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Institutional Sustainability of Payment for Watershed Ecosystem Services Enabling conditions of institutional arrangement in watersheds

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ABSTRACT

This paper analyzes the Payment for Watershed Ecosystem Services as an institutional arrangement under the approach of enabling conditions for the durability of institutions. This approach searches for specifying the conditions under which self organized groups of users, govern sustainably the resource upon which they depend. The attention in the paper is focused on the resource characteristics and the definition of the watershed as a Common Pool Resource is introduced. The critical enabling conditions for the sustainability of the watershed as a Common Pool Resource correspond to a different logic than that of a conventional Common Pool Resource. The interdependence among the resources in an ecosystem, in the particular case of land uses and water quality and quantity in the watershed, drives to different interactions among the users. This situation means the interaction of user groups with different interest and characteristics. Relevance and correspondence of a number of enabling conditions for PWES are discussed based on empirical information from four case studies. The conclusions identify the influence of the watershed as a complex common pool resource in the design of the institutional arrangement.

1 INTRODUCTION

The approach of sustainability of institutions seeks for the specification of conditions under which the institutions governing the commons are successful. Successful institutions summarized by Agrawal (2001) are “those that last over time, constraint resource users to safeguard the resource, and produce fair outcomes”. The significance of identifying the enabling conditions lays on the understanding about sustainable management of natural resources from empirical studies. In this paper this approach is adopted to analyze the Payment for Watershed Ecosystem Services, PWES as an institutional arrangement. Using empirical information from four case studies, the question of success of PWES is addressed examining the critical enabling conditions for the sustainability of institutions of the commons.

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The paper presents theoretical arguments and empirical comparisons in order to analyze the degree to which a number of these enabling conditions correspond to PWES. For this analysis consideration of PWES as an institutional arrangement and watershed as a Common Pool Resource, CPR are introduced.

In the last decades, PWES has emerged as an alternative to protection measures and as an instrument to internalize the externalities of land uses in the watershed. “Payment for Ecosystem Services (PES) is an economic instrument that promotes the production of positive externalities through the transfer of financial resources from the beneficiaries of an ecosystem service to the providers of the service”. (UNISFERA, 2004).

As described above, PWES implies an arrangement between two user groups of the watershed, where the definition of the rules of behavior in terms of land uses and compensations are defined to obtain specific ecosystem services, and it is considered in this paper as an institution.

PWES is an instrument contributing to the sustainability of the watershed, restricting the resource use by means of promoting change or maintenance of land uses that improve the watershed conditions to provide the ecosystem services. It produces fair outcomes through compensations given to land owners providing the ecosystem services. For this reason the approach of enabling conditions is considered pertinent to analyze the PWES as institution.

More over, this paper focuses the attention of resource characteristics on the watershed as ecosystem. References of the watershed using the Common Pool Resource (CPR) approach, explain characteristics of CPR of watershed elements like rivers, ground water aquifers or water quality. (See Ostrom, 1990; Kerr, 2007 and Sarker et al. 2008). In this paper the concept or the watershed ecosystem as a CPR itself is introduced.

Additionally based on the definition of the watershed as a complex CPR, the relevance and correspondence of a number of enabling conditions proposed in the list of Agrawal (2001) and Kerr (2007) are discussed.

2 CONCEPTUAL CONSIDERATIONS FOR THE ANALYSIS OF PWES AS INSTITUTIONAL ARRANGEMENT

In this section the theoretical arguments of PWES as an institution and the watershed as a CPR are discussed.

2.1 PWES AS AN INSTITUTIONAL ARRANGEMENT

Payment for Ecosystem Services is defined by Wunder (2005) according to the following criteria: “1) a voluntary transaction in which 2) a well defined environmental service (or a land use likely to secure that services 3) is “bought” by a (minimum of one) buyer 4) from a (minimum of one) provider 5) if and only if the provider continuously secures the provision of the service (conditionality)”.

Thus, at first sight, the payment is recognized as a transaction; however it is taking place in a wider arrangement. What is established between the providers of ecosystem services and the

buyers is a set of conditions, an agreement that often take the form of a contract including as a part of the rules, a compensation or payment to one of the parties.

According to the Bromley (1989:22) definition of institutions as the “rules and conventions of society that facilitate coordination among people regarding their behavior”, PWES can be interpreted as institution since it is a contract, a set of rules designed to coordinate the interaction between two user groups of the watershed about their “behavior” on the resource they have in common.

2.2 WATERSHED AS A COMMON POOL RESOURCE

For the analysis of PWES as an institutional arrangement using the approach of sustainability of the commons, conceptual considerations are taken into account. The conditions under which the institutions are successful, are observed from common resources. The characteristics of common resources determine the interaction among resource users and the design of rules of use.

Some of the watershed resources are identified as CPR, however, defining the watershed as a CPR is an integrative approach and allows to understand better the interaction of land users and water users and their interests and roles in PWES. Moreover, it helps to identify how the complexity of the watershed as ecosystem influences the correspondence and relevance of some enabling conditions.

For the description of the watershed as a Common Pool Resource, several aspects of the watershed are presented in this section: starting from the definition, a brief explanation of its ecosystem services, following with definition of the watershed as a fund-service resource finishing with the explanation of the excludability and rivalness problems and the description of the watershed as a complex CPR.

The strict meaning of watershed as defined by the *Oxford English Dictionary* is a dividing line: "the line separating the waters flowing into different rivers or river basins". However, as pointed out by Heathcote, 1998, since the United Nation Water Conference of Mar del Plata in 1977, the term watershed has come to mean also the drainage basin itself. For the purpose of this paper the meaning of a watershed is that of an area encircled by natural limits which determine where the water flows, that implies the watershed as a drainage basin, “an area of land within which all water flow to a single river system"(Heathcote, 1998:).

- Watershed ecosystem services

Water is available for human and ecosystems through the hydrological cycle. This paper is concentrated on the services of water quantity and quality provided by the watershed. The watershed as an ecosystem plays an important part in the provision of quantity and quality of the water available from the hydrological cycle through the processes that take place in it. As described by Millennium Ecosystem Assessment (M.A.:168). “ecosystems control the character of renewable freshwater resources for human well-being by regulating how precipitation is partitioned into evaporative, recharge, and runoff processes”

The capacity of the watershed to provide the ecosystem services is strongly related with the specific conditions of the watershed. Among the major processes influencing water quantity and quality at the watershed scale are changes in land use intensity and land cover change.

Land use changes affect evapotranspiration, infiltration rates and runoff quantity and timing. (M.A.p. 185). That is the reason why PWES are oriented to maintain or change land uses that increase or maintain the capacity of the watershed to provide the ecosystem services desired.

- Differentiation between resource system and resource units

For the analysis and understanding of Payment for Watershed Ecosystem Services PWES as an institutional arrangement, it is crucial to differentiate between the function of the watershed in the provision of ecosystem services, and the services themselves.

To distinguish these aspects for the watershed the approach of Ostrom (1999) in terms of *resource system* and flow of *resource units* is used.
According to Ostrom "*resource systems* are best thought of as stock variables that are capable under favorable conditions, of producing maximum quantity of a flow variable without harming the stock or the resource system itself. Examples of resource systems include fishing grounds, groundwater basins, grazing areas, irrigation canals, bridges, parking garages, mainframe computers, and streams, lakes, oceans, and other bodies of water". (Ostrom, 1999: 30).

Using this definition, the watershed can be identified as a *resource system,* which under favorable condition can produce a maximum quantity of flow of ecosystem services. However, the watershed similar to irrigation canals and bridges and contrary to lakes or other water bodies is not transformed in resource units when producing them.

To express it clearer, the watershed as a *resource system* is providing the ecosystem service of the regulation and renew (together with solar energy) of the hydrological cycle, the water in different states "flows" through the watershed, but the watershed itself is not transformed in resource units, is not transformed in water quantity or water quality.

A *resource system* that is not transformed in resource units corresponds better with the term fund-service resource used by Daly and Farley, (2004:77): "A fund-service resource, in contrast *(with the stock-flow resources),* suffers wear and tear from production but does not become a part of (does not become embodied in) the thing produced.

Thus, to sum up for the means of the analysis made in this paper, the watershed as *resource system* is identified not as a stock but as a fund-service resource adopting the definition of Daly et al.(2004).

The *resource units* considering the following explanation from Daly and Farley (2004:74) are recognized as stock-flow resources. "A stock – flow resource is materially transformed into what it produces. A stock can provide a flow of material, and the flow can be of virtually any magnitude; that is, the stock can be used at almost any rate desired. Further, a flow can be stockpiled for future uses. Finally, stock-flow resources are used up, not worn out".

This definition coincides with that from Ostrom of *resource units* as "what individuals appropriate or use from resource system". Ostrom (1999:30). The streams, rivers and groundwater basins as stock-flow resources are found in the watershed, the fund-service resource. They are renewed through the ecosystem service of the watershed in regulating the hydrological cycle. Referring to this classification of resources, the analysis is focused on the production of ecosystem services generated by the watershed as a fund-service resource, and the quality of that provision in function of the "favorable conditions" under which they are

produced. Favorable conditions for the watershed in the case of PWES are the land uses and agricultural and cattle ranching practices that permit the watershed to provide the ecosystem services of water quantity and quality as mentioned in the definition of PWES.

In summary, "intact ecosystems are funds that provide ecosystem services, while their structural components are stocks that provide a flow of raw materials. …The ability of ecosystem fund-services to reproduce themselves distinguishes them in a fundamental way from manmade fund-services". (Daly and Farley, 2004:104).

It is important to point out that the watersheds where PWES emerge are not intact ecosystems, but ecosystems intervened by agricultural and cattle ranching activities. To which extend the ecosystem can be used without affecting the capability of the watershed to provide the ecosystem services, is a question of sustainable practices, and replenishment rate. The fact that the watershed is not an intact ecosystem but an agricultural area is one of the reasons for the creation of PWES to guaranty the provision of ecosystem services.

- Excludability and Rivalness problems in the watershed

In the former section some structural characteristics of the watershed as a resource were described. In this section the economic characteristics of the watershed as a Common Pool Resource are explained based on the definition of the watershed as a fund-service system.

According to the classification of goods, the particular characteristic of CPR is that they are at the extreme of high rivalness and difficulty of exclusion. Regarding rivalness it implies that one person's use of the good will affect the availability of the good for another person. And on the subject of exclusion, it means that it is costly to exclude or limit potential beneficiaries of the resource from using it once the resource is provided by nature or by the activities of other individuals (Ostrom et al.; 2006).

		RIVALNESS	
		Low	High
EXCLUSION	Difficult	Public Goods	Common – Pool Resources
	Easy	Toll Goods	Private Goods

Table 1. A general Classification of goods.

Kerr (2007) and Sarker et al. (2008) who have referred about the watershed as a CPR focused on the characteristics of the resource units of the watershed. Kerr (2007:90), for example mentions that "many resources of the watershed are characterized by high exclusion cost and subtractability" and Sarker et. al (2008) expose that water quality, although an attribute of the water which is a resource unit or good, possesses CPR characteristics.

What is wanted to be described in this paper are the CPR characteristics of the watershed as fund-service resource and not the characteristics of the resource units, water quality and quantity, available in the watershed. It means that the focus of the explanation of the watershed as CPR is made from the point of view of the watershed as an ecosystem. In this sense the problems of excludability and subtractability are approached as follows.

In one side, it is difficult to exclude people from appropriating the capacity of the watershed to regulate the hydrological cycle through agricultural activities and land uses that deteriorate the conditions of the watershed.

There are two points that need to be cleared. First point is that landholders of the watershed when making use of their appropriation right on the land, are also appropriating one of the ecosystem services of the watershed.

The second point is that the appropriation of the ecosystem service by the landowners is what has been called in this paper an unobserved appropriation. Landholders when making use of their right to produce, cultivate etc, on their land, are not in all cases aware of the impacts on water quality and quantity. They are not necessarily in contact with the resource that is being affected by their activities, something that is different from the classical CPR like fish grounds or grazing lands.

On the other side, the rivalness problem of the watershed is described following the concept of Daly and Farley (2004) according to whom there are two types of rivalness in fund-services resources. The first one refers to the spatially rivalness at each point in time: once one part of the resource is taken, it can not be used by other user. In the case of the watershed, once one piece of land is used by one owner with a specific land use, it can not be used by another. And depending on the type of land use, it will be determined to which degree the ecosystem services down streams will be available for the water users.

The second type of rivalness is the quality rivalness that refers to the deterioration over time produced on the resource by its use. For technical fund-service resources like machines the quality rivalness is the depreciation. But for ecosystems it makes reference to the deterioration caused by activities that affect the regeneration capacity of the ecosystems. Even with the renewable nature of ecosystems, “the use of a biological stock at a non-sustainable level in general also depletes a corresponding fund and the services it provides”. (Daly and Farley 2004: 106).

In the case of an intervened watershed, the activities carried out up streams affect the capacity of the watershed to generate the ecosystem services because the structure of the ecosystem is modified. The quality rivalness in this case is the deterioration over time in the capacity of the watershed to provide the ecosystem services caused by the up stream activities. With PWES it is intended to have a sustainable level of use with the land use and practices promoted.

- Watershed as a complex CPR

Although the water quality and quantity are the ecosystem services of interest in PWES under study, the characteristics of the watershed as a CPR as here described are concentrated on the side of the land resource and its users and not on the water resource and its users. It can be explained by the fact that the watershed is not a conventional CPR. It belongs to the complex, multiple-use CPR as defined by Steins and Edwards, (1999:242): “Complex, multiple-use CPRs are resources that are used for ***different types*** of extractive and non-extractive purposes by ***different stakeholder groups*** and are managed under a ***mixture of property right regimes***”.

The different types of extractive purposes in the watershed (from the point of view of PWES) correspond up streams to land use and down streams to water use. The different stakeholder

groups are: a) the land users, who are not aware of the appropriation of the ecosystem services they are making through their activities and do not have the need to arrange rules of common use of a resource and b) the water users who observe the decrease of provision of the water ecosystem services. The mixture of property right regimes correspond on one side to the private property rights up streams (for the case studies selected), where the land is a private individual property. On the other side it corresponds to the character of public goods of the ecosystem services provided by the watershed.

Under these circumstances emerge the interest from the water users to maintain the conditions of the watershed in order to obtain the ecosystem services. The maintenance of the conditions of the watershed does not depend upon the practices of water resource but on those of land resource, whose owners are not facing a problem of joint resource use. That is why the institutional arrangement is developed by the water users, offering compensations to the land users to change their practices. Through this interaction of the different stakeholder the unobserved appropriation of the ecosystem services of the watershed by land users becomes for them to some extend "observable".

PWES is one alternative to create the interaction between the up stream – down stream users of the watershed. As mentioned above it is of interest to identify the critical enabling conditions of PWES as institutional arrangement for the management of a complex CPR.

3 CRITERIA OF SUCCESS IN MANAGING THE COMMONS

The research on the commons is inspired in part from the interest to learn about successful experiences of managing natural resources used by many individuals in common. It focuses on self-governing resource experiences as arenas to obtain insights and answers on how to best manage natural resources, different from the options of privatization or state intervention.

The studies on the commons have shown that resource users rely on "institutions to govern some resource systems with reasonable degrees of success over long periods of time" (Ostrom, 1999:1). In research on the commons it is of interest to understand more about the conditions under which user groups are able to design successful institutions. Agrawal 2001, based on studies on the commons summarizes the definition of successful institutions as "those that last over time, constraint resource users to safeguard the resource, and produce fair outcomes".

More over he synthesized a set of enabling conditions "under which groups of self organized users are successful in managing their common dilemmas" identified in CPR studies from Wade 1988, Ostrom, 1990 and Baland and Platteau 1996, "the three of the most significant book-length analyses of local, community based efforts to manage and govern common pool resources".

PWES and success in managing the commons.

As mentioned above in the introduction section, PWES are considered an institutional arrangement since it is a contract, a set of rules designed to coordinate the interaction between two user groups about their "behavior" to the resource they have in common: the watershed.

Additionally, PWES is an instrument contributing to the sustainability of the watershed, restricting the resource use by means of promoting change or maintenance of land uses that improve the watershed conditions to provide the ecosystem services, and producing fair outcomes through compensations given to land owners providing the ecosystem services.

In that way PWES as institutional arrangement presents two of the aspects mentioned by Agrawal as successful institutions. In order to identify enabling conditions for PWES, referring not only to resource use restriction and fair outcomes, but also to stability over time, to the last aspect was specially paid attention, in the selection of the case studies. Among the criteria of selection the long time of operation was considered as a key feature.

4 CASE STUDIES

The empirical information from which the analysis of enabling conditions is made corresponds to four case studies, two of them from Colombia which have been operating since 8 and 15 years, and two from Germany, with 16 and 17 years of operation. The case studies were selected for a comparative research and are not described in detail in this paper (it is object of forthcoming publication), since the information for the analysis in this paper is concentrated on the institutional arrangements and their enabling conditions. General information is presented in Table 1.

In correspondence with the aim to explore and understand the enabling conditions of PWES, the information was collected principally through semi structured interviews. The interviews were designed to identify critical enabling conditions taken from the list of Agrawal (2001), complemented by Kerr, 2007.

The interviews were carried out with representatives of all important stakeholders group of each case. In the case of land users, interviews were made with farmers from each area of the up stream zone. Secondary sources of information were also consulted.

Table 1. General Information of PWES case studies used in the analysis of enabling conditions

Case study	Ecosystem services	Land uses or practices paid for	Financial resources	Time of operation (years)
Bolo River Water Users Association – ASOBOLO. Pradera, Colombia	Water quantity Flow regulation	Reforestation activities Protection of water sources Organic farming	Fee paid by down stream water users (mainly sugar cane producers)	15
PROCUENCA Project. Caldas, Colombia	Water quantity Flow regulation initially (CO2 fixation was included later)	Forestry as production alternative	10% of the income for sale of services of the water company to the municipality Forestry incentive Land tax exception	8
Cooperative agreement between land users and the water company of Hanover in the Fuhrberger Feld area. Hanover, Germany	Water quality	Agricultural practices to reduce fertilizers applications	Water abstraction charge	17
Organic farming in the catchment area of Mangfalltal. Munich, Germany	Water quality	Organic farming	Water Tariff	16

5 ENABLING CONDITIONS FOR THE SUSTAINABILITY OF PWES

The set of enabling conditions synthesized by Agrawal (2001) based on empirical research on the commons corresponds to *1) resource system characteristics; 2) group characteristics; 1) and 2) Relationship between resource system characteristics and group characteristics; 3) Institutional arrangement; 1) and 3) relationship between system and institutional arrangements and 4) External environment.* This set of conditions is supplemented by Agrawal (2001: 1659) in what he called "critical enabling conditions for sustainability on the commons" and it is the list from which a number of enabling conditions are used to analyze PWES in this paper, complemented with that of Kerr, 2007, who modified the list of Agrawal for research on watershed.

More than a synthesis and a supplementation of the enabling conditions recognized by researchers of the commons as important for achieving institutional sustainability, Agrawal identified some obstacles and limitations of the list. One of the points that is criticized and that is taken into the considerations for the analysis of PWES is about the little attention paid to resources characteristics: "The limited attention to resource characteristics is unfortunate. Even if we leave aside the climatic and edaphic variables that may have an impact on levels of regeneration and possibility of use, there are grounds to believe that other aspects of a resource may be relevant to how and whether users are able to sustain effective institutions".(Agrawal, 2001: 1655).

In the case of the watershed the "other aspects of the resource" (different e.g. from biophysical conditions) relevant to how users are able to sustain the institution are related to

the complexity of the watershed as common pool resource. In the cases of PWES, there are at least two user groups of different resources of the watershed: land and water users. And this particular situation determines a different logic of the enabling conditions of the institutional arrangement.

Logic of enabling conditions in PWES

The critical enabling conditions for the sustainability of the watershed as a common pool resource correspond to a different logic than that of a conventional CPR.
The interdependence among the resources in an ecosystem, in the particular case of land uses and water quality and quantity in the watershed, drives to different interactions among the users.

In this situation the group of water users who observes the effects of land use on the ecosystem services of water quantity and quality, faces a collective action problem and this group is the one designing the institutional arrangement. More conditions of this group correspond to the list of Agrawal, than the conditions for the land users group, as it is explained in the following section. Other conditions that present a different logic from the point of view of PWES are also explicated.

Table 2. shows the set of conditions adopted from the list of Agrawal, (2001:1659) and complemented with one condition presented by Kerr, (2007: 96-97) who makes reference of the conditions specifically for watersheds. For the set of conditions *group characteristics* and the *relationship between resource system and group characteristics*, in the table is indicated the division of up stream and down stream groups following the discussion of the influence of the watershed as complex CPR in the approach of enabling conditions of PWES.

Table 2. Critical enabling conditions for the sustainability of the commons adapted for the analysis of PWES[*]

1. Resource system characteristics		
Small size (W, O)		
Well-demarcated boundaries (W, O)		
Traceability of resource improvement to a particular intervention (K)		
2. Group characteristics	**Up stream**	**Down stream**
Small SIZE (W, B&P)		
Shared norms (B&P)		
Past successful/organizational experiences (W, B&P)		
Appropriate leadership (B&P)		
Interdependence among group members		
Homogeneity of interests (even with diversity of economic and political assets) (O, B&P)		
Low poverty (A)		
3. Relationship between resources system and group		
Overlap between user group residential location and resource location (W, B&P)		

[*] Adopted from Agrawal (2001) who synthesized the list from Ostrom (1990) (O), Wade (1988) (W), and Baland and Platteau (1996) (B&P). The conditions complemented by Agrawal are indicated with (A) and the one included from Kerr (2007) is indicated with (K).

High levels of dependence by group members on resource system (W)		
4. Institutional arrangements		
Rules are easy an simple to understand (B&P)		
Ease in enforcement of rules (W, O, B&P)		
Graduated sanctions (W, O)		
5. External environment		
Central governments should not undermine local authority (W, O)		
Appropriate levels of external aid to compensate local users for conservation activities (B&P)		

5.1 RESOURCE SYSTEM CHARACTERISTICS

The first set of conditions corresponds to the resource system characteristics from which the size of the resource, clear boundaries and the traceability of resource improvement to a particular intervention are discussed in terms of their relevance for PWES.

The small size of the resource system is listed as a facilitating condition for the sustainability of institutions of the commons. However, as mentioned by Agrawal one of the obstacles of the list is that it is expected that the conditions pertain to all common pool resources instead to be related or be dependent from other conditions.

In the case of the watershed the question that arises is what is considered a small size watershed? Gibson et al. (2000:203-231) defines the size in terms of "the resource is sufficiently small given the terrain, the transportation available, and the communication technology in use, that users can develop accurate knowledge of external boundaries, and can develop low cost monitoring arrangements". Landell Mills and Porras, (2002:130) formulate a classification of the level at which PWES are implemented according to the following categories: local, state – wide, provincial, national, regional or even international. They found from a study of 61 cases that most of the cases have emerged at a local level, involving watersheds that supply urban or rural settlements.

The four case studies selected have approximated extensions of 40000 and 110000 hectares in Colombian cases and 6000 and 30000 hectares in Germany. According to Landell Mills and Porras classification, these watersheds correspond to the local and provincial level (the watersheds include more than one municipality).

But even at local and provincial level, the areas of the watershed under study present a diverge range of sizes and the larger ones may pose more challenges to develop knowledge of external boundaries and monitoring arrangements. However, given the characteristics of the watershed as a complex CPR, large size of the watershed represents fewer difficulties than for conventional CPR, because the land users are not facing the situation of arranging rules on resource use. The limitation posed by the size of the resource lay on the side of the water users in developing activities like initial meetings, contact of land users, and monitoring.

It is suggested here based on the information of the research that this limitation is overcome due to higher relevance of other conditions such as *high level of dependence on resource* (in this case water quality and quantity that make it necessary to take actions to maintain the resource), *appropriate levels of external aid to compensate local users for conservation*

activities (that is interpreted for this analysis as financial resources assigned to carry out the complete project, not only the compensations).

Well demarked boundaries are a fundamental condition for PWES. The boundaries of the watershed determine the drainage area and define as well the area where the activities of land use change need to be proposed and carried out in order to improve the water quality or to influence the capacity of the watershed to supply water.

What is particular to the case of the watershed in terms of demarcation of the boundaries is that the information is available from authorities in charge of natural resource management in the watershed (environmental agencies), or from the water companies and it does not represent an additional effort for the water users.

Kerr, (2007: 96) introduced the condition of **"**traceability of resource improvement to a particular intervention**"** to the set of variables of resource system characteristic and indicated it as specific factor to watersheds. One of the critical aspects of PWES is to determine the effect of the land use changes or activities promoted on the generation of the ecosystem services desired.

In the German cases selected, the water quality is the ecosystem service of interest, the aim of PWES is to reduce nitrates concentration in water. Therefore, in one case agricultural practices are promoted reducing the application of fertilizers and in the other case organic farming is the strategy adopted to reduce the content of nitrates in water. In both cases a decrease of nitrates concentration has been registered. For these cases where it is aimed to fulfill with standards for water supply (limit of nitrates concentration), the traceability is important to decide about the continuity of the PWES.

On the other hand, Colombian cases are addressed to maintain and increase water quantity services. Both cases base their land use change activities on the *environmental land use plan of the watersheds*, where the optimal land uses are recommended according to biophysical and socio economic conditions of the watershed. It is expected that implementing the change to the optimal land uses recommended in these plans, the capacity of the watershed to provide the ecosystem services will improve. The traceability of increase of water flow in both cases does not show significant changes. Although one aspect to be inquired is the effectiveness of the land uses promoted on hydrological services, effects on ecosystem services can be of long term nature. Even though in these cases there are not traceable results yet, it does not represent a threat for the continuity of the PWES. According to information obtained from interviews, stakeholders are aware of the long term of results expected and are convinced of the improvement of watershed conditions with the activities promoted.

5.2 GROUP CHARACTERISTICS

In the set of conditions of the characteristics of the group, the influence of the watershed as complex CPR in the logic of enabling conditions for PWES is more noticeable. The fact of having two user groups of two different resources of the watershed implies different interests and roles of each group and therefore a different logic of enabling conditions. The different characteristics of both groups, up stream and down stream, are discussed below.

The argument behind the small size of the group having a positive relation with the durability of institutions is the "stronger ability to perform collectively" (Baland and Platteau

(1999:773), cited by Agrawal (2001:1657). The down stream groups of the case studies include the water users, represented by the water companies and in one case by water users for agricultural purposes. Other stakeholders of the down stream groups are the environmental agencies acting in all cases at the regional level, also forestry offices and those organizations that have been created to manage the institutional arrangement or acting as external consultants for implementing the activities.

In the four case studies a small size of down stream groups of 5 to 8 stakeholders has been observed. The groups are constituted by representatives of organizations, in all cases with a professional educational level, with technological facilities for communication and transportation and with access to information about the resource. It can be said that the small size of the group as a facilitating condition applies for the down stream groups of the cases under study.

However it is not the case for the up stream groups, with a range of 150 to 300 land users observed in the cases. PWES is an institutional arrangement with the objective to improve the watershed conditions to ensure the provision of ecosystem services. Therefore it is intended to involve as many land users from the up stream area as possible to generate an impact in the conditions of the watershed.

Here an aspect with respect to the correspondence of enabling conditions is discussed. Unlike down stream user group the land users up streams do not need to agree collectively on rules on the resource use. Thus the large size of the group, even representing challenges for the arrangement, is not as limiting as it would be in case they would face a collective action problem.

Moreover, in PWES the large size of the group in the up stream area is not identified as negatively relationship with the durability of the institution; (although it has to be considered that the size of the group is related to other aspects such as the size of the resource, the distribution of the land in the up stream area among other), a large group size for the cases under study is part of the core of the arrangement. The question for the emergence and durability of the institution is rather oriented to the availability of financial resources to cover the high costs that a large group size implies for the arrangement.

In terms of shared norms, from the point of view of up stream group members, they do not share norms of land resource use. The stakeholders of down stream group share norms about the improvement or maintenance of the watershed conditions and it facilitates the emergence of the PWES. It could be said that between the groups the shared norms take place with the PWES where they agree on certain rules for the watershed use as common resource through a compensation scheme.

In the four cases there had been past organizational experiences in the up stream group, before PWES implementation. This fact is seen as an advantage by the down stream group especially in the first step of the PWES. It facilitated the communication and diffusion of information when it was necessary to contact and inform the land users about the arrangement. On the other hand in the down stream group either the water companies or water users had previous contact or relation with the environmental agencies. For the two Colombian cases this factor was of positive influence for the emergence and design of the arrangement.

The condition of appropriate leadership was observed to be more relevant for the down stream group. It is the down stream group the one facing the collective action problem of maintaining

or improving the condition of the watershed to obtain the ecosystem services. Appropriate leadership is needed for developing the initiative to design a new arrangement, contacting organizations, identifying and compromising financial resources for the PWES. In the cases under study appropriate leadership on the side of water users was a key aspect in the development of PWES. There were in each case from one to three people that initiate the processes and were motivated to realize the project of the institutional arrangement.

The complexity of the watershed as CPR also implies no coincidence with some conditions. For example as mentioned by Kerr 2007, the interdependence and homogeneity of interest may not hold for the watershed. The dependence of the groups in PWES is unidirectional from the water users on the land users. And both groups have diverse interest in different resources of the watershed.

From the general sense it is easier to create a new institutional arrangement under situations of low poverty, this condition applies for the down stream group in the cases selected. While low poverty in up stream group may signify higher compensations amounts to be offered in order to incentive the participation of land users, as is the situation for the German cases. On the other hand, in one of the Colombian cases it has been observed by the manager of PWES that in areas with lower income the participation of land users is higher because it is identified as an opportunity to receive benefits from other source. In the other Colombian case the forestry activity is offered as a production alternative to coffee crops that were affected by the decrease of international coffee price. Several from the farmers interviewed join the PWES because they identified in it alleviation to the coffee crisis.

5.3 RELATIONSHIP BETWEEN RESOURCE SYSTEM CHARACTERISTICS AND GROUP CHARACTERISTICS

From this set of conditions the *overlap between user group residential location and resource location* and the *high level of dependence by group members on resource system* are considered. The former condition has a positive relation in a CPR management in terms of the facility to distribute the resource units, or to observe the state of the resource.

However, from the point of view of the unobserved appropriation of the ecosystem services made by land users, it can be said that this condition has more relevance for the down stream group. The overlap of residential location and resource location allow the water users to observe the changes in the resource but not the land users to realize about the effects on ecosystem services.

On the other hand, both groups have high level of dependence on different resources: land and water. But the down stream group is highly dependent on the ecosystem services provided by the watershed, affected by land uses. The high level of dependence on water quantity and quality was identified in the cases under study as a critical factor to initiate an arrangement with the land users.

5.4 INSTITUTIONAL ARRANGEMENTS

As explained above, PWES can be seen as an arrangement of rules on the watershed concerning the ecosystem services connected with land and water resources.

Because of the complexity of the watershed as CPR, some particular aspects take place in the definition of the rules. As already mentioned, the rules are designed by the water users (or down stream group) based on a compensation scheme. The other users of the watershed, land users, decide voluntarily to participate or not.

Because in the up streams area there is not a common property in play (at least in most of the cases), but many private properties, PWES proposes an individual negotiation with each land user. This is the strategy to deal with the mixture of property rights of the complex CPR.

The fact that the arrangement is voluntary and that land users have the option to decide the area of the farm to be included in the arrangement (as experienced from 3 of the cases under study), was identified as a positive factor for the participation of the land users.
Under these conditions the activities are implemented according to the specific characteristics of the farm and considering the criteria of the owner (it is not the same for a land user with a property of 30 ha. of extension to plant 10 ha. of forest as it is for a farmer with 12 ha.).

Concerning the condition *rules are easy and simple to understand* it can be said in general that it applies for PWES rules. They are based on the conditionality principle of Wunder (2005:3) in his definition of PES: the payment is completed "if and only if the provider continuously secures the provision of the service".

However, the format of the contract or arrangement will depend on each case. In two of the cases under study it was observed that land users are confronted to a complex contract of several pages. Both cases are financed with public resources and need to fulfill more strict rules to follow the standards of public organizations to control the investment of financial resources. This long contract format implied for the farmers an increase of transaction costs in terms of time to sign the contract, in some cases the consultation of lawyers or the advice from the experience of other farmers that had already signed the contract or to consult the organization in charge of the PWES.

Regarding the condition of *ease in enforcement of the rules*, it is taken as the ease of application of agricultural practices or land use changes. It was found in the cases under study that each organization in charge to promote the enforcement of the rules counts with staff, or a division in the project to provide technical assistance to the land users.

The technical assistance is a decisive factor of the success of PWES. For example it is a critical factor in a Colombian case where forestry activities were introduced in a traditionally coffee production area. Other example can be found in a German case where the total area of the farm has to be changed in to organic farming.

On the subject of *graduated sanctions* it is valid for the cases under study. The organizations in charge of the agreement (water companies, water users association, and other organizations) count with graduated sanction system. PWES search for the continue participation of the land users and extreme sanctions in first instance would not help to that purpose.

5.5 EXTERNAL ENVIRONMENT

The last set of conditions of Table 2. refers to the external environment. Two points of the condition of the state as stakeholder are discussed: *central government should not undermine*

local authority and *appropriate levels of external aid to compensate local users for conservation activities.*

PWES can be organized as users-financed or government-financed programs. In some cases the user-financed programs are completely independent from the state. In government-financed programs the role of the state can range from providing financial resources only, to active participation designing the arrangements as a stakeholder. From the cases under study the stakeholders formulating the PWES did not identify in the state an undermining authority. They identified either a supportive role of the state through different incentives that could be included in the arrangement or low participation given their expectations.

It could be said that depending of the type of financial sources of PWES the management approach can range from self-governing (the case of some users-financed programs) to co-management in government-financed programs.

6 CONCLUSION

The approach of enabling conditions for the sustainability of the commons offers a comprehensible structure to analyze PWES as an institutional arrangement. Nevertheless, because the complexity of the watershed as a CPR, a number of considerations have to be taken into account.

The main considerations are related with the fact that two user groups of two different interlinked resources of the watershed are involved in the arrangement; with the additional particularity of the unobserved appropriation of ecosystem services made by land users. This situation means the interaction of user groups with different interest and characteristics.

Some of the enabling conditions examined do not correspond completely with those proposed in the list of Agrawal. In PWES the collective action problem is faced only by one user group, the water users, who depend on the land users to obtain the ecosystem services. Some conditions related to the interaction of the users follow a different logic for the group of land users and are even contrary as it is the case of the large size of the group up streams that is in identified in PWES as a positive condition.

From the information of the case studies a number of enabling conditions are recognized to have higher relevance for the durability of PWES like the high dependence on the resource, appropriate leadership and the availability of financial resources (appropriate levels of external aid to compensate local users for conservation activities).

In general, the group up stream of the case studies recognized as important condition the transparency of rules with the contracting part of the down stream group. Other condition is related to the easy in enforcement of the rules where the technical support provided to the up stream group is crucial for the enforcement of land use changes and new agricultural practices.

From the analysis made in this paper it is acknowledged the relevance of the resource system in the design of the institutional arrangement and its implications are accounted in the examination of the enabling conditions. The considerations described contribute to the analysis of an institutional arrangement in the watershed as a complex CPR and they may be helpful as well for institutional analysis of other complex CPR.

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