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Payments for Environmental Services (PES) and the Characteristics of Social Ecological Systems: the Case of Lake Naivasha Basin

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Abstract

After a brief description of the ecological problems faced in the Lake Naivasha basin in Kenya, this paper describes shortcomings of existing environmental policy instruments employed by the Kenyan government. We argue that under certain conditions a bargaining process among commercial resource users at the lake and farmers at the upper catchments could enhance the robustness of this specific social ecological system (SES) by making use of Payments for Environmental Services (PES). The necessary conditions are: lake users' perception of damages from permanent environmental problems like siltation and eutrophication that can be addressed by actions in the upper catchment, a minimal back up from the government that allows user groups to enforce their own rules, and a sufficient level of trust inside and between the different user groups. At the same time, the analysis identifies substantial obstacles for using PES to reduce water abstractions in the upper catchment and points out that the nature of the ecological problems and the societal situation at the lake interdependently determine the success probabilities of PES.

Keywords: institutions; social-ecological system; resilience; payments for environmental services

JEL classification: Q25, Q38, Q57.

1 Introduction

The region around Lake Naivasha in Kenya is a well-known RAMSAR-Site that, according to the RAMSAR convention (2011), is "an ecosystem very rich in biodiversity since it provides habitat for a wide range of terrestrial flora and fauna and aquatic organisms …" At the same time this area is home to a flourishing floriculture and horticulture industry and a population that has increased dramatically over the past 35 years, both around the lake and in the upper catchments. Together these developments have resulted in ecological problems stemming from siltation, eutrophication and drought besides substantial water abstractions for crop irrigation and household use. The ecological problems again lead to economic repercussions as, *inter alia*, water availability for farming becomes volatile and the reputation of the flower industry is negatively affected by media attention on ecological problems. The region therefore is an interesting example of a social-ecological system (SES) where the social system and its associated economic sub-systems mutually interact with the surrounding ecosystems.

Anderies et al., (2004) emphasize the importance of operational rules and collective choice processes in building the robustness of a SES. Robustness is defined as ''the maintenance of some desired system characteristics despite fluctuations in the behavior of its component parts or its environment'' (Carlson and Doyle, 2002) and is an economic variant of the many different definitions of resilience. The idea of linking institutions (formal and informal rules) to SES robustness is based on the perspective that institutions do constrain the behavior of resource users and thus not only influence the intensity of resource use, but also the incentives of human actors to initiate changes in the institutional system (Ostrom, 1990), therefore ultimately also influencing the adaptive capacity of a system. Institutions are carriers of social memory which is gathered over time through institutional learning and enhances the capacity of a system to adapt to change (Folke et al., 2003).

Lake Naivasha is an especially interesting case for looking into the functioning of different formal and informal institutions as it has a long-lasting history of formal regulations as well as of self-organized water user groups. Some of these groups are currently engaged in a pilot Payment for Environmental Services (PES) scheme between lake users and the upper catchment land owners which can be seen as an answer to shortfalls of the existing formal institutions. We use the example of these (PES) to look into prerequisites of such an informal solution as substitute for formal regulations and argue that the feasibility, viability and sustainability of such informal institutional solutions will itself crucially depend on the nature of the ecological problem.

This paper builds on data collected through a household survey, expert interviews, focus group discussions, and archival research conducted in the Lake Naivasha basin in Kenya between October 2010 and August 2011. It is structured as follows: Section 2 describes the research area, whereas section 3 provides a historical background of the agri-environmental institutions in the Lake Naivasha basin and the challenges encountered in the course of implementing these institutions. Section 4 discusses the prerequisites for a wider use of PES that have already been used in pilot projects, and relates them to the nature of the environmental problem at hand before section 5 concludes.

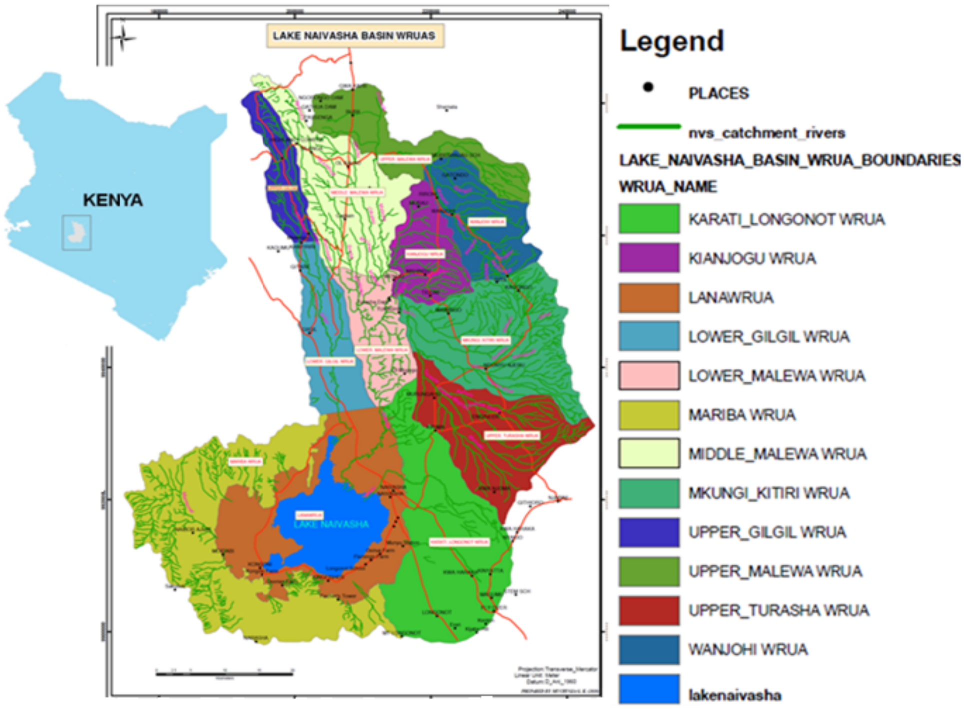
2 The Lake Naivasha Basin Social-Ecological System

Lake Naivasha is the second largest fresh water lake in Kenya and a Ramsar site located in the Rift Valley ($0^0\ 45'\ S,\ 36^0\ 20'\ E$) with a basin approximating 3400 Km^2 (Figure 1). The Lake basin can be viewed as a SES with coupled ecological and social systems, with strong interdependent feedback mechanisms. The basin ecosystem is composed of an endorheic fresh water Lake system, with a main Lake, a semi-separated sodic extension (Oloiden Lake) and a separate sodic crater Lake (Sonachi). The inflow into the main Lake comes from two rivers (Malewa and Gilgil) which enter the Lake through a riverine floodplain. The main Lake is a freshwater wetland with fringing shoreline vegetation dominated by swamp species, *Cyperus papyrus* (Harper and Mavuti, 2004) and many other floating wetland plants and submerged species. The river delta vegetation plays an important role in regulating incoming materials such as dissolved and/or suspended nutrients and sediments. The separate sodic Lake is dominated by blue-green algae and soda-tolerant plants.

The RAMSAR convention (2011) describes the Lake Naivasha ecosystem as very rich in biodiversity since it provides habitat for a wide range of terrestrial flora and fauna and aquatic organisms all which play an important role in sustaining ecosystem services and supporting anthropogenic activities. The Lake basin supports a vibrant commercial horticulture and floriculture industry, whose growth has accelerated greatly in the past two decades due to good climatic conditions and existing links to local and international markets for vegetables and cut flowers. The industry promotes economic growth and livelihood support in the basin by offering employment and income opportunities and engagement of small holder farmers in out-grower schemes. Further, the Basin supports tourism, fisheries, and pastoral and small holder subsistence food production systems. Irrigated floriculture occupies about 5025 ha around the Lake (Reta, 2011) while small scale farms averaging 2.5 ha dot the entire basin, especially on its upper catchment. Another integral component of the social system consists of the rules governing resource extraction and use, and the infrastructure providers, namely: government organizations, intermediary organizations (NGOs) and resource user groups.

The growth of the horticulture industry was accompanied by an average annual population growth of 6.6% from 237,902 people in 1979 (WWF, 2011) to 551,245 in 2009 (KNBS, 2010). This rapid population growth is responsible for the mushrooming of unplanned settlements around the lake and the problem of sewerage and solid waste disposal often associated with such settlements.

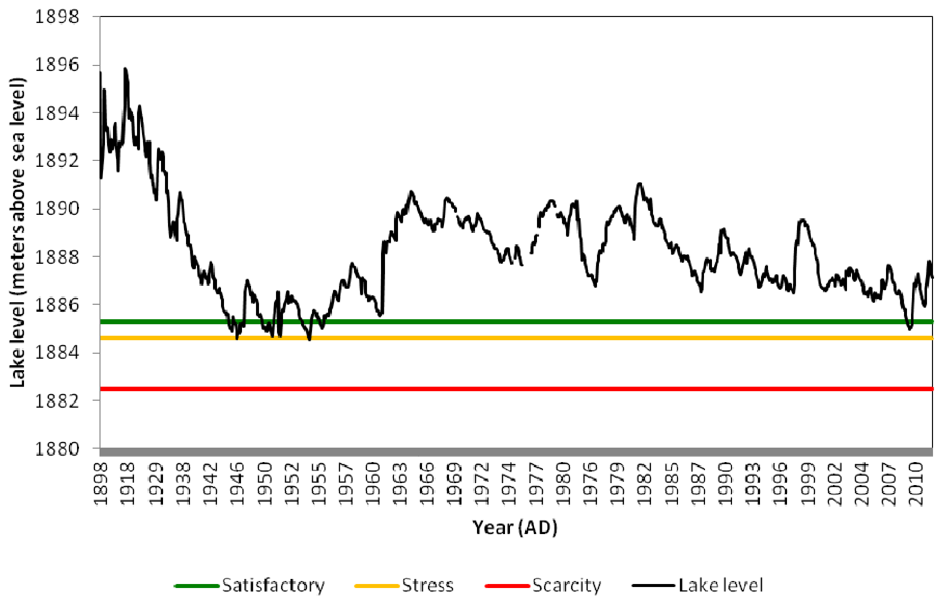
Figure 1: Lake Naivasha basin showing the 12 Water Resource Users Associations



Expansion in agriculture around the lake has also had a negative impact on the quantity of water resources in the basin. Becht and Harper (2002) demonstrate the impact of water abstractions on the Lake level. Their model shows a deviation of observed lake level from the simulated level since the onset of intensive flower industry around the Lake in the early 1980's and estimated a drop in the long term average Lake level by 3-4 M as a result of abstractions. Water abstractions play an important role in determining the long term lake balance. The Lake level is highly volatile and mainly depends on natural conditions (rainfall, surface inflow, evaporation and subterranean discharge) and human abstractions (irrigation and domestic use). The impact of water abstraction is likely to be felt more during periods of low rainfall hence reduced surface inflows. In a dry year, the lake would lose 37.5% of its average volume with abstractions and 25.1% without abstractions. During the wettest years however, the Lake would actually gain, with or without abstractions. In the long run, the Lake level would reach a stable equilibrium in the absence of abstractions (Becht and Harper, 2002; Mpusia, 2006 and Yihdego, 2005).

To respond to the impact of water abstractions on the lake level, a water allocation plan (WAP) was developed through an initiative by the Lake Naivasha Growers' Group (LNGG) a local users' organization. The WAP sought to align water abstractions with the status of water resources at any point in time. As indicated in Figure 2, thresholds were established using the traffic light system. Green indicates satisfactory status (>1885.3 masl) and users can abstract up to the maximum permitted quantities. Amber indicates stress status (1884.5-1885.3 masl), where restrictions are imposed on the amount to be abstracted, while red indicates scarcity level (1882.5-1885.5 masl), with no abstractions allowed. However, it is obvious that the red line is defined in a way that it has never be neared in the last hundred years, whereas lake level has declined to the stress status during the 1940's and 50's as well as around 2009. In both periods climate conditions have played an important role.

Figure 2: Lon-term levels of Lake Naivasha and the WAP water abstraction thresholds



Since 1947, the total cultivated area has grown tremendously not only around the lake, but also in the upper catchment, resulting in a negative influence on quality and quantity of the lake water. Settlements in the catchment area have grown during the last 5 decades, with an estimated 490,000 people (or 75% of the total basin population) living in the catchment by 2009 (KNBS, 2010 and WWF, 2011), farming over 210,000 ha.

Expansion of crop land into sensitive areas such as steep-slopes and riparian land is responsible for increased soil erosion leading to siltation/sedimentation in the water bodies (Becht, 2007 and Stoof-Leichsenring et al., 2011). Anthropogenic impacts on the ecosystem are evident with a rise in sediment yield in the past 5 decades, from 1.3 tonne ha^{-1} $year^{-1}$ in 1947 to 8.9 tonnes ha^{-1} $year^{-1}$ in 2006 (Stoof-Leichsenring et al., 2011). Within the 50 year period, approximately. 3.4 million tonnes of sediment have been deposited into the Lake. Given the shallow nature of the Lake, it is obvious that although siltation may not cause an alarming impact on the lake depth, it is likely to affect the turbidity of the lake water with indirect influences on water use for human activities, fisheries, tourism and agriculture.

Over the same period, Kitaka et al., (2002) show that due to continuous nutrient (N and P) deposition, the Lake has degraded into a eutrophic status. Eutrophication and siltation cause poor light penetration, restricting water use for fisheries, drinking and recreation. Poor light penetration, together with the introduction of alien species such as Cray fish, is also responsible for extinction of benthic flora (Macrophytes) which were an important component of the ecosystem (Becht, 2007).

In the subsequent sections we concentrate on these negative influences on the lake that stem from activities in the upper catchment because the payments for environmental services that have emerged in the basin are also addressing this relation.

3 Performance of agri-environmental institutions in the lake Naivasha basin

The institutional framework for environmental management in the Lake Naivasha Basin consists of both formal and informal institutions which can be traced back to the late 1920's. In this aspect the situation for making use of collective action to support or replace government action is very favorable compared to many other regions in the world. Nevertheless, as we will see, there still remain many obstacles.

3.1 *Assessment of the performance of formal environmental institutions*

Formal environmental institutions started with the Water Ordinance of 1929, which was designed, implemented and enforced by the colonial government through water bailiffs. This legislation was later revised into the Water Act, Cap 372 laws of Kenya which was enacted in 1952. The rules therein were felt to be sufficient when most parts of the country did not face water scarcity and environmental challenges were limited. However, with increased pressure on the ecosystem as a result of economic development and population growth, numerous environmental challenges emerged which required redress through institutional change. The response to these challenges saw the enacting of the Environmental Management and Co-ordination Act (EMCA), 1999 and the Water Act, 2002 which repealed the Water Act, CAP 372 laws of Kenya. The new legislations introduced mechanisms for management of the environment and coordinate natural resources allocation. The water Act for example established rules for allocating water and water rights through water permits and volumetric water pricing. Theoretically, environmental pollution through agricultural and non-agricultural activities is also addressed comprehensively in these laws (GoK, 2002, 1999). A sample of these rules is presented in Box 1.

Box 1: A sample of rules obtained from 'Water Resources Management Rules, 2006'

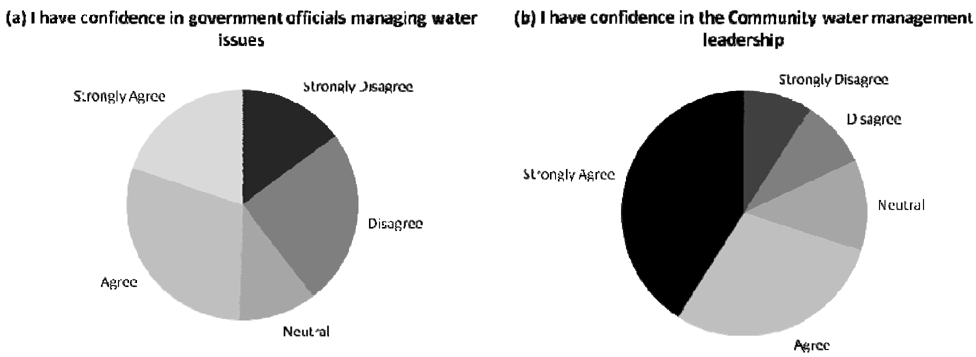
- Any person who intends to use water on large scale (Class B, C, and D) must obtain a permit.
- Discharge of any poisonous substance or effluent into water bodies is prohibited.
- All permitted water users are required to pay water charges depending on the actual quantities abstracted.
- Land users are required to protect any riparian zone on their land; some activities and tree types are prohibited on the riparian zone.

Generally, the governmental institutions set up in the Lake Naivasha basin to influence water abstraction are water permits and water charges. In spite of the comprehensive regulation compliance levels are very low. Currently, illegal water abstraction is ubiquitous, since only 8% of water abstraction points are legal (de Jong, 2011 and WRMA, 2009). Measuring devices for abstraction are quasi-non-existent. Further, the sedimentation rate has been on the upward trend, and so is the rate of eutrophication in the Lake. The state body WRMA lacks sufficient financial and human resources for effective enforcement of rules in the Lake basin. Therefore, attention is focused on a few and large actors around the Lake who are convenient to monitor. Moreover, discretionary power of the government agency is strong, resulting in a principal agency problem. Under these circumstances, incentives other than sound environmental management take priority. In this case and given the poor financial resources of the agency, one of the main objectives of the government activity is to raise finances to support the budget for its own operations. This might explain that collection of water fees tends to be limited to the biggest users in the basin, assuring that collections attain the budgetary targets.

The implementation of policies on soil conservation measures has also been a challenge. Despite the existence of many government policies to encourage soil and water conservation (GoK, 2002,1999,1955), soil erosion continues to be a major threat to sustainable food production in Kenya. Implementation of soil conservation measures across the country has been challenged by policy, demography and production related issues. On the policy side, there has been low investment in public agricultural extension services since mid 1980's (Milu and Jayne, 2006), coupled with low enforcement of institutions on soil conservation and long-term unresolved land tenure issues which all impede the implementation of erosion reduction measures. This description also characterizes the situation in the Lake Naivasha Basin.

The compliance to and consequently, the enforcement of institutions may also be influenced by resource users' *awareness of rules*, their *perceptions of the water scarcity problem* and the *confidence that they have in the body managing resources*. Results of an own survey indicate that about 57.8% of sampled land owners in the upper catchment of Lake Naivasha basin are aware of at-least one government rule touching on the environment while only 26.9% of the sampled water users were aware of the permit requirement. Further, respondents indicated to have higher confidence with communal officials managing water issues than the government officers (Figure 3). This result can be explained by the fact that people are likely to be confident with water management officials who are locally elected since they are accountable to the water users.

Figure 3: Water users' confidence in (a) government and (b) communal water administrators



As government authorities do not enforce the command and control institutions in the Lake Naivasha basin, the question arises in how far collective action institutions that have a long history at the lake could mitigate the problems stemming from unsatisfactory implementation of formal institutions.

3.2 *Assessment of the performance of informal institutions*

The first coordinated attempt to manage Lake Naivasha basin through user designed institutions was already in 1929, when the land owners around the lake founded the Lake Naivasha Riparian Owners Association (LNROA). Their key objective was to manage the Lake Naivasha environment by adjudicating the Lake riparian land as a way of limiting human influence on the Lake. The LNROA developed by-laws which were mainly self enforced, and also an agreement between the government and the LNROA was established to allow the British colonial land owners to use the exposed land below their riparian boundary for grazing, cultivation and for access to the lake (Enniskillen, 2002). At that time, the upper catchment of the lake basin was practically unpopulated and therefore there were no serious environmental threats to the lake originating from that end. Before 1950 AD, the lake could still sustain the existing human activities, even between 1944 and 1955 when the lake level declined by about 5 M (Stoof-Leichsenring et al., 2011 and Verschuren et al., 2000).

As from 1950 onwards, the Lake Naivasha basin entered into a new phase that was characterized by intensified anthropogenic influences. As from that time, commercial irrigated agriculture started to emerge in the basin and has ever since exhibited rapid growth especially around the Lake where the area under irrigation has displayed an average annual growth of 17.0 % between 1975 and 2009 (Reta, 2011).

During this phase of intensified anthropogenic activities in the basin communal organizations for water provision started to emerge in the upper catchment in the 1970's. Popularly known as community water projects (CWA), these initiatives were a replication of the co-operation around the Lake, but with different goals. Their key goal was to provide domestic and irrigation water to their members, guided by self crafted and enforced rules (see examples for these rules in Box 2). Our survey in the upper catchment revealed that 70.8% of the sampled households were members in these water projects.

Box 2: A sample of community water project rules extracted from group bi-laws

- All water users are required to use water efficiently and avoid wastage.
- Irrigation during the day is prohibited.
- Vandalism of water system is prohibited and all members are required to report any form of vandalism and/or damages noted on the water system.
- Members are prohibited from allowing non members or members whose water has been disconnected access to water.
- All people are prohibited from blocking/obstructing a water course hence denying downstream users access to water.

Further, self organization continued among water users around the lake, with emergence of the Lake Naivasha Growers Group (LNGG), an association of horticultural and flower farms in the Basin. The LNROA was also restructured and renamed Lake Naivasha Riparian Association (LNRA) to extend membership beyond land owners. The idea of involving water users in environmental management (specifically in water management) received a boost when the government, through the Water Act 2002, established 12 Water Resource Users Associations in the basin (refer to Figure 1). The WRUAs were established to assist the government in monitoring and enforcement of rules at sub-catchment level. The WRUAs, LNGG, LNRA and other stakeholders have developed rules and codes of conduct/practice to enhance sustainability. For instance, the LNGG code of practice reads in part..... ‘‘*The aim of the code is to guarantee that crops are grown under sustainable environmental conditions, with a focus on sustainable* *developments that provide for a safer and better environment, which includes water, land, air, flora, fauna, and the human labour force*''[1]. However, an interesting question is whether these institutions have achieved the stipulated objectives, an aspect we briefly assess in the next section.

Through self organization and self regulation, the flower industry in Lake Naivasha basin has managed to successfully create initiatives for sound environmental management. The LNGG has been instrumental in implementing its code of practice among its 21 members and in the implementation of the development of theWater Allocation plan (WAP) (WRMA, 2010), with the support of WRMA. Most of the farms are also currently using water saving technologies such as drip irrigation and hydroponics in-line with the broad goal of sustainable water use. Some farms have also invested in systems for recycling and UV treatment of irrigation water. Similar efforts to enhance sustainable water use is also found among the water projects, who have also established rules to encourage efficient water use, some of which were summarized in Box 2. We see that self-organisation has to some extend been successful around the lake and among the community water projects in the upper catchment.

The newly established WRUAs, which in principle are better placed to enhance establishment of basin wide cooperation because of their size, are yet to gain substantial communal support. From our survey, membership into WRUAs was estimated at 48.4 % of sampled water users. From these, about 62.4% indicated that they were benefiting by being WRUA members citing better access to water and training opportunities on water conservation as the major benefits. Overall, 48.4 % expressed satisfaction in the performance of WRUAs in water management, 21.7% were dissatisfied while the rest were indifferent. We note that

[1] LNGG code of Practice available at: http://lngg.org

popularizing of the WRUAs to gain wide spread acceptance could further boost self organization efforts, and play a key role in basin wide collaboration.

A pilot PES scheme that was established in 2010 within the basin can be used to demonstrate the role that WRUAs can play in establishing upstream-downstream institutional arrangements for dealing with agri-environmental problems. The PES scheme was initiated by two intermediary organizations, WWF and CARE –Kenya and sought to establish a financial mechanism for delivering environmental benefits and improving livelihoods in the basin. The pilot project involved one WRUA located downstream as the ecosystem beneficiary and two upstream WRUAs as ecosystem stewards. Contracts were negotiated where the upstream stewards agreed to engage in land use practices that would enhance water quality and quantity, given that the beneficiaries would compensate them for the income foregone. The agreed activities included rehabilitation and maintenance of riparian land; planting of filter grass strips and construction of terraces to prevent run-off; better use of fertilizers and pesticides and tree planting. In the next section we will discuss the possibilities and prerequisites for the emergence and expansion of payment for environmental services between the lake users (as the buyers) and farmers at the upper catchment (as the sellers) from a theoretical perspective. A comparison with the actual PES in place allows a first assessment about how the theoretical reasoning fits to the reality at the lake Naivasha basin and could be generalized to other SES.

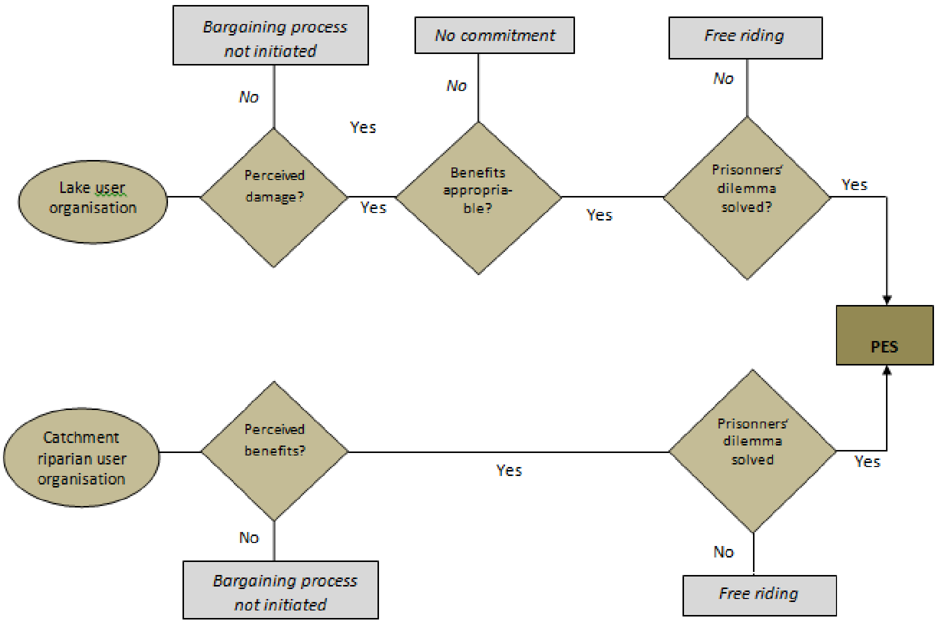
4 Prerequisites and possibilities for Payments for Environmental Service at the lake Naivasha Basin

Figure 4 shows the different conditions that must be fulfilled by buyers and sellers in order to arrive at a contract on PES. In our context, negotiations occur between the lake water users who are the buyers, referred to as “lake users”, and the sellers consisting of land owners adjacent to the feeding rivers in the upper catchment, called “riparians” here.

Without any assignment of property rights from the government we have a de facto laissez-faire situation (Coase, 1960), where all property rights are assigned to the polluters (or the first abstractors): The lake users are the victims of the actions of the riparians at the upper catchment. It therefore follows that they will generally be the ones to take action if they want the situation to change.[2] A first condition for any Coasean bargaining process between a buyers' group and a sellers' group is therefore the perception of the users that the action of the possible contracting partner inflicts a damage on them that warrants action. Majority of water users around Lake Naivasha face three main environmental problems: water shortages, eutrophication and siltation. Water shortage is a non-permanent but recurrent problem while eutrophication and siltation are permanent but slowly occurring processes which may endanger the usefulness of the lake. In the short run, siltation on the Lake water may directly impact on the cost of purifying (highly turbid) water to avoid plugging of drip emitters and water pumps by silt.

[2] Due to prohibitively high transaction costs there is no possibility for a user to act alone and as there are already existing user organizations at the lake we are assuming that users are already part of a user organization or could be organized in one so that we do not consider the formation of user organizations as a further step in arriving at PES.

Figure 4: Necessary and sufficient conditions for arriving at a PES contract in a Lake Basin



Siltation and eutrophication also threatens flora and fauna in the lake ecosystem, which has an impact on tourism and fisheries sectors. Siltation affects the populations of clear water species while eutrophication has caused emergence of alien species such as water hyacinth which raise the cost of fishing by increasing the effort per catch and disrupts boat movement. It can clearly be seen that the environmental problems highlighted may impact on profitability across all sectors although the scale of these impacts will vary with the problem and the sector affected. Environmental effects that do not result in a change of profit will generally not be taken into account by users.

By themselves, lake water users can mitigate impacts on water quantity and also nutrient load since these problems originate from both upper and lower catchment. However, siltation can only be addressed through measures implemented in the upper catchment, where the bulk of the problem originates from. It is possible that reduction of water abstraction as well as of nutrient load might be possible at lower costs in the catchment, therefore it is necessary for lake users to seek cooperation with the upper catchment.

Even if the actions of the riparian farmers at the catchment negatively affect the lake water users, they will only have an incentive to act if there is a possibility of appropriation of the benefits that stem from the action of the riparian farmer with whom they may want to contract. A contract between an upstream user group and a lake user group only makes sense if the results of the action can be appropriated by the lake users. In the case of reduced water usage upstream (mitigating the quantity problem) users that are situated at one of the feeder rivers between the two contracting user groups can easily use the surplus amount of water in the river. In the end, lake users, who come last in the asymmetric water access situation, may not get any additional water. Since water is a rival good and water abstraction cannot be prevented by the lake user groups, a contract concerning abstraction would only make sense if the whole feeder river can be included in the contract, probably a prohibitive condition. In the case of water quality (siltation and eutrophication) this is different. Quality aspects of water are a non-rival good. If water is abundant, but its quality (silt, nutrients) is not sufficient, the lake water user is not harmed by positive effects of improved water quality that may also accrue to other users along the river. Of course though, the outcome of the bargaining process will not be optimal if not all benefits of the contracted action are taken into account.

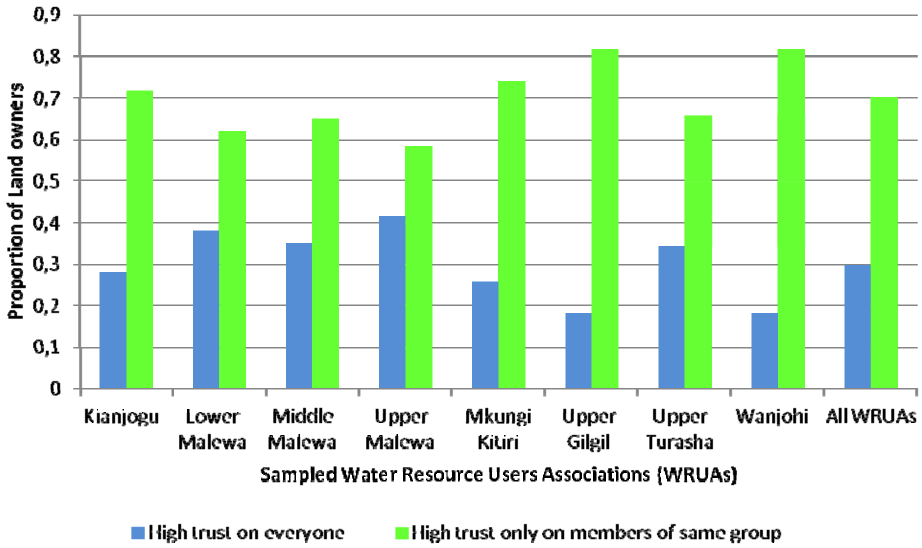
Even if the members of the user organization at the lake perceive that their total benefits from a contract are higher than the total costs they would have to pay in the contract, this does not necessarily mean that a majority of the users in the user association will vote for such a contract. As Olson, (1969) shows, fiscal equivalence is one possibility to overcome this problem, when the participation of a member to payments is oriented at the utility he will receive from the action (e. g. making bigger producers pay more than smaller ones). Still, the lake user organization has to overcome an internal prisoners' dilemma. That is, it has to be able to prevent free riding. The possibilities to overcome this problem are relatively good in user organizations, which are already an example of collective action. But as Ostrom (1990) shows, one of the conditions for successful collective action is a recognition and support by external formal institutions, which for example allows the user organization to sue members that are not paying their contribution.

To wrap up, a user organization will act as a buyer in PES if the total benefits of the contract are perceived to be bigger than the contracting costs (including transaction costs), if benefits from the contracted action will really reach the users paying for it, if a payment rule can be found that follows fiscal equivalence considerations and if there is enough formal and legal back up for the user group to prevent free-riding of its members.

In order to act as sellers, upstream users must as well be organized in user associations; otherwise transaction costs for negotiating contracts with individual riparians would be prohibitively high. In the lake Naivasha case, communal water projects as well as WRUAs could possibly act as sellers. Community water projects might even have an advantage as they are already accepted by the local users, but they are so small that other issues of distribution and increasing transaction costs arise. Again, the total gain perceived from the contract must be higher than the costs riparians would have to bear, and the distribution of contracted money (or other benefits) would have to be correlated to costs borne in order to ensure that all members agree to the contract. The riparian organization would then have to ensure that it fulfills the contract, which again means it has to prevent free riding (receiving money without contributing to the fulfillment of the contract).

It seems to be relatively easy to make payments to individual members of the selling group conditional on fulfilling certain actions. Members will agree to this if they trust in being compensated later, which makes trust among the members of a user organization an important prerequisite for collective action in this case. As we have seen, in order to undertake more substantial efforts which might include true (opportunity) costs, a certain level of trust between and inside the groups is necessary. From our survey, it emerged that about 70% of the sampled water users expressed more trust for members of their own groups as compared to those from external groups as indicated in Figure 5. High trust for members within the group would imply that members of the organizations engaged in the contract feel assured that once the buyers transmit the payments, there will be no misappropriation and hence they will access their share. However, the trust on external organization (the buyers) is also important and appeared to be low across the sampled WRUAs. Trust in this case could stem from the reputation of the buyer organization and past experiences. The pilot PES programs could be a good opportunity for building such reputation and hence trust if the buyers demonstrate commitment to their part of the bargain. Where trust between parties engaged in a contract is low, the problem might be mitigated if legal support from the government is reliable to ensure that the contracts are enforceable.

Figure 5: Within-groups and between groups level of trust among sampled water users in the Lake Naivasha basin



However, if payments are conditional on the fulfillment of certain conditions, it is necessary to conduct some monitoring of individual actions. Here again, Ostrom's design principle for successful collective action show that local groups may have advantages, if monitoring occurs through other members or through monitors who are accountable to the members (Ostrom, 1990) . Some measures that are promising to reduce siltation and nutrient inflow such as terracing, planting Napier grass or trees are easy to monitor but will not result in a change in water abstraction. In the case of the Lake Naivasha basin, where farmers may abstract water directly from the river or from boreholes that are not registered and have no measuring devices, controlling abstractions will be as impossible for water user organizations as it is for government authorities, although members of the user associations have an advantage in detecting non-registered boreholes. However, there are some measures that might reduce water use at the catchment and are easily observable, such as planting of crops which demand less water and converting cropland to pasture, or forest plantation. A problem with all those measures is that their effects might only be visible in the long run and not necessarily be directly attributable to the contracted action. This is even more relevant for measures concerning water quantity than for measures concerning water quality.

To sum up, like the buyers' group, the sellers' organization has to perceive higher total benefits than costs from the contracts, has to find a mechanism to distribute gains according to the costs incurred by individual members and has to enforce the obligation leading to payments. This means that activities that erosion prevention measures that are easy to observe have an advantage over those related to water abstractions, which are challenging to monitor.

Bringing together both sides, we see that contracted measures must be perceived by both parties to have a positive internal cost-benefit-ratio in order to agree on payments that will cover the costs. This will be easiest if most of the beneficiaries in the lake user organization are participating and it excludes payments for measures to reduce abstraction, as long as users situated between the contracting groups can capture the benefit from the contracted actions. There are different aspects that show an advantage of developing contractual arrangements on measures to prevent siltation and nutrient inflows:

- Quality improvements are non-rival and will therefore reach the contracting party.
- Measures to prevent siltation and nutrient inflow are much easier to monitor than obligations to reduce abstraction.
- In general these measures also generate a benefit to the land owners in the catchment because soil and nutrients are kept on his land, reducing the costs that have to be compensated.

A problem of these measures is that their influence on the profit function of lake users is not clear. Although it is clear that eutrophication and siltation have long term implications on the ecological health of Lake ecosystems (Smol, 2002; Stoof-Leichsenring et al., 2011 and Verschuren et al., 2000), there is still not very clear documented information on the magnitude of the impact of siltation and eutrophication problems on different commercial activities. This might reduce the willingness of LANAWRUA members to pay. Another obstacle to a true PES is the difficulty to make members pay their contribution once the user association has decided to join a PES agreement. Both factors lead to reduced possibilities to pay for environmental services. Eutrophication has in the past caused sudden calamities such as massive fish kills as a result of oxygen depletion. This has had a negative impact on the reputation of the flower industry which may influence profitability indirectly. The location of the flower farms close to the Lake makes it convenient to link any negative event (e.g. massive fish kills) to the activities of the flower farms. Therefore it would be especially in the interest of the flower farms to address the eutrophication problem.

Comparing our reasoning to the PES program in the Naivasha Basin we indeed see that focus has concentrated on measures to reduce siltation and nutrient inflows. The payments induce measures which also yield direct benefits to the riparians in the catchment. Results from our survey show that land owners perceived soil erosion to be a problem in the basin as reported by 71.1% of the respondents. However, about 70% of the sampled households perceive soil conservation technologies as difficult to implement. Another problem that prevented these households from undertaking erosion prevention measures are insecure property rights on land. In our sample only 62.3% of all land owners have secure land ownership. In this situation, direct payments, even if they are low, have the potential to shift the balance to undertaking erosion prevention measures.

With our reasoning we can also explain that the money for the payments stems from rather few members of LANAWRUA, who are committed to the collective action initiative by being members of LNGG. However, these are not necessarily the members that directly get the highest benefit from the contracted measures. These big commercial water users also have an interest in sustaining negotiations with user organizations at the upper catchment that might allow them to further contract them on more measures to improve water quality. If government authorities fail, own action is the only other potentially viable possibility to reduce environmental problems. In this situation, due to transaction costs, functional user organizations are imperative for collaboration. Like in many other cases in the world, social capital on the micro-level could be a substitute for inadequate government action (Grootaert and Bastelaer, 2001 and Williamson, 2000).

As we have seen, any cooperation or contracting between lake users and riparians needs organized users and it needs trust inside and between the associations. The PES-scheme in the basin may only be small at the moment, but it creates possibilities for further cooperation. Also the role of siltation and nutrient inflow on the commercial activities on the lake seems not to be clear yet, which might be another reason why users are reluctant to engage in a more substantial program. In addition to the points discussed in this paper we find an involvement of the WWF and CARE-Kenya, who acted as a catalyst for this program, helping to overcome initial difficulties, by providing funding and coordination. They can be seen as a party interested in the direct environmental effect of the measures that will not be taken into account by the commercial users at the lake.

5 Conclusion

The Lake Naivasha Basin is faced with increasing problems regarding quantity and quality of the available water. An important reason for this situation is the insufficient enforcement of rules by governmental authorities. Under such conditions, self organization by users is one possibility to improve the management of the basin's water resources. The pilot PES scheme that has been tentatively started between LANAWRUA and two other WRUAs in the upper catchment is an interesting instrument here. The scheme is only possible because water user organizations exist. Though the existing PES scheme is small and of experimental nature, it is fostering the institutional infrastructure that might also be used for more important schemes. We can therefore identify self-organized groups as an important element in enhancing at least the short-term robustness of the lake Naivasha Basin SES. They compensate for the weaknesses of formal water institutions and, at the same time, create adaptive capacity to new problems through the building of mutual trust between heterogeneous user groups. Within LANAWRUA we find own initiatives to reduce problems of both quantitative water shortage and problems of water quality, but being an arrangement between numerous water user groups, the PES are only aimed at quality enhancing measures. We explain this with the character of water quantity as a rival good on the one hand, and with the opportunity to create win-win situations by pursuing almost any strategy to prevent siltation and nutrient inflow to the lake.

On a more general level, this analysis therefore shows the importance of the nature of the specific environmental problem for possible informal solutions as answers to shortcomings of the formal institutions. It is especially the non-rival characteristic of water quality which makes agreements on quality enhancing measures more feasible than measures directed at temporarily or permanently reduced abstractions.

Of course, this remains a second-best solution, improving matters only in a situation where the government does not enforce its own assignment of water abstraction rights and quality enhancing rules and measures. With self-organized

PES only those water users that are organized in a water user group pay, while more users might benefit from the environmental services generated, which leads to suboptimal improvements even in the short run. The situation aggravates if we consider the long run: The laissez-faire policy of the government de facto assigns property rights to those that cause the environmental problems. Those who use the lake have to pay for a change in the situation. This favors actors located at the lower catchment, where infrastructure and available workforce still enables them to competitively remain in international trade of horticultural products. This increases the already existing incentive for horticultural farms to move further upstream away from the lake. From an individual firm's perspective that has the advantage that more water may be available, especially if ground water can be used. PES that make lake water user associations pay for mitigation actions to those that are located in the upper catchment may enhance this effect, and with additional water abstractions at the feeding rivers reduce the water reaching the lake. In this case enhancing the short-term robustness of the SES may in the long run increase the ecological problems at the lake itself.

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