



Approaches in social sciences to
assess situations of natural
resources management:
an introduction

Nicolas Faysse

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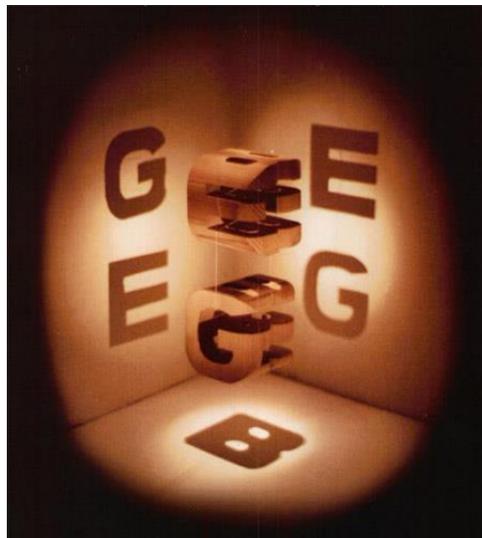
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This text proposes an introduction to the main approaches used in social sciences to study situations of natural resources management. This document is mainly written for students who would like to use a social science approach for studying situations of natural resource management, but who wonders which approach is most relevant to their case or research questions. This document was developed based on a course given in the Master in Natural Resources Management at the Asian Institute of Technology (Thailand).



Cover page of the book *Gödel, Escher, Bach: An Eternal Golden Braid* (Hofstadter, 1979)

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1 Introduction

Around the world, the management of natural resources faces many challenges, for instance their overuse, or conflicts between actors for controlling access to these resources, etc. Since this management often involves many stakeholders (actors that may use the resources in different ways, several public administrations, etc.), problems of coordination frequently arise. For instance, an aquifer may be used by farmers, by industries and by municipalities for drinking water use, and organizing a sustainable management of groundwater use may require involving not only the Ministry of Water Resources, but also Ministries related to each of the above-mentioned types of use (e.g., Ministry of Agriculture). Legal frameworks are often inadequate or insufficient and public organizations have often limited resources to set up processes involving all stakeholders in order to collectively organize management of the resource and/or to set up and implement regulations to control its use.

For each of these natural resources, studies (e.g., Molle, 2008) have shown time and again that there are no “silver bullets”, i.e. there is no organizational setting or governance system that can guarantee sustainable management of natural resources and that can be implemented wholesale in any situation. Therefore, in order to study one case of natural resource management and possibly assess opportunities to improve the management, it may be interesting to know similar cases but, eventually, the most important thing is to analyze what is happening in this case, because solutions have to be designed for each case specifically.

Social sciences have designed several approaches that can be used to understand situations of natural resource management. Similar analytical tools may be used for studying the governance of a forest or the governance of groundwater resources. This text proposes an introduction to three main approaches that are used to assess cases of natural resource management: ***institutional economics***, ***political ecology*** and ***actor-oriented analysis***. We will see that each of these three approaches has a specific focus or “entry point” in assessing a situation of natural resource management. The approaches presented here can be implemented for a large diversity of natural resources, for instance pastures, forests, fisheries or water resources. Moreover, the approaches can also be used, to some extent, for the study of global commons (for instance, Earth’s atmosphere).

These three approaches can be compared but are not completely on the same level in terms of what defines them. For instance, institutional economics (I will present in particular here new institutional economics) include both some general assumptions and a general method. By contrast, studies in political ecology share the same themes and same interests, but methods may vary widely. The next three sections present these three approaches and a fourth one organizes a comparison between them.

2 Institutional economics

Institutional economics study the creation, the functioning and the evolution of institutions¹ especially in the economic sector. Since the beginning of the 20th century, “old” or classic institutional economics attempt to explain the creation of organizations in the economic sector and how economic transactions are embedded in wider social relationships (e.g. Commons, 1934). Some of them study cases of natural resource management (Marangos, 2009). From the 1970s onwards, new institutional economics were developed and propose to explain the creation, functioning and evolution of institutions based on methodological individualism (Hodgson, 2009). Most of studies of

¹ An increasingly agreed-upon definition of an institution is the “rules in use”, i.e., the rules that in practice influence actors’ behavior, see Ostrom (1999). This concept has to be clearly differentiated with the one of “organization”. An organization is a group of people that is organized to achieve a specific goal, for instance a firm, an administration, a water user organization or an informal farmer group.

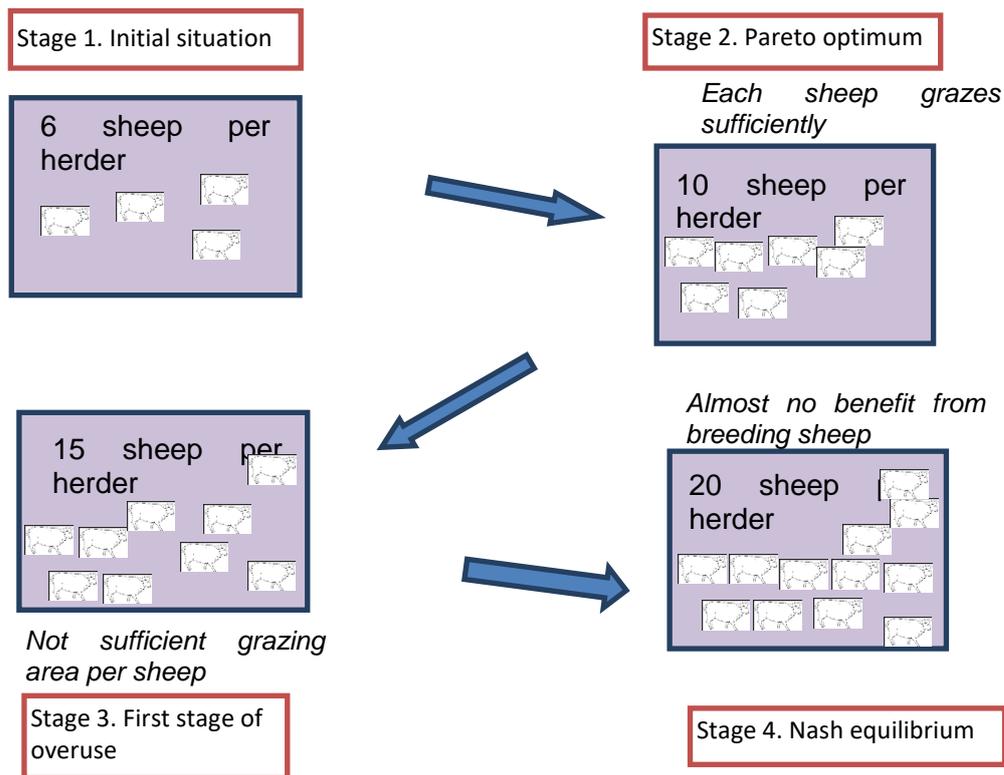
natural resource management based on institutional economics use this new institutional economics approach, and more specifically focus on one type of issues: the coordination between actors to find solutions to social dilemmas.

2.1 Social dilemmas

A social dilemma is a situation where coordination between actors can generate greater benefits, for each actor, than if actors adopt individual strategies with no coordination (Poteete et al., 2009). In the field of natural resources, social dilemmas occur in two main cases. The first one is when actors use a natural resource and there is a risk of *overuse* of the resource, which may lead to its depletion. The lack of coordination between actors accessing a resource in open access (i.e., with no regulation to control this access) is likely to lead to the overuse of the resource, a process that was described by Hardin (1968) as a “tragedy of the commons”. Second, actors may need to organize a collective investment (for instance an irrigation scheme) or set up an organization to manage the natural resource. Then, actors may under-invest in the collective investment or the set-up of the organization. This issue is referred to as a *provision* problem. Below, I present each of these two dilemmas in more details.

In order to explain the Tragedy of the Commons, let’s imagine a village in a mountain area. Ten herders live in this village and jointly use a pasture for the grazing of the sheep they breed (see Figure 1 for the process described hereafter). Initially, each herder has 6 sheep and sends them all to the pasture. There is grass for every sheep and sheep are sold at a good price, say at 100 dollars per sheep. Then, in a situation where there is no collective rule to manage the number of sheep that are sent to the pasture, each herder has an economic incentive to increase the number of sheep the following year. Sometime later, each herder puts 10 sheep, thus in total 100 sheep graze the field. Each “square inch of grass” is grazed, but the sheep are still sufficiently fed. Each herder gets a profit of 1000 dollars. At that moment, every herder thinks: “100 sheep or 101 sheep, it is almost the same: since I make benefits for each sheep I send for grazing, I will increase the number of my sheep from 10 to 11 sheep”. Then, the year after, there are 110 sheep in the common pasture: each sheep does not eat sufficiently, the herders earn only 80 dollars per sheep, and thus overall they earn less than the previous year (880 dollars instead of 1000). But still, even at that stage, for each of them (and if they do not talk to each other to collectively deal with the situation), it makes sense to increase to 12 sheep then 13 sheep, because, still, adding one more sheep will still lead to an increase of various hundreds of dollars in benefit. Herders will thus go on increasing the number of sheep until a situation whereby each herder has put 20 sheep and makes almost no profit (say, for instance, 3 dollars per sheep).

Figure 1. A process of “Tragedy of the Commons”



There are two key stages in this process. Stage 4 in Figure 1 is the situation involving 200 sheep grazing the field. This situation is unsatisfactory for every herder. The point is that none of them would accept *alone* to decrease the number of sheep that he or she sends to the common pasture: if one herder decreases from 20 to 19 sheep when the others still send 20 sheep to the pasture each, he/she will lose doing so (if she sends 20 sheep, she earns 60 dollars and if she reduces to 19 sheep, she earns only 57 dollars). The herder will reduce the small profit obtained without a significant improvement of the amount of grass available per sheep and thus the price at which the herder will sell his or her sheep. If there is no coordination between herders to move away from this situation, this situation is stable, in the sense that nobody has incentive to decrease alone the number of sheep he or she sends. This situation is called a *Nash equilibrium* in game theory. To summarize, if there is no coordination, the sum of actions taken by herders that were based on rational economic calculation will lead to the worst situation for everybody. Hardin (1968) describes the (apparently) unstoppable process towards overuse in the following way: *“But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit-in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons.”*

The second key stage is the one of 100 sheep sent to the pasture (Stage 2 in Figure 1). This situation amounts to the best income for each herder and thus also for the whole group. This situation may be referred as a Pareto optimum. However, this situation may be unstable: if there is no regulation or if there are no sufficient enforcement capacities to make sure that herders abide by some regulation, then each herder will have an incentive to cheat, thus moving forward towards the Nash equilibrium.

The process can be read also as a problem caused by the occurrence of externalities. When there are 100 sheep in the field, each herder perceives all the benefits of putting one sheep more (approximately 100 dollars) because the negative consequences of his/her action will be spread over all herders, thus this herder will only be affected by a small share of the negative consequences of

the overuse of the pasture that would be caused by having more than 100 sheep in the field (represented by a slight decrease in prices because his or her sheep will not be fed enough).

Other classical examples of overuse of resources resulting from a process of “Tragedy of the Commons” are groundwater overuse, overfishing, deforestation, etc. The pollution of a natural resources and the emission of greenhouse gas lead also to similar social dilemma. The term “tragedy of the commons” has become a popular term to describe this process, though Ostrom (1990) and many other scholars showed that the term is misleading: such process occurs in situations of open access and situations of resources “in common” (whether it means that there is a form of common property or that the natural resource is a common-pool resource- see Box 1) are not necessarily in a situation of open access. In particular, herders of the above-described imaginary village can sit around a cup of tea and discuss rules to control the number of sheep. This is not always easy, but by no means impossible!

The other type of social dilemmas is the provision of a public or club good (see Box 1). For instance, using the same previous examples, herders may decide to sow the pasture with forage crops. This will increase the amount of feed available for grazing. However, if there is no rule to force herders to contribute in the sowing of forage crops, then each herder will have an incentive not to contribute anything and let others bear the costs of sowing the forage crops (see Ostrom, 2000b for a similar example). In the absence of coordination between herders, the Nash equilibrium will be that nobody invests in sowing forage crops.

Box 1. Goods and property rights

The natural resources discussed here can be generally considered as common-pool resources. A common-pool good is a good that is both excludable (what somebody use will not be available for somebody else) and for which it is difficult – but no impossible – to control its use. Other types of goods exist. A club good is an excludable good (it is possible to prevent somebody from using a resource) and a non-rivalrous one (the use by somebody does not affect the use by somebody else). This is the case of satellite television for instance. In the case of natural resources, a club good may be for instance the building or maintenance of an irrigation scheme. A public good is a non-excludable good and a non-rivalrous one. This is the case of radio broadcast for instance.

This typology of good does not have any relation with the type of property of the resource. In particular, common-pool resources should not be confused with common-property resources (i.e., a resource that is jointly owned by a group). A common-pool resource may be managed under various property regimes and a common-property resource may not necessarily meet the two above-mentioned criteria (for instance, a common-property resource may be a club good).

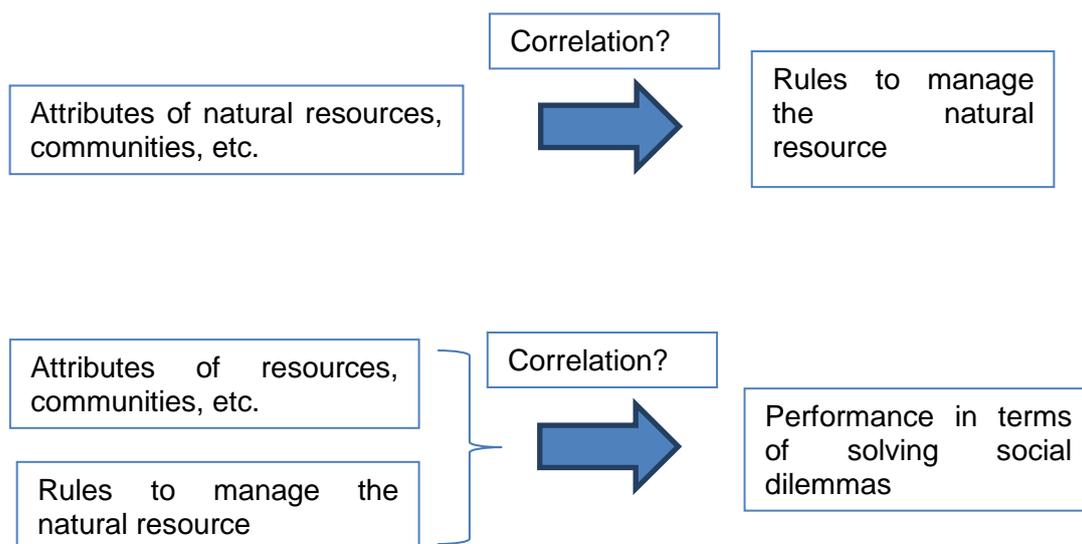
2.2 Assumptions, research questions and frameworks

Many studies in new institutional economics aim to identify the factors that influence the actors’ capacities to cooperate and, in particular, their capacity to set up institutions. These studies are based on methodological individualism, whereby actors act in a rational way according to preferences that existed before the institutions were created (Vatn, 2007). They use frameworks and models to structure the comparison between different cases of collective action (Poteete et al., 2009) and to obtain synthetic findings, especially in terms of correlations between explanatory and explained variables (Cox, 2014).

New institutional economics studies of natural resource management mainly attempt to identify regularities among a large variety of situations, in order to relate characteristics of the system (actors, resources, rules) with the outcome, especially in terms of solving social dilemmas. Generally, the questions are formulated in terms of identifying correlations between explanatory (or independent) and explained (or dependent) variables (Figure 2). First, the correlations can be identified between certain characteristics of actors and natural resources (and possibly technical

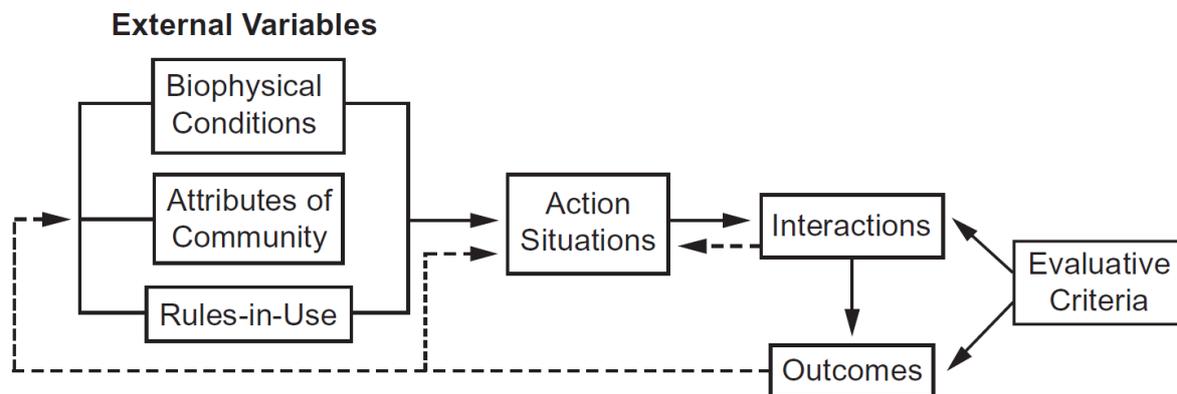
systems) on the one hand, and the type of institutions created on the other. Second, correlations can be identified between the characteristics of actors, natural resources and institutions, on the one hand, and the effectiveness (or performance) of collective actions in terms of solving a social dilemma on the other (Ostrom, 2000a; Agrawal, 2001; Baggio et al., 2016). Less frequently, regularities are studied in terms of a general correlation between all variables, using for instance principal component analysis (e.g., the study by Bouriaud et al., 2015, of forest management in Europe).

Figure 2. Two main types of questions used in approaches in new institutional economics that study natural resource management



Studies that attempt to identify the second type of correlation increasingly use the Institutional Analysis and Development framework (or frameworks derived from it). This framework links the different variables involved in the second category of correlations (See Figure 3 and Ostrom, 2011). These studies focusing on the second type of correlation need to define performance. Performance can be considered as a measured “distance” between the existing situation and one considered as “good”. Criteria have to be defined for defining a “good” situation and for assessing the distance between the current situation and the good one. What is considered as a “good” situation may differ from one actor to another. For instance, in an irrigation scheme, farmers will generally consider that the water user association performs well if water is delivered when demanded and with a low tariff. By contrast, the administration that monitors the water user association will often consider that the water user association performs well if sufficient funds are provided to ensure the maintenance of the scheme. In new institutional economics studies of natural resource management, the performance of the management is mainly measured in terms of the capacity of actors to solve social dilemmas (for instance, their capacity to design rules to make sure that a forest is not overexploited or that users of an irrigation scheme sufficiently contribute to its maintenance).

Figure 3. Institutional analysis and development framework (Ostrom, 2011)



2.3 Main results

Ostrom is clearly the most quoted author in the school of new institutional economics studying natural resource management. Ostrom spent many years identifying factors that may support the possibilities that users solve together social dilemmas related to natural resource management. In her 1990 book “Governing the Commons”, she studied cases where users had managed a common-pool resource for a long time in a sustainable way and she identified eight general principles that the rules designed by these users generally followed. This book is also valuable because it both involves a qualitative analysis of several cases and a comparison between these cases. Ostrom (2000a) identified characteristics of the users and of the natural resource which support or weaken the prospect of successful collective action to solve social dilemmas. Ostrom (2010), in her 2009 Nobel prize lecture, indicated that theorists could predict the outcomes of the interaction between actors based on characteristics of the natural resources, of actors and on the type of interactions between them. Thanks to the work of Ostrom and others, all core elements of the approaches used by this school were already “in place” in the 1990s. I review hereafter the main results that this school has obtained over the last 25 years.

2.3.1 Doing meta analyses

Many authors have tried to build large sets of cases, in order to find regularities between independent and dependent variables (Poteete et al., 2009). The analysis of a set of already existing cases studied at local level is referred to as a meta-analysis. For instance, Cox et al. (2010) reviewed 91 cases of user-based natural resource management and the quantitative analysis of this case confirmed Ostrom’s (1990) eight principles for rule design that are conducive to a sustainable user-based management of natural resources.

2.3.2 An endless quest for a complete set of criteria

Researchers have proposed various lists of design principles for rules that can facilitate actors’ capacities to solve social dilemmas (Agrawal, 2001) or have attempted to build a list of the most important characteristics (of the resources, of the actors and of the institutions) that influence performance in terms of solving collective dilemmas (Epstein et al., 2014; Ostrom, 2000b; Ostrom and Cox; 2010). These types of work try to predict, for each of these characteristics, whether it generally supports or weakens collective action.

However, this type of research has faced two main difficulties. First, these lists can be extended infinitely and the usefulness of large and universal lists of factors to assess one specific case or a general set of cases in practice does not come out clearly. The characteristics that mostly influence collective action generally differ from one case to another. There has been also an attempt to add

characteristics related to social interactions (e.g. power) in the Institutional Analysis and Development framework (Epstein et al., 2014; Whaley and Weatherhead, 2014), with limited success to date.

Second, some of these characteristics have been studied in detail and it appears that there is not a universal relation between some of these characteristics and the performance of collective action. This is the case for instance of the degree of heterogeneity among users, which can be measured in terms of users' wealth, users' quantitative use of the resource, the benefits that users get from using the resource, etc. (Faysse, 2005; Andersson and Agrawal, 2011). Basically, key arguments are that, on the one hand, when there is a high heterogeneity in interests, the users with high stakes will accept to pay the "provision costs" of designing rules and will get involved in management. This argument was initially formulated by Olson (1965). For instance, Shah (1996) studied farmers' groups that collectively invest in boreholes in India. The president of the company that each group creates is usually among the farmers that invested most. The president has thus high stakes in achieving a good performance of the company. On the other hand, high heterogeneity can lead to increased social "distance" between users and also increased differences in interests, which may make it more difficult for resource users to find agreements (Cardenas, 2003).

2.3.3 Assessing large or complex socio-ecological systems²

Initially, most studies in institutional economics focused on community-based management of natural resources, at a local level. There were much fewer works on situations of co-management between users and public organizations. This has evolved a lot over the past 20 years. First, Ostrom, from the 1990s onward, repeatedly affirmed the relevance of polycentric governance, i.e. that decision-making should not be made in a single place or center (for instance, an organization or a multi-stakeholder platform), but in various connected centers. Second, later studies broadened their scope of analysis. Some studies of local resources integrated external actors (Lopez-Gunn and Martinez-Cortina, 2006). Others broadened the scale of the studied natural resources (Villamayor-Tomas et al., 2014), for instance by focusing on global commons (Stern, 2011) and testing Ostrom's principles (Cox, 2014). Third, studies in new institutional economics show a growing interest in socio-ecological systems and how they transform. For instance, Steed (2010) studied the long-term evolution of situations of groundwater management in California.

2.3.4 Use of role playing or simulation games

Ostrom and her colleagues initiated several tests in experimental economics with students (Ostrom et al., 1994). Typically, students have to deal with a social dilemma (for instance, the use and possible overuse of a common-pool resource). Different settings are tested, for instance heterogeneity in wealth, transaction costs, monitoring costs, etc. The capacity of students to solve the social dilemma is measured in each of these settings. Cardenas (2003) conducted similar experiments with people who were involved in their daily lives in the management of natural resources. He played a game with villagers in Colombia around the issue of over-extraction of wood from forest. He showed for instance that communication within the group during the game and previous relations between players were factors that increased the capacity of the group to solve the social dilemma set in the game.

2.4 Related works

Some studies organized comparison between various cases of natural resources and identified factors that helped or hindered actors' capacities to solve dilemma, but did not necessarily base their analysis on methodological individualism. Ricks (2015) compared for instance the level of activity of

² A socio-ecological or social-ecological system is a system formed by a coherent biophysical unit (e.g., an ecosystem) and the actors that interact with or in relation to this biophysical unit.

several water user associations in Thailand and identified factors affecting this level of activity. Similarly, Faysse et al. (2010) identified a series of factors influencing the dynamism of water user associations and other farmers' organizations in Morocco. These factors were:

- the history of State involvement in a specific region: the more the State had been present in the past, the more it was difficult to set up strong farmers' organizations;
- farmers' positive (or negative) past experiences with farmers' organizations;
- the type of activities of farmers' organizations: some activities (such as water management) were risky and collective action could achieve only low benefits, whereas milk collection by cooperatives involved limited risks and were highly beneficial to their members;
- the accountability of the leaders of the farmers' organizations to members: farmers organizations at regional level were run by the rural notability with no linkages with grassroots farmers, whereas accountability was much stronger in village-level farmers' organizations.

2.5 Some conclusions

Approaches in new institutional economics have proved their capacity to structure comparison over a wide number of cases. However, all studies over the past 25 years have also showed the absence of a universal set of factors that would capture, in all cases, the most relevant drivers of the success or failure of collective action.

3 Political ecology

3.1 Principles

Political ecology can be defined in opposition to "apolitical ecology" (Robbins, 2011, which is also a good reference book for this school of thought). Apolitical ecology means considering that natural resource management is about identifying technical problems that can be solved thanks to purely technical solutions. Apolitical ecology assumes that new technologies or sector-specific policies can systematically, and on their own, solve problems of natural resources (Robbins, 2011). Political ecology stands against this assumption. Political ecology rose also as a reaction against the fact that many studies of natural resource management tended to sideline or disregard issues such as power relationships, the role of local elites or corruption.

Political ecology focuses on the study of power relations with regards to the management of space and environment and of what actors gain or lose in their interactions with regards to natural resource management. A common assumption in political ecology is that political, social, and economic differences will lead to uneven distribution of costs and benefits in relation to natural resource management, which may in turn further differences between actors (Bryant and Bailey, 1997). Another common assumption is that, in situations of very asymmetrical power relations, it is illusionary to look for win-win solutions (see Box 2).

Box 2. Integrative and distributive negotiations

It is possible to differentiate between situations: 1) where some win-win solutions exist (i.e., everybody will be better off – according to their own criteria - compared with the initial situation); and 2) where what someone earns will be taken away from somebody else. Such a latter case is also referred to as a "zero-sum game". In the first type of situation, negotiations can be described as "integrative" and, in the second type, "distributive" (Leeuwis, 2000).

For political ecologists, environmental problems are not simply a reflection of policy failure but a manifestation of broader political and economic forces, associated notably with the global spread of capitalism (Bryant, 1997). Thus, political ecologists generally consider that in order to solve environmental problems, there is a need to implement radical changes to the local and global

political economy, and a need to address the highly unequal power relationships within society in general.

Political ecology does not promote a specific research approach or method. Rather, according to Robbins (2011), it is a community of practice (i.e. groups of academics that exchange together) that study changes in social-ecological systems, with an explicit consideration of power relationships in their studies.

3.2 General themes and theses

Political ecology gives attention to two main themes: i) the access to natural resources, seen as objects around which power is expressed, and the management of these resource; ii) the production and consequences of discourses.

3.2.1 Access to and control of natural resources

Studies in political ecology mainly assess how actors compete over the access to or control of natural resources. For instance, Springate-Baginski et al. (2013) study how staff from a forest department in India act in order to obstruct the implementation of an Act that would lead to land being reverted to local communities.

We will see hereafter four general theses related to this theme in each of the following subsections. The core elements of the three first theses are based on Robbins (2011), but examples presented are different from those proposed in his book.

3.2.1.1 Degradation and marginalization

In many cases, economically or socially marginalized actors are blamed to be the cause of the overuse or pollution of natural resources. Political ecology approaches often show that it is important to understand the broad political and economic context in which overuse or pollution takes place. Often, marginalized actors are trapped in situations where, because of the macro context, they have limited agency³ in changing their behavior vis-à-vis the natural resource. In particular, traditional production systems, that used to have low impacts on natural resources, have sometimes become harmful after their integration in larger markets of agricultural products.

For instance, one (among many others) of the drivers of deforestation of the Amazon forest is the practice of slash and burn by small-scale farmers. In some areas, once these small-scale farmers have cleared a patch of forest and have started farming, they are unable to obtain capital that would enable them to initiate more sustainable farming practices. They are forced to sell the deforested land to bigger farms. Small-scale farmers are then forced to go on clearing other forested areas (de Souza Mello Bicalho and Hoefle, 2008).

3.2.1.2 Conservation and control

Environmental conservation policies may have pernicious results. The control of natural resources may be taken away from local communities in the name of sustainable management. This leads to a disruption of local livelihood systems.

For example, Clay (2016) describes the social dynamics involved in the creation of a conservation area spread over parts of the Republic of Congo, Cameroon and Central African Republic. The area was divided into specific zones, each one dedicated to a specific economic activity, such as safari hunting or industrial logging that would be made in a way not to harm the ecosystem. However, local inhabitants used to practice subsistence agriculture, hunting and gathering in zones that are now officially dedicated to other uses. These inhabitants are now barred from using these zones.

³ See definition in section 4.1.

3.2.1.3 Environment conflicts and exclusion

This thesis argues that environmental conflicts are part of larger gendered, classed, political or raced struggles. For instance, Mukherji (2006) sets out to explain an apparent paradox. In the state of West Bengal in India, public regulation of farmers' access to groundwater is strong, although data show that groundwater overuse is limited. By contrast, in Gujarat (another state of India), groundwater overuse is common in many areas, but the state government had (before 2006) taken limited actions to address the problem and especially to regulate farmers' access to groundwater. Her explanation is that the government of West Bengal has been run for decades by a urban elite, and farmers' organizations are generally weak in this state. In Gujarat, farmers' organizations are strong and they have close connections with politicians. These organizations are able to mobilize farmers and organize large demonstrations each time the government tries to set up some form of regulation or tries to decrease the subsidies for the electricity that farmers use to pump groundwater.

3.2.1.4 Official and actual decision-making power of marginal actors

Many development projects have attempted to ensure that actors that had in the past limited decision in natural resource management were empowered to have a much more important role in decision-making in new governance structure. However, many studies in political ecology showed the difference between the presence of marginal actors as shown in official organizational charts and their actual capacity to influence decision-making.

For instance, Dahal et al. (2014) studied the participation of marginalized groups (poor, women, lower caste, and landless) in management institutions in a natural conservation area in Nepal. They showed that the actors were officially members of the local village committees. However, for many reasons (lack of time and resources, lack of capacity-building), their role was de facto limited.

3.2.2 *The production and consequences of discourses*

The second main theme addressed by political ecology focuses on the production and consequences of discourses. Indeed, natural resource management problems do not exist per se: they are social constructs. Political ecology studies how actors frame discourses in public arenas and attempt to impose their views on how to consider problems related to natural resources.

For instance, Birkenholtz (2009) studied the production of discourses over the issue of groundwater overuse and over solutions to solve this issue, in Rajasthan state in India. Groundwater depletion is common in many areas of this state, due to the presence of approximately 1.4 million tube wells. The government of Rajasthan promoted a new law to regulate groundwater, with the support of the World Bank. The law scheduled that there would be new authorities in charge of groundwater regulation. These authorities would be organized in three tiers with no election. These organizations would set rules to control tube well drilling. The Act also scheduled the delivering of individual and tradable entitlements to use groundwater. The Act was based on the assessment of a "groundwater problem" framed as a technical (i.e. not political) problem that required technical solutions. The government tried to impose its discourse, which involved the idea that farmers overused water because they were unaware of the groundwater depletion process, therefore they should be trained to use water in a responsible way. A water awareness campaign was launched to promote the way the government framed the problem and the proposed solution, i.e. the new Water Act.

Birkenholtz (2009) made a survey about farmers' perception of the groundwater problems and about the solutions proposed in the new Act. He found that scheduled class farmers were not against regulation for lack of knowledge, but because they lacked trust in the impartiality of State regulation. They said for instance: "Government is corrupt. Legislation would just mean more bribes to government officials and the wealthy would get their tube wells anyway". Bribes could be used already to obtain an electrical connection for a pump. By contrast, the local elite farmers were in

support of regulation because first they considered that scheduled class farmers were the ones misusing water. Second, they thought that they would be able to control water access thanks to their close connections with local authorities. Birkenholtz concluded with the need to develop accountable institutions at different levels.

A dominant discourse may be manipulated by actors that are not in position to challenge it. In Indonesia in the 1990s, international donors produced a dominant discourse (we can say also narrative), which maintained that deferred maintenance was the key factor behind the poor performance of irrigation schemes. Indonesian irrigation agencies did not believe in this narrative, but acknowledged it officially to obtain funds in order to rehabilitate the irrigation schemes (Suhardiman and Mollinga, 2012).

3.3 Related works

Other works in sociology and anthropology provide details assessments of social processes related to the use and management of natural resources, without framing these assessments in a political ecology perspective. This is for instance the case of Prakash (2005) who studied the “boom and dust” trajectory of groundwater use in a village in India (Box 3).

3.4 Some conclusions

Studies in political ecology address many issues and processes not accounted for in institutional economics. These studies open the “black boxes” of processes of natural resource management. They pay attention to how problems are framed and to the embeddedness of natural resource management within large social processes.

However, sometimes these studies have a tendency to consider that situations of natural resource management are always zero-sum games. Moreover, there is sometimes a difficulty to scale up the results obtained from the analysis of specific cases.

Box 3. Social dynamics related to groundwater use in a village of Gujarat, India (Prakash, 2005)

Prakash (2005) studied the social dynamics related to groundwater use in a village of Gujarat, India. In this village, many small-scale farmers used to work as laborers on larger farms. In the 1970s, electricity was introduced and farmers started using electricity to pump groundwater. The 1975-1985 was the “golden age” of groundwater use: at first, the large-scale farmers sold the groundwater pumped from their boreholes to small-scale farmers, which could use this water to initiate more intensive farming on their plots. Later on, small-scale farmers also delved into the “groundwater economy” and drilled boreholes on their own plots. However, groundwater levels soon started to decline. Groundwater level decreased from 2 m below land level to 130 m in 40 years. Boreholes located in the plots of smallholders dried up, and these farmers had not the means to go on drilling to still be able to tap groundwater. These smallholders had to go back working on the farms of larger farmers, who had the capital required to drill their boreholes deeper. Large-scale farmers started using their income to prepare a future in cities.

4 Actor-oriented analysis

The third approach is possibly less known and delineated than the two previous ones. A key reference is Long’s (2003) book entitled “Development sociology: actor perspectives”. Long framed the term of “actor-oriented analysis” that does not capture very well the core idea of the approach (interface analysis might for instance be actually more suited) but this is how this approach is generally referred to.

4.1 Agency

The concept of agency is key in this approach. Agency is the ability to take action and make a difference over a course of events (Giddens, 1984). “Agency concerns events of which an individual is the perpetrator, in the sense that the individual could, at any phase of a given sequence of conduct, have acted differently” (Giddens, 1984). Verschoor (1997) adds that agency represents “the ability to make decisions based on social experience combined with the capacity to manipulate social relations and to enroll others into his or her projects”. Giddens (1984) proposes that agency is the result of: 1) knowledgeability, whereby experiences and desires are reflexively interpreted and internalized; and 2) actors’ capability to command relevant skills, access to material and non-material resources and engage in particular organizing practices. All these definitions have been proposed by sociologists. The economist Amartya Sen (2001) proposes a largely similar definition, i.e., the capacity of somebody to pursue and realize goals that she values or has reasons to value.

Actor’s agency is expressed within structures. These structures are the formal and informal contexts within which actors operate, such as laws, regulatory frameworks. These structures provide both constraints and resources to actors.

4.2 Methodology

Actor-oriented analysis is based on the study of arenas (or 'interfaces'). “Arenas are social locations or situations in which contests over issues, resources, values, and representations take place” (Long, 2003). These arenas are the places where actors coordinate and negotiate. The study of these arenas makes it possible to understand the viewpoints of actors, their strategies, their resources and eventually their agency. Arenas may be specific, and sometimes informal spaces (for instance, the interactions that take place between a forest department and local communities after the first one found out areas that had been illegally deforested) or they may be institutionalized spaces (for instance, a water basin committee).

If a researcher asks actors about their relationship with other actors, the answer may be very general and insufficiently based on specific arguments. If actors are asked about their general role, they may also answer about their official role – not what happens in practice. Asking actors about specific issues helps making this link between actors’ assertions and specific topics, events, actions, or discourses. In particular, the main idea of the actor-oriented approach is that the interactions between actors become more explicit during a specific event

The methodology may involve assessing the following elements (that can be typically inserted in interview guides) around a specific issue (e.g., a drought that recently occurred):

1. actors’ perception of the socio-ecological system, of other actors’ agency and of their own rooms for maneuver;
2. actors’ goals and strategies vis-à-vis the specific issue;
3. how actors interacted;
4. the outcomes of these interactions and especially if each actor was able to reach his or her objective;
5. what actors learnt from this experience and the possible changes in their perceptions.

Ben Mustapha (2016) assessed the management of water user associations in Tunisia using such an approach (see Box 4). Similarly, Faysse and Thomas (2016) analyzed the negotiation that took place around two tree farming development projects in Morocco. They analyzed the goals of each of the actors involved in the projects in terms of the characteristics of these projects, how the negotiation took place and finally the outcomes of the negotiation in terms of the final characteristics of the projects.

Box 4. Interactions among actors in irrigation schemes in Tunisia (Ben Mustapha, 2016; Ben Mustapha and Faysse, 2017)

In Tunisia, medium scale irrigation schemes are managed by water user associations. Farmers and public administration generally have not the same criteria for defining the performance of these associations. Despite this diversity of viewpoints, most farmers and staff of the public administration concur to say that the performance of these water user associations is mediocre.

Ben Mustapha (2016) studied three of these water user associations and for each of them, she selected 2 or 3 issues around which actors were interacting with regards to the management of the water user association. She studied for instance water allocation, water quality, the management of a period of drought, or the management of debts that farmers have vis-à-vis the water user association. For each issue, she used the above-mentioned list of points in her interviews with actors. She then used the following typology of coalitions that had appeared for each issue.

- Coalition of level 0: actors do not share a common assessment of the issue;
- Coalition of level 1: actors share a common assessment, but they do not identify win-win solutions;
- Coalition of level 2: actors identify win-win a solution, but are not active to implement it;
- Coalition of level 3: actors of the coalition act together in order to achieve a solution that should enable each of them to achieve his or her objective in the short term;
- Coalition of level 4: actors of the coalition act together in order to achieve a win-win solution taking into account possible future evolutions of the socio-technical system.

Coalitions of level 1 and 2 may be qualified as “potential coalitions”, whereas actors group into “active coalitions” when level 3 and 4 are reached.

For each issue, Ben Mustapha identified the coalitions involved (some actors belonged to various coalitions) and also identified the factors that impeded the group to achieve a higher degree. For instance, in one of the water user associations, small-scale tenants and users close to the boreholes located within the irrigation schemes wanted to set up rules for a more equitable allocation of groundwater, but the management committee of the association and large-scale tenants blocked their initiative. Therefore, the coalition involving small-scale tenants was of level 2. The analysis also involved an assessment of how relations between actors evolved over a period of 5 years.

5 Linking and comparing the approaches

Scholars that study collective action for the management of “commons” created an association in 1989 that is now labeled the International Association of the Study of the Commons⁴. This association encompasses researchers from different academic traditions. The association enabled a collection of a huge number of cases at local level, thanks to a website, conferences and the International Journal of the Commons. However, despite these opportunities for exchange, there has been limited theoretical discussion between the different academic traditions.

5.1 Criticisms of institutional economics by other disciplines⁵

Since the mid-1990s, scholars who adopt sociology or anthropology approaches have published numerous articles that point out the shortcomings of the approaches in institutional economics in terms of their theoretical bases, goals, assumptions and methods. Mosse (1997) and Steins and Edwards (1999) were particularly convincing because they showed that undertaking a (short-sighted) analysis, based on theories in institutional economics, would lead to a misunderstanding of what actually occurs in the cases they studied.

⁴ See <http://www.iasc-commons.org/>

⁵ This section largely draws from Faysse and Ben Mustapha (2017)

Mosse (1997) studied the collective management of irrigation tanks in India. In a small water basin of South India, there are rules for water allocation for the tanks in almost all of the 56 villages situated in the upstream part of the basin. By contrast, there is no rule in the 21 tanks situated in the downstream part. There, farmers do not use water from the tank or access it individually. Mosse (1997) sets out to understand why such difference occurs. He first tries an analysis based on a perspective in new institutional economics. This works at first sight because, indeed, there are sandy soils in the upstream part and there, irrigation is necessary for cultivation. Therefore, there will be high benefits from cooperation. In the downstream part, the black soils can retain water from rains, thus irrigation is less important and cooperation is much less necessary. Thus, an approach in institutional economics would claim that the soil characteristics explained differences in the collective management of tanks. However, Mosse (1997) showed that in villages situated downstream, tanks had previously been managed collectively. The soil characteristics actually made it possible for some of the farmers in these villages to stop using tank irrigation water because they considered that the tanks were poorly managed. The difference in soils appeared to be not an opportunity to build collective action in the upstream part, but an opportunity to diversify from rice production and « exit » from traditional authoritarian rule in the downstream part. Mosse concluded that common-pool resources are not only physical resources, but also symbolic ones. They constitute an important locus of social and power relations. Based on this example, Mosse argued that approaches in new institutional economics fail to take into account power relation and the history of social relations

Similarly, Steins and Edwards (1999) analyzed a fishing cooperative in Ireland. Fishers mainly fish in a bay. In the 1980s, three salmon farms were installed in this bay, which led to a decrease in the fishing area and also created marine pollution. The fishermen created in 1991 a cooperative with the official goal of producing shellfish. Some years later, the production of shellfish was ailing because of problems of coordination among members. However, the cooperative met all Ostrom's (1990) principles for the sustained user-based management of common-pool resources. Steins and Edwards (1999) showed that the cooperative members did not create the cooperative with a view to achieving its officially stated goal, namely, to develop joint economic activities in a bay. Instead, they were motivated by a hidden objective, which was to assert their rights in the bay and to limit the development of salmon farms.

In the light of this analysis, Steins and Edwards argued that performance of collective action should be assessed based on members' own definition of performance. "Any research that starts with the assumption that some form of collective action is 'successful' while another is a 'failure' will never get to analyze how the distinction is constructed and used". More generally, they consider that a social constructivist approach is required to study collective action. Social constructivism gives importance to the way people construct and assess their reality and considers that social science should focus on deciphering the multiple representations of reality rather than trying to unveil an "objective one". Steins and Edward conclude that Ostrom's 8 principles should be used not as prescription over what natural resource management should be but as a possible good basis to help frame research questions.

Generally speaking, many sociologists and anthropologists consider that studies from the new institutional economics school are based on a relatively functionalist and utilitarian approach to common-pool resources. They claim that new institutional economics analyses focus exclusively on the questions of "incentives" in order to understand how and why actors manage to solve social dilemmas (Hall et al., 2014). In addition, sociologists and anthropologists generally consider that the new institutional economics school uses an oversimplified model to explain the relationship between actors and between actors and natural resources (Mosse, 1997). In particular, they criticize the gap they perceive between: 1) the research findings in sociology and anthropology, in terms of the key elements that should be considered in a case study of collective action (as mentioned above); and 2) the elements that the new institutional economics school includes in its theoretical bases. The

following list presents the main criticisms and shows, for some of them, how the new institutional economics theoretical bases have evolved in a way that answers these criticisms to some extent:

- **Multiple issues and social embeddedness.** The theoretical bases used by the new institutional economics school generally consider that actors involved in a socio-ecological or socio-technical system interact around a single issue (e.g. a social dilemma concerning the sustainable use of a common-pool resource). However, in practice, actors' interaction is usually linked to several issues, in distinct but interrelated arenas. For example, actors involved in natural resource management may also be involved in local politics and there may be possible competition between different families or groups, etc. (Steins and Edwards, 1999).
- **Multiple values, objectives and definitions of performance.** In general, the new institutional economics theoretical bases assume that actors' behaviour is driven by economic rationality. For instance, they consider that users of a natural resource aim to benefit as much as possible from using that resource (Nightingale, 2011). Sociologists and anthropologists consider that new institutional economics approaches give little or no attention to the cultural and symbolical values, which users attach to common-pool resources (Mosse, 1997), despite the importance that these values may have when it comes to defining the users' identities (Gerkey, 2011). Moreover, according to the new institutional economics school, collective action involves coordination among actors with a view to solving a social dilemma. This entails the use of a universal definition of the performance of collective action, which is evaluated according to its capacity to solve a given dilemma. However, actors generally have many different objectives and, therefore, how they define the performance of collective action is likely to differ (Steins and Edwards, 1999).
- **External actors and factors.** Initial works in new institutional economics, such as Ostrom (1990), focused on the management of local common-pool resources. Initially, limited attention was given to actors and factors external to the local communities (Agrawal, 2002; Ojha et al., 2016). However, new institutional economics approaches have evolved, and as seen above, have taken into account other actors and worked at larger scales.
- **Power relationships.** The new institutional economics theoretical bases focus predominantly on the rules and characteristics of the socio-ecological or socio-technical systems, but tend to sideline issues of power relationships (Mosse, 1997).
- **History and processes.** According to Mosse (1997) and Johnson (2004), the new institutional economics theoretical bases give limited importance to the dynamics of socio-ecological systems. Studies using these theoretical bases have been accused of providing "snapshots" of management regimes (Steins, 1999). However, Ostrom has attributed greater importance to the evolution of institutions in her last works (e.g. Ostrom, 2014).

These criticisms have been repeated time and again (see Hall et al., 2014 for a recent overview), but have failed to trigger real debate. Key authors from the new institutional economics school have barely responded to the criticisms, leaving sociologists and anthropologists with nothing but "imaginary conversations" (Mosse, 2006). In particular, Ostrom never quoted Mosse's article (1997). She referred to Steins and Edwards (1999) and their criticism that her work was based on an "overgeneralization to a broad range of cases, abstracting excessively from the local context and the history of particular cases" (Ostrom and Cox, 2010). However, Ostrom never published a detailed response to the criticisms expressed by Steins and Edwards or other sociologists/anthropologists for that matter. Similarly, Agrawal (2001), whose approach can also be placed within the new institutional economics school, briefly mentioned Mosse (1997) and Steins and Edwards (1999), without responding directly to their criticisms.

In general, authors from the new institutional economics school have shown a positive appreciation of the in-depth studies conducted by sociologists and anthropologists. However, they criticize the latter for generalizing on the basis of a very small set of case studies. They also claim that there is no

guarantee with regard to case study selection bias or representativeness (in terms of the diversity of situations) (Agrawal, 2001; Poteete et al., 2009).

5.2 Attempts to link both groups of theories

Academics from both groups have conducted numerous studies, which borrow elements (framework, concepts, etc.) from the other. Firstly, some studies remained firmly anchored in sociology or anthropology. They followed the proposal made by Steins and Edwards (1999), namely: to use key elements and results from new institutional economics studies (e.g. Ostrom's design principles, the Institutional Analysis and Development Framework) as guides for in-depth investigations of specific cases using a social constructivist approach (Wutich, 2009; Cinner et al., 2012; Gruby and Basurto, 2013; Afroz et al., 2016). This approach helped to structure some aspects of the analysis, without excluding other dimensions. Secondly, studies in institutional economics proposed adding concepts used in sociology and anthropology (e.g. power) to one of the new institutional economics frameworks. Some articles made theoretical proposals (Epstein et al., 2014; Whaley and Weatherhead, 2014). Others adopted the approach for a few cases, thus, deviating from the meta-analysis approach of the new institutional economics school (Clement, 2010). Few papers actually included concepts used in sociology and anthropology for a comparative analysis of several cases (Cox et al., 2014).

In fact, studies in sociology and anthropology have identified a broad set of elements, which they proved was important for understanding collective action in many of the examples that they studied in rural areas around the world. Integrating all these elements in one of the existing new institutional economics frameworks appears to be an impossible task. Therefore, despite the fact that some interesting results have emerged from the study of specific cases, both new institutional economics and sociology/anthropology approaches have failed to build a theoretical basis that: allows for a structured comparison between different cases; and at the same time provides a response to the criticisms made by sociologists and anthropologists regarding the new institutional economics theoretical bases.

The attempt to establish common ground between the two groups of theories has made little progress in the past 20 years. Therefore, a number of studies proposed to draw a line between the theoretical bases used by the two groups in terms of their goals, assumptions and methods (Mehta et al., 2001). Bardhan and Ray (2006) described the two groups of theories as being on opposite sides of several dichotomies, such as outcomes versus processes or autonomy versus embeddedness. Johnson (2004) went even further to argue that it is inevitable that the two groups of theories coexist separately, rather than find common ground.

Faysse and Ben Mustapha (2017) propose to move out of the current impasse in terms of communication between new institutional economics on the one hand and approaches in sociology and anthropology on the other side by focusing on meso level analysis. A meso level relates to a specific "sector" (e.g. a specific type of farmer organization in a given country, a specific problem of natural resource management in a region): it comes midway between approaches that try to identify rules or factors that would be universally valid, and others that only be relevant in one or a few cases.

5.3 Some conclusions

The three main approaches presented here should be seen as providing complementary rather than opposed views of socio-ecological systems. This complementarity takes place along various dimensions. First, institutional economics do not open the "black box" of the processes of interaction between actors and propose to link up characteristics of the actors, of the natural resources, etc. with the outcomes of actors' interactions. This enables a structured comparison between cases. Political ecology and actor-oriented analysis attempt to open this "black box" of the processes of

negotiation. They pay attention to the path dependency of the process, i.e., the idea that what happened during the process influences the outcomes of actors' interactions as much as the initial situation of the socio-ecological system.

Another difference is that political ecology and actor-oriented analysis pay attention to assessing the diversity of viewpoints of actors in terms of the criteria of performance, whereas institutional analysis usually uses only one predefined viewpoint on how to assess this performance. Table 1 compares the three approaches according to various dimensions.

Table 1. Comparison between different schools

	Institutional economics	Political ecology	Actor-oriented analysis
<i>What is the main focus of research?</i>	Identifying relations between characteristics of the social-ecological systems and the outcomes in terms of performance of natural resource management	Assessing the way power relations are exercised in natural resource management and how discourses are framed and communicated	Analysis of coordination and negotiation between actors
<i>What are the requirements in terms of data?</i>	Data set of various cases	Detailed assessment of the actors' visions, discourse and their relations	Detailed studies of arenas of coordination and negotiation between actors for specific issues related to natural resource management
<i>Possible drawbacks</i>	Does not open the black box of negotiation processes Tends to under-estimate power asymmetries	Tends to underestimate possibilities for win-win agreements	A focus on "microevents" that may pay less attention to global or long-term issues
<i>Main advantages and drawbacks in terms of enabling generalization and providing recommendations to support public debates</i>	<i>Advantage</i> Easy generalization of research results <i>Drawback</i> sometimes dubious results in terms of general relations between the characteristics of the social-ecological system and outcomes in terms of natural resource management	<i>Advantage</i> Clarifies the requirement for empowering weaker actors <i>Drawback</i> Possible difficulties in generalizing research results because they were obtained on one or a very small group of cases	<i>Advantage</i> Clarifies ways to improve the coordination and negotiation processes between actors <i>Drawback</i> Possible difficulties in generalizing research results because they were obtained on one or a very small group of cases

These differences approaches have their respective advantages and disadvantages. Each approach presents a specific viewpoint and – whenever possible – it may be interesting to combine viewpoints. The figure on the first page of this document (taken from the book by Hofstadter, 1979) illustrates the complementarity between the different viewpoints: depending on each viewpoint, the image that appears is different and in order to fully understand the complex structure of the object, the best would be to see the object from different angles.

Finally, another difference takes also place in terms of the researchers' position. Political ecologists generally prefer to observe studied situations and generally do not suggest solutions to "improve" the situations (one reason being that they are aware of the different viewpoints with regards to what can be seen as an improvement). This is however not always the case (for instance, Birkenholtz,

2009). By contrast, many works in institutional economics propose some recommendations based on their findings.

This document presents very briefly the key approaches used in social sciences to study cases of natural resource management. For the reader interested in knowing more about a specific approach or topic, I provide below references of books and articles. These references just provide an introduction: students willing to improve their capacity to study natural resource management first need to read many more cases of natural resource management. Having in mind these cases will help them identify some important issue when analyzing a specific case that might have otherwise remained unnoticed. Second, theory can inform practice, but cannot replace it: building one's capacities to design relevant frameworks to study situations of natural resource management best occurs thanks to repeated opportunities to design such frameworks and test them.

6 References

In the following list, we follow the typology of the Current Opinion in Environmental Sustainability journal. One star () means a paper of interest and two stars (**) means a key resource reference for somebody who wants to study further the ideas presented in this document. I also provide sometimes a comment for some of the quoted references.*

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