pool resources, "a mix of institutional types; and designs that facilitate experimentation, learning, and change" are required.

The following thoughts on governance build on the previous, which have identified the necessity to link sustainable use of biodiversity with more than one order of economizing. Linking different orders of economizing includes the link to more than one governance regime, as well as a variety of different sets of formal and informal institutions. This strategy of creating institutional diversity is also a strategy of risk minimization. Linkages and response mechanisms between third, second, first order economizing and the embeddedness level, reduce the risk of economic failure, e.g. market failure. In single governance settings, mechanisms and regulations which would

alleviate the environmentally adverse consequences of price changes, e.g. by the involvement of the state, do not exist. Market failure and the production of externalities belong to the kind of failure also resulting from a loss of institutional diversity, not only from the failure to internalize values of the ecosystem. The sole reliability on one governance regime (e.g., the market) increases the risk of failure as one type of governance cannot be universally applied to all kinds of goods and services from biodiversity. Therefore, governance failure, such as that of the market can occur because the governance structures do not fit with the biophysical attributes, or because the system of governance ist not diverse and flexible enough to delegate the governance of different ecosystem attribute to different governance types.

Governing biodiversity in a sustainable fashion builds on the specific attributes of the ecosystem functions (biodiversity products). What makes the issues of governing biodiversity confusing is the fact that bundles of ecosystem goods and services with different attributes need to be governed. The potential for markets to shape positive incentives for sustaining some bundles of ecosystem functions (e.g. watersheds, ecosystems that have a potential to attract tourism, or those that sequester carbon) are larger than for others. This rests on the possibility to draw boundaries or quantify aspects of these biodiversity products (private goods/services) which makes it easier for markets to function as compared to other ecosystem functions with, e.g. public good features.

The discussion over building of adequate governance structures is also influenced by two other issues which are frequently referred to as bottom-up versus top-down model, the institutional versus the evolutionary model or the collective action versus the social practice model. The differences between these different models are differences in the perception of the human actor and differences in perspective regarding the question from where rules and governance should originate and evolve. Krishna (2002) identifies contrasting hypotheses which can be termed bottom-up, top-down, and the middle way.

The first two refer to the social capital versus the institutionalists' perception on how governance should be build. Put into our context of governing biodiversity, the social capital thesis states that social capital is necessary and sufficient for building governance. The thesis states that societies well supplied with social capital will be able

to innovate and adopt new organizational forms, since a high degree of sociability will permit a wide variety of social relationships to emerge (Putnam et al. 1993, Fukuyama 1995). This thesis states that good governance cannot be build from the top-down and that it must be built up in the every traditions of trust and civic virtue among citizens. The institutionalists' model supports causality from the top-down. It starts from the belief that the state has an important role in establishing and enforcing the property rights that make trust possible. Political structure has impact on behavior and attitudes of citizens. Social capital may be built by how government institutions operate and not by voluntary organization. Social capital is regarded as a by-product of institutional incentives and induces the question which institutional arrangements provide effective incentives for building trust (Knack and Keefer 1997, DeSoto 2000). Bowles (1998) argues that markets and other economic and political institutions, apart from allocating goods and services, also substantially influence the evolution of motivations, values, preferences and thereby social capital in large.

Young (2002: 29) presents two ways of thinking about the role of social institutions. He distinguishes the collective action model from the social practice model. Similarities to the previous models are obvious. The collective action model draws on the intellectual capital of economics and public choice. This model partly resembles the institutionalists' approach by neglecting the role of social institutions at the embeddedness level. Actors are seen as utilitarian calculators, weighing benefits and costs resulting in their behavior. They are identical and unaffected by participation in specific institutional arrangements. Context does not matter and the effects of the social environment cannot be endogenized. The social practice model draws on anthropology and sociology and emphasizes the role of norms, culture and habits as source of behavior. Institutional arrangements give rise to social practice that shape identities, generate discourse and draw participants into routinized activities. In contrast to the logic of consequence in the collective action model, the social practice model stresses the logic of appropriateness. Actors comply with rules because such behavior is deemed normatively correct.

This short excursus into different perceptions of how institutions and governance can be built suggests that either one or the other model can be applied universally and

that the institutional and organizational landscape should be approached as carefully as the ecological in order to clarify features that contribute to the resilience of social-ecological systems.

Solving governance problems of biodiversity related to the nature of common pool or public goods has traditionally been approached by either market or state solutions. Under certain circumstances, however, people are able to find sustainable solutions for governing the use of common pool resources themselves. Ostrom (1994) provides evidence for self-governing capabilities of people, which, in our chapter title we simply termed "people". However, just as markets can fail, self-governance may fail for a number of reasons: "Groups may be too large, rules may be inappropriately set, and also the world-views or "mental models" (Denzau and North 1994) of the individuals may be such as to effectively prevent fruitful cooperation" (Lütge 2004). Therefore markets, the state and people need to engage in a process of cooperation, learning, exchange and communication to find appropriate governance structures for their specific wants and needs in the broad context of biodiversity governance.

Ostrom (1998) complements her views on self-governance as an alternative to either state or market solutions and propagates institutional complexity for the governance of biological complexity. Ostrom (ibid) cites W. Ross Ashby (1960), a biologist, who developed the "Law of Requisite Variety", which states that any regulative system needs as much variety in the actions that it can take as exists in the system it is regulating. Translated into the biodiversity context this means that "any governance system that is designed to regulate complex biological systems, must have as much variety in the actions that it can take, as there exists in the systems being regulated" (Ostrom ibid). Single governance systems "can not have the variety of response capabilities (and the incentives to use them) that complex, polycentric, multi-layered governance systems can have." Indisputably, markets are able to enhance productivity and they work well for the allocation of private goods. When it comes to common pool and public goods, markets frequently fail. Also centralized governance approaches have repeatedly failed to govern social and ecological complexity.

Conclusions

Investing in sustaining biodiversity becomes a realistic option for farmers as soon as the benefits of maintaining biodiversity outweigh the costs. This is a necessary but not sufficient condition to achieve sustainability. Such isolated economizing at the level of resource allocation needs to be complemented by economizing on the institutional, governance and embeddedness levels of society. Therefore, single governance solutions (either market, state or people) are unlikely to produce sustainable outcomes for sustaining biodiversity. Self-organizing processes, e.g., strongly benefit from support of markets and state involvement. Therefore, biological diversity requires a diversity of institutions and potential governance structures which adequately address the specific attributes of social and ecologic systems. Sustaining biodiversity relies on ecosystems which are complex and adaptive systems. Accordingly governing these systems requires regimes which are flexible and have the ability to respond to change. Orientation for the match of social and ecological systems can be taken from design principles. No universal rules for systems match can be established. Linkages and response mechanisms between third, second, first order economizing and the embeddedness level reduce the risk of economic failure, e.g. market failure. Market failure and the production of externalities belong to the kind of failure resulting from a loss of institutional diversity, not only from the failure to internalize values of the ecosystem. But social diversity is not required simply because it corresponds with biological diversity. The crucial point is that with increasing institutional diversity we are able to better economize on all the different aspects required for the sustaining biodiversity. The institutional economists' perspective is a useful way to adequately frame and approach the challenge of biodiversity.

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