

ENVIRONMENT, INSTITUTIONS AND SOCIETY IN THE MANAGEMENT OF COMMON-POOL RESOURCES: LINKING IAD FRAMEWORK WITH THE CONCEPT OF SOCIAL CAPITAL.

By

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Abstract: Since using IAD framework significantly helped researchers in empirical analysis of common-pool resources ranging from local to global scale, it is not surprising that it is now widely appreciated as a major analytical tool. A second fundamental concept rising in the last fifteen years is social capital. Its application field seems also wide, and range from economic development analysis to comparative researches on institutional performance, to studies regarding collective action. Social capital includes elements like internalized values, relations, trustworthiness of social environment, and local institutions. My proposal is to range them in a scale of increasing collective action difficulty, i.e. the higher is the place held in the scale, the greater is the need of collective action both to create and maintain the element.

The paper inquires the possible links existing between the two schemes, starting from the analysis of factor of both social and institutional origin affecting actors interacting in the action arena. My proposal is indeed to characterize those factors using the concept of social capital. The main aim is to show that - considering social capital elements and the relations among them as factors affecting the action arena, and analyzing the feedback effects illustrated by the IAD framework - it is possible to reach a greater evidence in explaining performances in CPRs management situations. Empirical examples are provided, showing the possibility of application of the new scheme.

Résumé

L'Institutional Analysis and Development (IAD) framework est désormais considérée un outil essentiel dans le champ des recherches sur les ressources communes. Un des principaux avantages de son utilisation est la possibilité de l'appliquer à études sur échelles différentes, au niveau micro (local) comme au macro (global). Un deuxième concept de croissant succès pendant les quinze années dernières, surtout dans le champ des sciences sociales et politiques, est celui du capital social. Le concept regroupe les valeurs internalisés, les relations sociales, la fiabilité du milieu social et les institutions locales. Il est possible de ranger ces éléments en échelle en fonction du besoin d'action collective: Plus haute est la place occupée sur l'échelle, majeur est le besoin d'action collective pour sa création et son fonctionnement.

Objet du présent essai est l'étude des liaisons existantes entre les deux notions à partir des facteurs d'origine sociale et institutionnelle influents sur les acteurs interagissant dans l'arène d'action, facteurs qui vont être caractérisés par moyen du capital social. Mon but est de montrer en utilisant des exemples empiriques qu'il est possible de mieux expliquer les différences de résultat dans la gestion endogène de ressources communes en considérant les éléments de capital social et leur relations comme facteurs influents sur l'"arène d'action" et en étudiant les effets de rétroaction illustrés par le *IAD framework*.

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Introduction: The Institutional Analysis and Development framework

Originating with Larry Kiser's and Elinor Ostrom's (1982) work and further developed in the following years (Ostrom, 1988 and 1999; Ostrom, Gardner and Walker, 1994, 23-50), the Institutional Analysis and Development (IAD) framework is a positive attempt to link different scientific disciplines in the analysis of how institutions affect individuals behavior. Its aim is to identify the main variables existing in all institutional arrangements in order to provide a tool for both theoretical and empirical analysis.

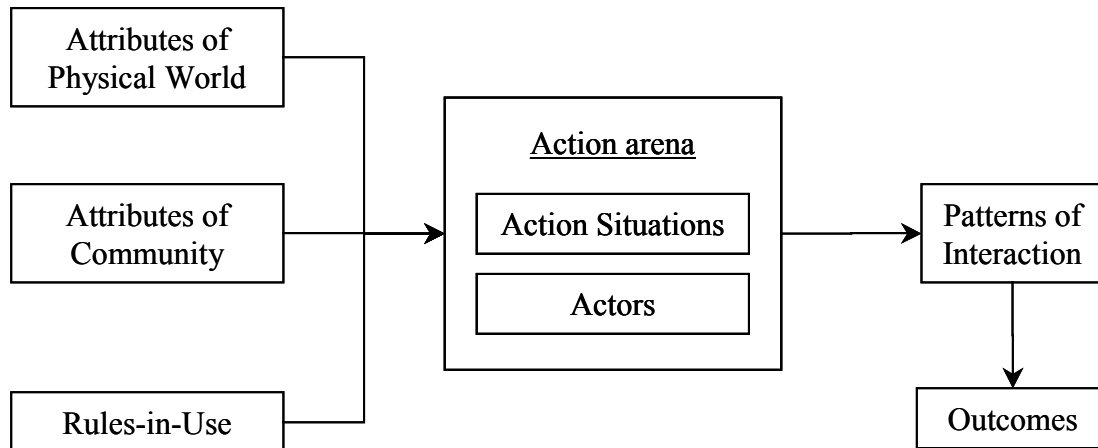
The term *institution* refers to the "shared concepts used by humans in repetitive situations organized by rules, norms, and strategies" (Ostrom, 1999). Institutions affect the behavior of actors through *rules* and *norms* stating what actions must, must not or may be done. Both express a prescription, but their enforcement uses different mechanisms. The first ones use formal agents for monitoring and sanctioning transgressors or informal control linked with some form of social sanctioning. The second ones are "internal evaluations" attached to particular actions, learned in the social milieu, and self-enforced through psychological costs or gratifications (Ostrom, 1998).

Without pretending to describe the IAD framework in its entirety, I will now summarize some of its main points referring to Ostrom (1999) for a more accurate picture. The framework core is a conceptual unit - the *action arena* - where *actors* interact in a social space named *action situation*¹. The characters of actors and of the action situation define the arena, while activities, interactions, exchanges, etc. among individuals inside the arena produce the *outcomes* of the institutional arrangement.

¹ Seven groups of variables characterize an action situation: the participants, their positions, the possible outcomes, the links existing between actions and outcomes, the level of choice participants possess between the different actions to be taken, the information they have, and the costs and benefits assigned to each possible outcome. Actors own also different individual characters - as resources, valuations, knowledge, and selection processes - affecting the outcomes. See Ostrom (1999) and Ostrom-Gardner-Walker (1994, 23-50).

Action arenas do not include all what is needed to analyze an empirical situation. Three classes of external factors affect indeed the structure and the variables of action arenas: (1) the states of physical world where actions are undertaken, (2) the rules in use by participants to order their interactions, and (3) the structure of the community where participants act.

Figure 1: The IAD framework.



Source: Ostrom, Gardner and Walker, 1994, 37.

The basic scheme of the IAD framework will be maintained in the paper. The aim is indeed to characterize some of the factors affecting the action arena as collective action problems, studying the relations among them, and showing their effects on cooperative behavior of actors managing CPRs.

Next paragraph will separately describe the different factors affecting the arena. The second one will try to place them in a scale of increasing difficult collective action, showing the existing relations and their effect in creating a self-reinforcing versus a self-weakening environment. The last paragraph will present some empirical illustrations as example of application of the new scheme.

1. Factors affecting the action arena

Attributes of the physical world

The attributes of the physical world are external to the appropriators' community, but represent a fundamental background for the structuring of the action situation. They include the characteristics

of the resource and all relevant material aspects in shaping the practical possibility of the actors' actions and of possible outcomes. They also affect actors' knowledge and the information they possess regarding the resource (Ostrom, Gardner and Walker, 1994, 44). For instance - studying irrigation in Nepal - the size of the system and the technical characteristics of the channels - even if they not determine the results of collective action, which are also influenced by social and institutional variables - are fundamental factors affecting actors' behavior, (Lam, 1998, 63-78).

A basic aspect of the physical attributes is the effect they have on other factors, and especially on the rules used by the resource appropriators. Indeed, "the same rule configuration may yield entirely different types of action situations depending upon the types of events in the physical world being acted upon by participants" (Ostrom, Gardner and Walker, 1994, 44). From a different point of view, the physical world is the actual playground of the actors' actions and the vertical relations with their environment not only affect the meaning of rules, but they also constitute the fundamental ecological link with the resource. This link is the core of the relationship between human being and nature, and the logical start of any analysis on natural resource management.

Social and institutional factors

The IAD framework considers two other classes of factors affecting the action arena, namely the "rules in use" and the "attributes of the community". Increasing the depth of analysis, I will divide those socio-institutional factors in four groups: (1) *Internalized norms and values*, (2) *social relations*, (3) *trustworthiness of social environment*, and (4) *institutions*. The first step is to consider them separately.

1) Internalized norms and values

Internalized norms and values can be seen not so much as explicit rules of behavior themselves but as "evaluations", positive or negative, which actors assign to specific actions or behaviors. (Ostrom, 1998, 9). The level of analysis is here the individual, still the internalization of different norms and values has clear social effects and - vice versa - the social and institutional environment surrounding the individual greatly influence the process of internalization.

Researches in the fields of evolutionary psychology suggest that human beings during their evolution may have developed capacities and cognitive means to recognize and learn norms as instruments to facilitate problem-solving through social exchange. (Cosmides and Tooby, 1992; Ostrom, 1998, 10). Part of this process actually consists in internalization of norms and values, starting probably in early childhood and continuing throughout all different aspects of social life.

Family, school and other institutions affect it, as do other actors with whom the individual is in contact (Dasgupta, 1999, 338-339).

Internalized norms and values change the incentives actors face in particular situations. It is possible to conceive their effect as an "internal parameter" - often in the form of sentiments such as shame or guilt, if the action violates a specific norm or value, or satisfaction or pride when the prescription is suited - which alter the objective costs or benefits of an action (Crawford and Ostrom, 1995, 587-588; Ostrom, 2000, 143-144). The introduction of the "internal parameter" can help to understand cooperation in situations where interaction takes the objective form of a collective action problem.

To put it in a different way, the possibility of learning and internalizing norms means that not all actors will play as "rational egoists" in collective action situations. Indeed, some of them will be "norms using players", for instance "conditional cooperators" or "willing punishers" as described by Ostrom (2000, 141-143). The first ones are tit-for-tat players, while the seconds are willing to pay a cost for punishing free riders. Empirical results in experimental economics appear consistent with Ostrom's model, which leads to prediction of greater cooperative behavior in collective action problem situations than in the standard rational choice ones.

2) Social relations

This group includes all the links, connections, and other relationships - variable in stability, value and contents of the exchange - that link different individuals in a given context. Relations are the "building blocks of social organization" (Coleman, 1990, 43). They can be "simple", if all incentives to maintain the relation are intrinsic to the relation itself, or "complex", where a third part is needed to uphold them. This second class of relations constitutes the basis for building more formal and complex social structures, i.e. organizations (Coleman, 1990, 43).

Individuals involved in stable and dense networks have more incentives to cooperate in collective action situations. Favoring the exchange of goods, services and information, social relations create incentives for long-term involvement, spread information regarding the trustworthiness of other actors, and increase the payoffs of agents using reciprocal strategies (Ostrom and Ahn, 2001).

Hence, the stability and density of the network of social relations can facilitate the solution of collective action problems, including CPRs dilemmas. For instance, in the well known case of Törbel (Switzerland) - studied by Netting (1981) and included in Ostrom's "Governing the Commons" examples - stability of membership and day-to-day multiplex relations of the Alpine-village life help explain the successful creation and functioning of CPRs management institutions (Singleton and Taylor, 1992, 320).

3) *Trustworthiness of social environment*

This factor refers to the trustworthiness of a group of actors. It can be seen as the probability of running into a trustworthy individual selecting him casually from a given population. In collective action problem situations, a trustworthy individual is someone who "abides by the norm of reciprocity" (Ostrom and Ahn, 2001, 22), i.e. an actor willing to cooperate with other cooperators. Therefore, a high level of trustworthiness of social environment increases cooperation allowing a reduction in uncertainty regarding the possible actions of other group members.

Since high levels of trustworthiness have the same effects for all the actors included in a given social environment and their benefits are not weakened by use (rather with disuse), they possess a clearly public good value. Moreover, in many situations individuals can raise higher payoffs cheating the trust shown by other people, in this way eroding the general reliability levels. Therefore, the creation and maintenance of trustworthiness is not automatic and constitutes in itself a collective action problem.

For instance, high levels of trustworthiness are essential for the functioning of Southeast Asia rotating credit associations described by Coleman² (1990, 306-307). A single opportunistic act (i.e. a person who receives the collective payout at a given time and leaves the group before depositing his/her subsequent contribution) can easily wipe them out, putting an end to the association at the same time. Therefore, the trustworthiness of the social environment can help the solution of collective action problems, but it is not self-maintaining and most of the time constitutes a new social dilemma.

4) *Institutions*

Institutions include, according to North's definition (1990, 384), the "informal constraints and formal rules" and "their enforcement characteristics", which "provide the rules of the game of human interaction". If efficient in their functioning, institutions reduce uncertainty in the behavior of individuals and create incentives towards greater levels of coordination and cooperation. They represent a major force in shaping human behavior, and a fundamental way in solving collective action problems.

A slightly different way of describing institutions is to look at rules as "prescriptions that define what actions (or outcomes) are *required*, *prohibited*, or *permitted*, and the sanctions authorized if the rules are not followed" (Ostrom, Gardner and Walker, 1994, 38). As in the case of internalized values or prescriptions, it is possible to express external enforced rules by a parameter that alters the

² Coleman drew the example from Geertz (1962).

payoff of an action (Crawford and Ostrom, 1995, 587-588). The main difference between institutions and values is not in their effect but in their functioning, i.e. formal or informal sanctions applied by other actors that change the incentives regarding a given action in the first case versus self-inflicted psychological costs or gratifications in the second.

Whatever definition is used, institutions "are the results of human beings' efforts to establish order and increase predictability of social outcomes" (Ostrom and Ahn, 2001, 24), and have a public good character (Bates, 1988, 394-395; Ostrom, 1990, 42-43). Therefore, as in the previous group, the creation and operating of institutions constitutes a second order social dilemma. An example of the difficulties of institutional maintaining and efficient functioning in the absence of effective collective action is provided by Lam (1998) describing bureaucratic management in Nepal of irrigation systems, run by governmental agencies in the absence of farmers' strong involvement:

"Given that farmers lack incentive to engage in the governance and management of their systems, the viability of the system largely hinges upon the performance of irrigation officials. [...] Obviously, even the most well-intentioned and able officials cannot know the details of the physical structure of the canals as well as the farmers do. Nor can they always know what kinds of rules are suitable to farmers in particular time and place exigencies. Also, it is impossible for the officials to monitor and enforce the rules all the time. When irrigation officials are facing little incentives to see to it that the systems are well-managed, low levels of performance are a likely result." (Lam, 1998, 190).

Following the IAD framework, physical, social, and institutional factors affect incentives of actors facing the management common-pool resources. However, they are not mutually independent. The same institutional arrangement has different effects changing social contexts or in different physical environments. At the same time, institutions can deeply modify the relational or valorial patterns of a given community, for instance promoting the creation of relations, trust and cooperation between its members. Therefore, the next step is the analysis of relations and reciprocal influences among those factors.

2. Relations between factors affecting the action arena

Physical attributes describe the environmental and the infrastructural background where individuals act. The environment is both the starting point and the target of actions, setting up the possible moves and the payoffs for players managing a CPR. Considering the human time-scale, it is fixed and given at the time t_i , where actors choose the next move, and changes at the time t_{i+1} as consequence of the different actions and of their combined effects.

Just as physical attributes describe the environmental background where individuals managing a CPR act, internalized norms and values can illustrate the deeper motivations of their actions. Norms and values are not the result of conscious decisions and can be viewed as given for a specific individual at the time t_i . Subsequent interactions with other actors and the action of institutions will

eventually modify them. Physical attributes and internalized norms and values represent the very starting point of action. Once in place, they constitute a force that directly influences both factors included in other groups and actors interacting in the action arena. Moreover, in absence of external intervention, they are relatively stable over time.

This is not the case with the elements included in other groups: Social relations, trustworthiness of social environment and institutions are not self-maintaining and self-functioning. Indeed, they all pose collective action problems of increasing difficulty going up on a scale where at the lowest level are social relations, at the intermediate one trustworthiness of social environment, and at the top one institutions (see table 1).

Social relations present a free-riding problem since most of the times they involve a non-simultaneous exchange of material or immaterial goods of any nature between the actors involved. Therefore, there is always the risk of non-reciprocal behavior by the actor who first benefits of the relation. The problem here is twofold: A trust problem for the first actor, who needs to decide if the other one is trustworthy or not, and a temptation problem for the second actor, who must choose between reciprocating or not (Coleman, 1990, 111). The general problem takes the form of a Prisoners' dilemma. Notwithstanding the severe non-cooperative equilibrium of the PD game, the general collective action problem associated with the creating and maintaining of social relations is relatively easy to get through. In repeated games, i.e. non-occasional social relations, cooperative strategies are likely to emerge following Axelrod's (1981) statement. Tit-for-tat players are players willing both to place trust in other actors in the first round and to reciprocate for the goods they subsequently receive. Since for individuals using reciprocity there is an incentive to acquire a trustworthy reputation and to trust other trustworthy individuals in a mutually reinforcing cycle (Ostrom, 1998, 12-13), social relations are likely to be created and maintained over time.

However, an initial cluster of reciprocal players is needed to start the cycle. Moreover, the greater it is with respect to the total population, the easier will be the emergence of a large number of stable relations. The figure is clearly affected by norms and values internalized by the actors composing the population. The presence of actors with internalized cooperative norms is therefore a crucial factor in helping the creation of social relation.

The action of the other factors affecting the action arena can also increase the stability and profitability of social relations. Specifically, high levels of trustworthiness of the social environment can increase the probability of meeting a trustworthy individual even if the first actor knows nothing about him/her, favoring the creation of new relations. Institutions, and especially informal social institutions, can also reduce the incentive of cheating, for instance via informal sanctioning to non-cooperators, like ostracism, breaking of existing relations, etc. Therefore, elements included in

groups higher in the scale are likely to have a reinforcing effect on the probability of establishing and keeping up productive relations.

If high levels of trustworthiness favor actors in creating social relations, still the maintaining of them poses a collective action problem. Everybody is better off in a high-trust environment, but a free rider can easily increase his/her payoff by cheating his/her trustors. By their actions, free riders erode the general trust, and this in turn incentives more actors to behave in a non-cooperative way. A negative self-reinforcing cycle can so be established leading to a new equilibrium with a lower degree of trustworthiness.

Nevertheless, a dense network of social relations can help the maintaining of a high-trust environment in two different ways. First, it can help the transmission of information regarding individuals who are trustworthy and who are not increasing the cost of opportunistic behaviors (Ostrom, 2001, 23). Moreover, the breaking of existing profitable relations by third parties constitute a form of sanctioning against individuals who take advantage from someone-else's trust. The presence of "willing punishers" - i.e. actors willing to pay a cost for punishing free riders (Ostrom, 2000, 142) - is hence a crucial point in explaining the reliability of behavior in high trustworthiness environments.

From the upper level of the scale, institutions can reinforce the general trust by reducing the incentives of cheating through the monitoring and sanctioning of specific opportunistic behaviors. Their placement at the top of the scale means that the collective action problems related with their construction and functioning are somewhat greater than in the groups above. As Bates (1988) points out, creating institutions to overcome a collective action problem is itself a collective action problem of a higher level, which can be better got through with the "soft" tools given by social symbols and community. However, the elements included in the groups above are largely those "soft" social capital forms, which help to cope with collective action problems in a better way. In a previous paper, I argued that other social capital elements are able to favor the creating of institutions and to back up their operating (Bertolini and Bravo, 2001). Working on developing communities, Anirudh Krishna similarly found that "Institutional Capital works best [...] when it goes side by side along with Relational Capital", and that "if norms of diffused reciprocity are practiced in the community, then the process of working out new rules becomes so much easier" (Krishna, 1999, 77).

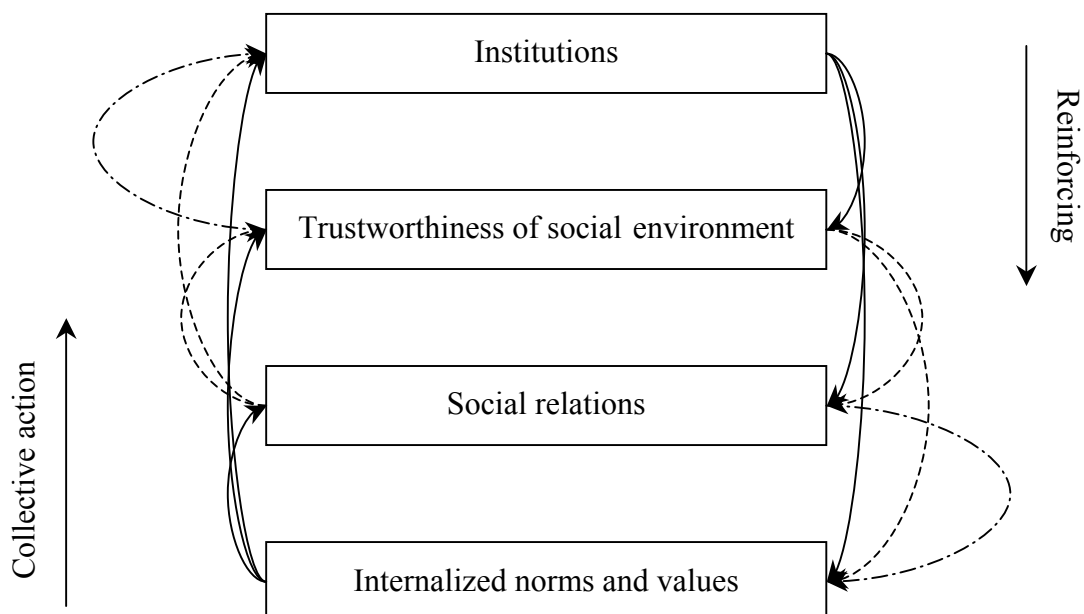
On the other hand, institutions are a powerful force in shaping human behavior and have therefore a strong impact on the elements included in the groups above (see figure 2). In particular, they affect the process of internalization of norms and values, and can reduce the incentives for non-cooperative behavior through formal sanctioning.

Table 1: Factors affecting the action arena and related collective action problems.

Scale	Group	Collective action level	Collective action problems
<i>Environment</i>	<i>Physical attributes</i>	None	- None (changes result from previous interaction in the action arena)
<i>Individual</i>	<i>Internalized norms and values</i>	None	- None (long term modifications caused by the interaction with other actors and the action of institutions)
<i>Society</i>	<i>Social relations</i>	Low	- Construction (cheating on the reciprocity norm)
	<i>Trustworthiness of social environment</i>	Medium	- Maintaining (eroding general trust by cheating the trustors)
	<i>Institutions</i>	High	- Construction (free-riding in the provision of the public good) - Functioning (violation of rules and ineffective monitoring/sanctioning)

Summarizing the scheme, I have placed social and institutional factors affecting the action arena in a scale of increasing collective action difficulty. The scale is characterized by the fact that the elements situated on the lower level on it can help solving collective actions problems of the higher ones. At the same time, the upper elements show a reinforcing effect on the lower ones. Each group is not independent and the existing relations - including circles of mutual strengthening or, eventually, mutual weakening - are fundamental in changing the incentives of actors moving in the arena and, therefore, the outcomes of interaction. As a consequence, analyzing them is of great importance in CPRs endogenous management studies to reach a better understanding of the differences between success and failure cases.

Figure 2: Relations between social and institutional factors affecting the action arena.



3. Applying the scheme: the management of alpine common-pool resources

This paragraph applies the depicted scheme to the case of traditional upland communities comparing the management of the common land across the Alps. Even if not universal, the common property of pastures was widespread across the Alps. Its diffusion can be explained as a rational strategy in coping with difficult environmental conditions, low productivity of the meadows, and optimization of the labor force distribution (Viazzo, 1989, 19-25). The economic centrality of the resource for the local populations in the past centuries engendered a number of potential collective action dilemmas, most of them controlled using specific governing institutions. The aim here is not to describe exhaustively the management of the resource in the Alps, but to offer some insight underlying the existing relations among social and institutional factors and showing how those relations can combine in creating new incentives for the resource users³.

A first illustration comes from the well known residential stability of alpine communities - both intra and inter-generational - analyzed by Netting (1981) in the Valais (Southern Switzerland), described by Marco Casari (2002) in Trentino (North-East Italy), and also found in my own studies regarding the Aosta Valley (North-West Italy)⁴. Casari, studying the "rural charters" (self-governance institutions) of a number of mountain villages between 13th and 19th centuries, argues that each community had formal institutional devices to increase the cost of moving across communities for young males, promoting in this way long-term relationships able to foster informal cooperation between the legitimate members. Lock in mechanisms included the inalienability of the common land, the losing of resource-use rights without the possibility of being refunded in the case of leaving the village of birth, and a number of obstacles for new residents in acquiring the full community membership. Those rules were explicit devices to set up long-term relationships and to restrain the possibility of access by outsiders to the common resources: Indeed, data show a limited mobility of males (who inherited the land use rights) across communities (Casari, 2002, 10-16).

Netting (1981, 70-89), also found a strong continuity through centuries in the family lines of the village of Törbel. Here again, institutional mechanism as the inheritance rules offered strong incentives to the community members in the direction of endogamic choices in wedding. Similar rules in the other villages of the region together with difficulties in acquiring new land settled a situation where "the best strategy for acquiring and enlarging the requisite property was to remain in the natal community where one could inherit, marry, manage family labor, get loans, and make

³ For more information regarding life, economy, and society in the traditional alpine communities, see Viazzo (1989).

⁴ For a deeper analyze of the cases, see Netting (1981), Casari (2002), and Bravo (2000).

deals" (Netting, 1981, 77). As in Trentino, long-term relationships were not a "natural" consequence of the economic or social situation, but the result of explicit institutional incentives.

A similar inter-generational stability results from my studies on the Valgrisenche (Aosta Valley) community. For instance, the users of the common alpine pasture named Verconey between 16th and 18th centuries were a few families living together in a small hamlet in Valgrisenche. The appearance of the same family names and, often, of explicit references to fathers' and grandfathers' first names in the written agreements used to organize the management of the common - dated respectively 1570, 1647, 1674, and 1749 (Viérin, 1997) - shows the permanence of the settlement and the strong residential stability of its inhabitants. From the institutional point of view, this case is similar to the Törbel one, with the *Coutumier du Duché d'Aoste* - the fundamental legal charter of the area until the end of 18th century (Carle, 1995, 235-237) - exhibiting strict rules on wedding and inheritance granting for the continuity of families and for the transmission in patrilinear lines of land-use rights. Here again, the institutions create strong incentives for the stability of the settlement and the existence of long-term relationships among villagers.

The diffusion of institutions creating incentives towards long-term relationships in the alpine villages conducts to the consideration of this last factor effects in the management of the common resources. Stable, multiplex, and direct relations, together with a common corpus of shared values and beliefs, are indeed the building bricks of the idea of community and represent a major force in increasing the probability of the successful solution of CPRs problems (Singleton and Taylor, 1992). However, in the absence of constraining institutions, and in the presence of many different villages with different resource allocations, there is no reason to expect the maintaining of long-run interaction among actors living in the same community (Casari, 2002, 7-8). In addition, rational individuals would have incentives to move from poorer to richer areas, creating disequilibria in the use of resources. Therefore, it is more correct to see stable relations as the result of both institutional incentives and the action of values and moral norms, i.e. of factors included respectively up and down in the scale. The presence of a relational network is, in turn, a powerful factor in increasing the possibility of building efficient institutions and in decreasing the costs of their functioning (Bertolini e Bravo, 2001; Krishna, 1999).

A circle of mutual reinforcing feedbacks among values, social relations, and institutions appears to have been in place in the traditional alpine communities, increasing the likelihood of cooperation among individuals in the management of common resources. The sustainability of the use of resources was indeed high in the presented cases. For instance, data regarding Verconey show a steady maintenance of the carrying capacity of pastures across time: 79 milking cows in 1647, 81 in

1674, 82 in 1749, and approximately 80 at the end of the 19th century when villagers stopped to use the pasture in common and sold it to a single family.

A second illustration of the relations between factors affecting the action arena comes from the analysis of the rules governing upland commons. Strict regulation strategies were widespread across the Alps. This results from environmental constraints in conditions where expanding the grazing as well as the agricultural land or intensifying the fields productivity was difficult or impossible (Netting, 1981, 56-59; Viazzo, 1989, 26-30). Pasture rules included limits to individuals' appropriation from the common meadows together with monitoring and sanctioning arrangements. Appropriation restrictions could be explicitly expressed through the number of animals that each family was allowed to pasture on the common meadows (Bravo, 2001; Sibilla, 1987; Sibilla and Viazzo, 1991) or through simpler, but effective, principles as the "no one is permitted to send more cows to the alps⁵ than he can winter" found in Törbel by Netting (1981, 61), and also used by a number of other Swiss and Italian communities.

In this context, the analysis of a specific, but widespread, rule can help to better understand the relations between social and institutional factors: the imperative collective ascent of all animals to the pastures on a given date, either fixed or chosen every year by the village counsel (Viazzo, 1989, 20). The meaning of the rule is twofold. From one side, it represents a further limitation to resource consumption: a restriction in appropriation time, and a stop to destructive "use-the-pasture-before-your-neighbor" races. On the other side, it can be viewed as an institutional arrangement to help mutual monitoring: it is indeed easier to count animals when walking as a single herd than later, scattered in the mountain pastures. Moreover, it helps to check the health of animals, where an attempt to use the common meadows by any ill-head could be a serious danger for all.

Formal monitoring was also present. Guards were rotating members of the community or, less frequently, officials appointed by the local lord. However, controlling the cattle was a time and energy consuming activity, and a part of the fine collected from rule-breakers was usually of allowance of the lord. The application of fines results therefore in a net subtraction of scarce monetary resources from the community. An effective mutual monitoring hence reduced the needs of formal control and could be both more efficient and less costly in reducing individual free riding incentives.

This example shows how a single institutional arrangement, rising the opportunity of informal control, can decrease the needs of formal monitoring. Still, the costs of mutual observation and sanctioning are far below zero, and rational individuals are not necessarily willing to pay for them. Informal sanctions range from simple verbal disagreement to the refusal of helping in all the

⁵ i.e. the upland pastures.

situations of daily life that need cooperation among members of the same community. Cooperation in a number of activities was indeed essential in traditional alpine communities (Viazzo, 1989, 21-23) creating a state of widespread mutual vulnerability, i.e. a "condition of a group of actors each of whom values something which can be contributed or withheld by others in the group and can therefore be used as a sanction against that actor" (Singleton and Taylor, 1992, 315). Life conditions were hence favorable to informal sanctioning. Still, the willingness to hold a cost to punish non-cooperators needs the presence of "willing punisher" actors (Ostrom, 2000, 142); in other words, individuals with strong internalized norms regarding the correct behavior in community situations and the just chastisement for dishonest people.

The frequency of different forms of informal control over individuals behavior in traditional alpine communities is also testified by the extent of discussions, and even heavy quarrels, which were frequent, and many had as a subject the cooperative aspects of village life and activity, and/or the breaking of shared rules of behavior. This is probably one of the reasons why some level of formal control of common activities was needed even in those face-to-face communities, mainly built on reciprocity-based symmetric relations. One explicit aim of the 1647 Verconey pasture regulation was indeed to avoid "*desbatz, querelles et batteries*" (debates, quarrels, and brawls) (Viérin, 1997, 55) among users. However, formal rules were embedded in a ground of shared norms, informal monitoring, and social sanctioning, composing a complex scheme of incentives against any non-cooperative use of the common resources (Bravo, 2001).

Conclusion

Factors affecting action arena, as identified by the IAD framework, describe the physical, social, and economical background for individuals managing CPRs. Studying them is therefore crucial in understanding the pattern of interaction inside the arena and its outcomes. However, those factors are not mutually independent, and the next step in the analysis is to consider the relations among them along with their combined action in modifying the incentives for sustainable resource use.

I have proposed to consider (1) internalized norms and values, (2) social relations, (3) the level of trustworthiness of social environment, and (4) institutions as elements describing a given situation, and to place them on a scale with increasing collective action needs. The collective actions requirements of the elements higher on the scale can be satisfied by their congruence with the lower ones. In other words, effective institutions rest on a background of high trust levels, of multiplex social relations networks, and on a milieu of coherent norms and values. At the same time, the elements higher in the scale play a central role in reinforcing and, eventually, modifying the lower

ones: institutions reduce uncertainty on individual behavior creating the conditions for trust, helping the creation of new relations among actors, and affecting the internalization of norms and values during human beings' life.

Applying Coleman's (1990, 305) definition⁶, those factors constitute social capital if they can be used by actors managing CPRs to achieve successful and sustainable results. Given the interdependence among them, no single social capital form will necessarily produce or hinder such outcome. Rather different balances of social, economical, and institutional factors will engender dissimilar consequences in relation with distinctive physical and ecological environments. Studying the connections and the cycles of mutual interdependence between factors increases the difficulty of analysis. Still, it represents a major step for a better understanding of empirical complexity.

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⁶ "The function identified by the concept of 'social capital' is the value of those aspects of the social structure to actors, as resources that can be used by the actors to realize their interests" (Coleman, 1990, 305).

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