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Exploring the Causal Mechanism of Collective Action for Sustainable Resource Management

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Atsushi Hanatani*

Abstract

Studies of commons management make it clear that collective action for resource management is a highly complex process in which the impact of different conditions often will vary according to physical and socio-economic contexts. This paper attempts to contribute to the understanding of this process by exploring the causal mechanism of collective action through an examination of the *intervening variables* that connect contextual and policy factors with resource management outcomes in an indirect way. Using four hypothetical causal variables – a) degree of resource dependence; b) predictability of benefit flows; c) possibility of sanctions application; and d) possibility of trust building – and relying on the institutionalist framework, a comparative institutional analysis is applied to the community-managed rural water supply systems of two Senegalese villages. The analysis demonstrates that collective action is possible even when some of the facilitating conditions normally associated with successful commons management – such as resource scarcity and small/homogeneous user groups – are missing. It thus confirms that intervening variables are important for understanding the broader process of institutional change for sustainable resource management, and consequently to the crafting of more suitable policy interventions.

Keywords: collective action, community-based resource management, motorized water supply system, ASUFOR, Senegal

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Introduction

Since the mid-1980s, the community-based management (CBM) approach to resources, both natural and man-made, has become central in the discourse of development intervention, particularly rural development, in most African countries. Due in part to structural adjustment policies and to decentralization, the approach has been widely applied in most spheres of rural development activity in Africa, from natural resources management (e.g., forests, wildlife, fishing grounds, watersheds) to provision of productive and social services (e.g., irrigation systems, rural water supply systems, agricultural extension services, community health posts).

The CBM approach is grounded in the theory of common-pool resources (CPR) and collective action (e.g., Olson 1965; Axelrod 1981; Baland and Platteau 1996; Ostrom 1990, 1992; Ostrom, Gardner and Walker 1994; Wade 1987, 1988a). Well-established strategies, such as state control and privatization of natural resources, have been challenged by scholars who argue instead for joint management of resources. Strong interest in the establishment of lasting institutions for joint management has focused attention on identifying the physical and socio-economic environments/conditions under which sustainable resource management is more or less likely to succeed. Scholars have compiled a list of "design principles" applicable to real-world cases. Widely-known examples include Ostrom's design principles (1990), Murphree's CAMPFIRE principles (1997) and CBNRM principles developed by Shackleton (2001).[1]

Through these efforts to abstract generalized findings from case studies, it has become evident that collective action for CPR management is a highly complex process. As Stern et al. (2002) point out, the process is "multivariate, path dependent (i.e., historically contingent) and reflexive (i.e., alterable in important ways by the process of learning)" (pp.446-5). The main factors creating this complexity are the following: the vast number of conditions affecting collective action (facilitating or enabling conditions); the feedback relationships among those

[1] For a summary overview of these design principles, see Fabricius, 2004.

conditions; and the adaptive nature of both collective action and its object (e.g., the state of the resources) (Meinzen-Dick et al. 2004). Part of the problem is attributable also to the manner in which facilitating or enabling conditions are associated with resource management outcomes. According to Agrawal, most of these conditions are "expressed as general features of long-lived, successful commons management rather than as relationships between characteristics of the constituent analytical units or as factors that depend for their efficacy on the presence (or absence) of other variables" (Agrawal 2002, 49). Given the complexity of collective action, the influence of different conditions on resource management may vary in different physical and socio-economic contexts and also through the process of institutional transformation.

To gain a clearer understanding of what constitutes sustainable resource management, it is necessary to move beyond a general understanding of facilitating conditions and collective action. We must try to "connect the different variables ... in causal chains or [propose] plausible causal mechanisms" (Agrawal 2002, 46). Put differently, effort is required to "narrow the range of relevant theoretical variables and their interactions" and to "identify the most important causal mechanisms" (Agrawal 2002, 68). It is not enough only for researchers to have a more generalizable theory of commons management; but development policy makers and practitioners also should have a more precise understanding of the process by which policy interventions lead to resource management outcomes (Stern et al. 2002, 450-51).

This paper explores critical variables in the causal relationships that contribute to the enhancement of collective action for sustainable resource management by examining rural water supply systems management in Senegal. In that country, an institutional reform of motorized water supply systems managed by user-communities was introduced in the late 1990s, informed by theories of CPR, privatization and decentralization. To date, this reform has produced remarkable results in terms of the rate of water tariff collection and the amount of savings available to cover operational, maintenance and repair needs (Sarr 2008).

The southern Tambacounda region of Senegal was selected for in-depth examination because successful community-based management of water supply systems has been observed in part of that region even though two important conditions identified by past researchers as conducive to successful collective action -- resource scarcity and homogeneity of resource users -- are lacking. Southern Senegal is relatively humid compared with other parts of the country, so that the availability of alternative water sources mitigates villager reliance on water supply systems. The region is also ethnically, linguistically and culturally heterogeneous because it borders five countries (Gambia, Guinea-Conakry, Guinea-Bissau, Mali and Mauritania).[2]

The two case study villages have similar rainfall and social settings and the same institutional arrangements for water resource management, but they have shown contrasting performances, one positive and the other negative. The research question asked in this paper is as follows: With reference to hypothesized causal variables, how can such performance difference be explained, and in light of an analytical framework, how can the effects of new institutional arrangements be interpreted?

The paper is organized in the following order. Section 1 begins by reviewing recent efforts to identify causal variables for collective action and then develops a hypothesis that leads the subsequent analysis. The method used for case analysis -- the institutional analysis framework -- is also explained in Section 1. Section 2 presents a brief description of ASUFOR (Association d'Usagers de Forages), an institutional arrangement used in Senegal for managing rural motorized water supply systems.

The process of institutional change and the relationship of this process to the contextual backgrounds of the two villages are described in Sections 3-4. These are followed

[2] While we recognize that homogeneity of resource users as a favorable condition for management may include various other socioeconomic dimensions (e.g., religion, income/wealth), we focus on the fact that Southern Senegal is particularly heterogeneous in terms of ethnicity. In Africa, ethnicity is often regarded as one of the sources of identify and social cleavage.

by a comparative analysis of the two cases (Section 5) and by conclusions (Sections 6).

1. Existing arguments, hypothesis and analytical framework

(1) Existing arguments

At the turn of the 21st century, after more than a decade and half of enthusiasm and progress, the study of the commons had reached a point where researchers felt increasingly that a synthesis of findings and lessons was necessary (NRC 2002). Numerous case studies and laboratory experiments had been conducted and results produced, but the establishment of causation among key sets of variables was clearly still a challenge (Agrawal 2002; Meinzen-Dick et al. 2004; Stern et al. 2002).

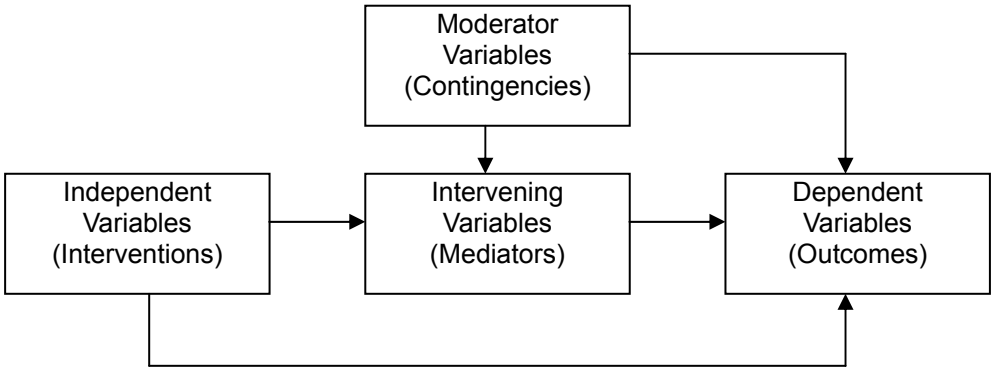
Agrawal (2002) presented illustrative sets of causal links in commons management after synthesizing and classifying factors identified by Wade (1988a), Ostrom (1990) and Baland and Platteau (1996) into four categories: attributes of the resource system; resource users; institutions; and external environment. In one such set of links, Agrawal defined durable institutions as functions of the following: (i) a high level of group interdependence; (ii) well-defined boundaries for the group and the resource; (iii) ease of rule enforcement; and (iv) government recognition. In another set of links, durable institutions were presented as functions of the following: (i) resource dependence; (ii) strong enforcement; and (iii) predictable flow of benefit. Though these models are not definitive, this effort to develop causal chains to explain collective action mechanisms has been of great value in narrowing the number of factors and advancing understanding of the relationships among them.[3]

Another effort to develop causal models that explain how certain characteristics of resource and user groups are linked to resource management outcomes was made by Stern et al.

[3] Agrawal himself acknowledges that these are not definitive by stating that "different analysts, depending on the context, may choose to highlight very different causal variables to explain the same phenomenon" (2002, 69).

(2002). Their study is notable for categorizing variables identified by previous studies according to their functions in overall causal relationships. The categories are presented as independent variables, dependent variables, moderator variables and intervening variables. The relationships among them are displayed in the following schematic diagram:

Figure 1. Schematic causal model proposed by Stern et al.



Source: Adapted from Stern et al. 2002 with modification by the author

In Stern et al.'s model, *independent variables* are those that can be altered by policy interventions, including institutional arrangement and technology choice. *Dependent variables* are the outcomes of collective actions essential for resource users, such as institutional durability, resource system sustainability, resource use efficiency, and equity of output distribution. *Moderator variables* are factors that cannot be altered by short-run policy interventions, such as characteristics of users and resource systems, but that may influence how interventions affect the intervening variables and outcomes.

Finally, *intervening variables* are those that directly affect dependent variables (outcomes) but which are influenced by independent variables (interventions) and moderator variables (contingencies). Intervening variables include user adherence to shared norms, ease/cost of monitoring the resource system and user behavior, and ease/cost of enforcing rules and sanctions, all of which directly influence resource management outcomes.

According to this model, while independent, moderator and dependent variables are mostly externally observable, intervening variables are best described as agents' subjective perceptions/judgments of the resource use and management situation. The theoretical significance of Stern et al.'s work is that it distinguishes types of variables in terms of their functions and clarifies their causal paths to the outcome. The inclusion of intervening variables helps to clarify that the effect of resource and resource user characteristics (independent and moderator variables) on resource management outcomes (dependent variables) are both direct and indirect in nature.

The focus in the present paper is on the effect of intervening variables – the central and most complex type – which directly affect resource management outcomes but which are influenced by independent and moderator variables. While much has been done to investigate the effect of the latter two types of variables on resource management outcomes, there has been much less consideration of the role of the former. As Stern et al. indicate, "many of the characteristics of resources and resource users that have been hypothesized to affect the success of institutions (however defined) do so only contingently and indirectly. Understanding the indirect effects is important for making sense of the inconsistent bivariate associations that are reported in the literature" (2002, 457). The present paper will therefore focus on intervening variables and attempt to evaluate their effects.

(2) Hypothesis

As a basis for the argument, a game structure is assumed that represents the collective action situations examined in this paper. Following Runge's (1984, 1986) suggestion, the game structure here is one in which the pay-off distribution is similar to that found in the "Assurance Problem" (AP).[4] While expectations of others' actions are obviated by dominant strategies in

[4] According to McCarthy, investments in community infrastructure sometimes have a game structure represented by AP (McCarthy 2004).

the single-period Prisoners' Dilemma (PD) game, it is implausible to assume a situation in which decisions to contribute to public goods are unaffected by expectations of the decisions of others, since for the provision of public goods jointness (among players) in supply is required (Runge 1984, 160).

As is well known, in the AP there are two equilibria: one is cooperation when the other cooperates as well, and the other is defection when the other defects as well. More precisely put, if each individual is assured that a critical mass of others will cooperate, he will have incentive also to cooperate (Runge 1986, 630). Hence, coordination is required among players to arrive at the Pareto-optimum equilibrium: cooperate-cooperate. In this game structure, however, the possibility of defecting while the other cooperates is not excluded, though the pay-off from this combination is lower than that obtainable from the cooperate-cooperate combination.[5]

Intervening variables conducive to collective action

In accordance with this game structure, four causal relations are hypothesized with regard to our four intervening variables: (i) degree of resource dependence, (ii) predictability of flow of benefits, (iii) possibility of applying sanctions, and (iv) possibility of holding trust with others. The first three are necessary conditions for the emergence of the pay-off structure represented by AP. They appear in one or both of Agrawal's sets of causal link, as noted above. The forth variable essential for a mutually cooperative strategy appears in another model developed by the same author, although expressed somewhat differently: as a "high level of group interdependence" (2002). Other of Agrawal's variables, such as "well-defined boundaries for the group and the resource" and "government recognition," are not included in

[5] According to Runge, AP is advantageous in capturing situations under repeated PD games, another game situation where cooperation is possible among players through a tit-for-tat strategy that "provides the simplest and most direct example of the sort of fairmindedness (i.e., preference for equal contribution) described by the AP, since one gives exactly as one gets (through tit-for-tat strategy)" (1984, 162). Tit-for-tat strategy is interpreted here as an expression of assurance that others will contribute their fair share, which provides the precondition for one to contribute.

our hypothetical model, as according to the conceptual model shown in Figure 1 these are moderator and independent variables respectively, not intervening variables.[6] Our hypothesis is that the higher the degrees of the four variables specified above are, the greater is the probability of successful collective action for resource management.

(i) Degree of resource dependence

Of the causal variables that aid the emergence of collective action, most studies seem to agree that a high level of user dependence on resource systems is important (Agrawal 2002; Fujiie et al. 2005; Wade 1988a). According to Wade's study of Indian canal irrigation villages, villagers demonstrate greater corporate organization in areas where the density of grazing livestock is higher (hence, greater dependence on limited land) or where reliability and adequacy of water supply is lower (hence, greater dependence on limited and unreliable water) (Wade 1988). Other conditions that are cited as relevant to degree of dependence include low level of articulation with the market for paddy irrigation villages (Fujiie et al. 2005) and low level of availability of substitutes (Agrawal 2002); both inferring a low availability of exit options for collective action. Contextual situations may vary, but resource users are likely to feel more inclined to establish cooperation when they are heavily dependent on the resource because the amount of benefit they can expect from cooperation exceeds the perceived cost to them of organizing the cooperation (Wade 1987, 1988a).

For a pay-off distribution similar to AP to emerge, the value of a pay-off obtainable from mutual cooperation must exceed that obtainable from a defection-defection strategy. If the value from mutual cooperation is lower than from the defection-defection combination, the situation is unsuitable for PD or for AP, and the best course of action is *not* to cooperate at all.

[6] "Well-defined boundaries for the group and the resource" are considered conducive to enabling monitoring and sanctioning of free-riders, hence they enhance the "possibility of applying sanctions". In this sense, neither condition corresponds to Stern's definition of intervening variable. Moreover, the type of resource dealt with here – infrastructure – is highly conspicuous in rural communities and the status of its functioning is easily monitorable by resource users. On the other hand, "government recognition" can be taken as a given, since ASUFOR is promoted as an official form of management by the government of Senegal.

With regard to the present case analysis, the availability of alternative water sources (e.g., surface water, rain water, water from shallow wells) may constitute an important factor influencing the degree of dependence on water from water supply system. The level of perception of hygiene might be another factor, since those who are hygiene-sensitive might prefer to rely on safe borehole water regardless of the availability of other sources.

(ii) Predictability of benefits flow

Even if one is aware of the net cooperative benefit, this might remain only a possibility for the future, not a persuasive reason for a doubtful person to engage in cooperative action now. To be sufficiently motivated, the doubtful person must be convinced that cooperation will actually bring the expected benefit, or that the probability of the benefit being realized is relatively high. In this connection, it is important to note the discussion by Blomquist et al. (1994) of the relationship between type of resource system and collective action. They suggest that resources that are "stationary – storage available" – are more conducive to collective action, not only due to ease of assessment and monitoring of the system's status, but also because the probability of future realization of the benefit is high. For example, resource storage is said to affect the resource users' willingness to cooperate by increasing the certainty that they will capture the benefit of their efforts (ibid., 314). A low probability of capturing the benefit, in turn, will reduce the present value of the future pay-off and accordingly the motivation to cooperate.

Users of water supply systems need a sufficient degree of confidence that their contributions to facilities maintenance will actually bring the expected benefit – a flow of water of sufficient quantity and expected quality. No matter how eager users might be to use water from the water supply system, if the chances of getting that water are low for other reasons – disrepair of the facility or deterioration in water quality – they will be less motivated to participate in any joint effort to maintain the facility.

(iii) Possibility of effective sanctions

With regard to intervening variables that are critical for sustaining institutions, again there seems to be general agreement on the importance of rule/sanction enforcement. Both of Agrawal's illustrative models mentioned above indicate "strong enforcement" as a factor for durable institutions (Agrawal 2001, 2002). Stern et al. give even greater importance to rule/sanction enforcement (Stern et al. 2002). Among the five intervening variables they list, three are directly related to rule/sanction enforcement (ease/cost of enforcing rules, user understanding of rules and sanctions, ease/cost of monitoring the state of user behavior). Furthermore, one of the two remaining variables, user adherence to shared norms, is again an expression of the importance of sanctions, for the actual existence of a norm implies a backing by sanctions (e.g., Coleman 1990, 266).[7]

This is intuitively understandable because collective management requires that free and unlimited access to and use of a limited resource be restrained. In addition, from the game theory point of view, the payoff from free riding has to be suppressed by some form of sanction (law, guilt, shame, reputation, etc.) to a level lower than that obtainable through a mutually cooperative strategy. From the perspective of the resource user, there must be a sufficient level of expectation that effective sanctions will be imposed in cases of rule violation, thereby reducing the incentive to free ride.

With regard to the present case analysis of rural water supply systems, sanctions are applicable to those who fail to pay the water tariff, levied primarily in the form of bans on defaulters from fetching borehole water and/or charges of fines by the management committee.

(iv) Possibility of holding trust

Many studies seem to concur that trust, or some form of social capital, also is a

[7] This does not mean, however, that the norm has to be backed by sanctions at all times. It is sufficient for a norm to become effective that people generally hold that there exists a potential for enforcement of sanctions. According to Coleman, "to say that there is an effective sanction does not imply that a sanction is always effective or effective for all target actors, but that it is effective for at least some target actors some of the time" (1990, 266).

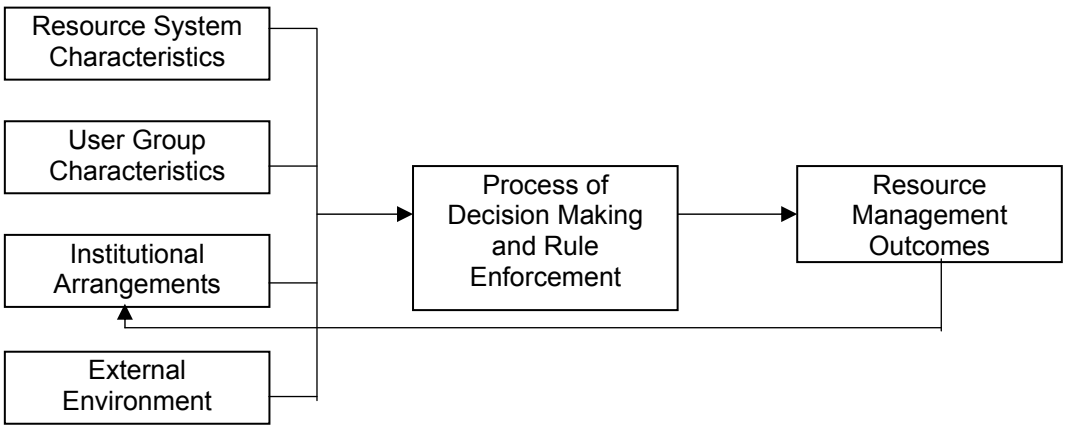
necessary ingredient in successful collective action (Wade 1988a, 1988b; Baland and Platteau 1996; Agrawal 2002). Ttrust here is defined as "a quality of confidence in a relationship which permits one party to act before knowing that the other will behave as promised" (Wade 1988b, 489). Whether it springs from moral obligation, past successful experience with cooperation, or a sense of reciprocity, there has to be a sense in the minds of resource users that "[most] others can be trusted to do their share [and] to abide by the rules" (Wade 1988a, 196) before they feel willing to do their share. Many of the attributes attached to "communities" are related to the holding of trust among group members. Small size, cultural homogeneity, frequent communication, and dense social networks – commonly-held properties of "communities" and conditions for collective action – all point to the likelihood that trust will be shared through face-to-face interaction, reputation or reciprocity.

Again, in the AP structure in which each player is presented with two equilibria – one a cooperation-cooperation strategy and the other a defection-defection strategy – trust in other players is vital in bringing about a mutually cooperative strategy.

(3) Framework and methodology for case analysis

With the causal model of collective action and the hypothetical intervening variables in mind, this paper now examines the usefulness of these by looking at actual cases of resource management, where multiple actors with multiple interests interrelate to develop, adapt, and enforce institutional arrangements. To analyze and understand more systematically the complexity and dynamism of institutional change and to help structure the empirical information, we use an analytical framework which allows contextual factors to be separated from action. It is informed by the "Institutional Analysis and Development" framework developed by Ostrom et al. (1994) and also by the one developed by Agrawal and Gibson (1999). Figure 2 displays this framework.

Figure 2. Framework of institutional analysis for resource management



Source: Adapted from Ostrom et al. (1994) and Gibson and Agrawal (1999) with author modification

The important feature of this framework is that it helps us to grasp the physical, socio-economic and external contexts in which interaction creates and deploys the institutional arrangements that shape collective decisions and action (Andersson 2006). These contextual features correspond to the independent and moderator variables discussed in Figure 1. For a better understanding of factors critical to the success or failure of local resource management, attention is paid also to interaction among actors: i.e., "Process of Decision Making and Rule Enforcement" (Agrawal and Gibson 1999). It is precisely in this process that the intervening variables discussed above perform their functions in the minds of the actors. In subsequent sections, this paper examines two cases through the lens of this analytical framework.

The data is taken from a qualitative survey conducted by the author in two villages in Tambacounda, a south eastern province of Senegal. The survey was conducted during the period September-October 2009. The two villages share many characteristics. They are located close to each other, at a distance of only 25 km. They are at almost the same latitude of N13°19'.[8] And they have similar rainfall conditions. The region is relatively humid and other

[8] In Senegal, isohyetal contours run almost paralell to latitude; hence one can expect similar amount of rainfall for the villages located on the same latitude (Agence Nationale de la Météorologie du Sénégal: ANAMS, Gamble 1957).

sources of water besides the motorized supply facility are available. The ethnic composition of both villages is heterogeneous, an important factor that can affect the norms and trust of resource users. Furthermore, the same institutional arrangements of infrastructure management have been applied by the government to thevillages' water user communities.

The survey included interviews with individual villagers, focus group discussions with leaders and water user association (WUA) officials, and participant observation.

2. Institutional arrangements of water supply system management

(1) Rural water supply systems in Senegal

One of the unique characteristics of rural water supply systems in Senegal is that they rely extensively on borehole water and motorized pumps. This is because due to Senegal's particular hydro-geological characteristics, exploitable aquifers in most part of the country are located deep underground (between GL –200m and GL –400m on average).[9] Today, there are more than 1,300 systems throughout the country, most of which are publicly owned but some of which are controlled by NGOs or private owners. The pumps are driven by grid electricity, internal combustion engines (diesel), or photovoltaic electricity. These systems serve approximately 4.4 million people (3,400 persons per system on average) in 5,100 villages. Water is delivered through 10,800 public standpipes and through 67,000 private connections. The total estimated output is 120,000 m^3/day (DEM 2009). In the southern Tambacounda and Kédougou regions, there are 130 systems (pumps).

In 1984, in accordance with a structural adjustment policy, the government withdrew from operation and maintenance activities and transferred management responsibilities to WUAs, then called "Comités de Gestion" (CdG). The government, however, retained infrastructure ownership rights. In 1996 the Water Sector Reform was launched which further

[9] The case villages in this study benefit from shallow ground water level as they are located close to the Gambia River.

promoted decentralization by reinforcing democratic representation in WUAs and which also introduced private sector participation in facilities maintenance.[10] At this point, the name for the Senegalese WUAs was changed from CdG to ASUFOR.

(2) Institutional arrangements introduced under the reform

Pre-ASUFOR arrangements

According to a donor evaluation, during the period of the CdGs, most committees implemented a flat monthly rate for water use (Ministere de l'Hydraulique/Agence Francaise de Développement 2005). Specifically, depending on the committee, between 100-500 CFA francs per month was charged for each married woman within a compound called a "carré" (a unit of extended household comprising two or more nuclear families, unmarried males, migrant workers and occasionally religious disciples who live in the compound and share meals).[11]

Under this arrangement, people used as much water as they wanted because the amount of water consumed was not directly reflected in the tariff. Those from small compounds found the system unfair, however, in that they were paying the same as those from larger compounds and those with a large number of livestock regardless of the actual amount of water consumed. Moreover, users who did not pay were seldom sanctioned (i.e., banned from fetching water from the borehole). Even when sanctions were applied, the delinquent easily received assistance from other families in the same compound and from friends or relatives in the same village (such activity is generally tolerated among villagers in the spirit of mutual assistance.). Thus, people felt free not to pay and readily became free riders. Unrestrained use of water and tolerance for free riders meant higher running costs and longer

[10] The issue of private sector participation – contracting periodic maintenance out to private sector service providers – is not accounted for in this paper, though it is an interesting initiative.
[11] See Gersovitz and Waterbury, eds. 1987 for a definition. In this paper, *carré* will be referred to as "compound."

pump operation hours resulting in insufficient maintenance and shortened service lives of the facilities.

New arrangement under ASUFOR

The new institutional arrangement introduced in conjunction with the 1996 Water Sector Reform, including the establishment of ASUFOR, can be characterized by the following: i) reassignment of operation and maintenance responsibilities between the government and the users; ii) assessment of water tariff by consumption volume; iii) definition of boundaries between member users and non-member users; and iv) transformation of the WUA structure to promote broader and more direct user participation, thus making ASUFOR a true community-based organization.[12]

Firstly, under this arrangement the users and the government have distinct roles. The users undertake water supply system daily operations, routine maintenance, minor repairs and replacement of pumps and generators. The government, which is the legal owner of the facility, bears responsible for technical and managerial skills training to assist with ASUFOR formations, for monitoring of the operational and management status of facilities and ASUFORs, for technical support in the case of breakdowns, and for major infrastructure repair and replacement of boreholes and water reservoir tanks.

Secondly, the water tariff is collected according to consumed volume measured by meters installed at each water point. The unit price is set between 200-400 CFA francs/m^3 depending on the decisions of users in specific sites/locations.[13] The price includes direct running costs (e.g., fuel or electricity costs, remuneration for pump operators), routine maintenance costs (e.g., lubricants, spares) and major repair/replacement costs (e.g., repair of

[12] By the end of 2008, of the 1,215 government-registered sites that have motorized water supply systems, nearly 700 sites (57%) have shifted to this new arrangement with support from government and various development partners. Each of the new features is described here in detail.

[13] In this paper, CFA franc converts to 1 US dollars at the rate of 655 CFA francs per dollar (0.0015 dollar per CFA franc), based on the prevailing rate in September 2009.

submersible pumps, generators).[14]

Thirdly, upon launching an ASUFOR, all persons expecting to use the water system are required to register as association members and pay a membership fee (normally 100 CFA francs per member). In principle, only those who pay the membership fee are entitled to fetch water from the facility. The system intends to create a clear boundary for users and tightly control access to the facility.

Finally, there are three tiers of organizations within an ASUFOR, namely the General Assembly of users (Assemblée Général: AG), the Committee of Directors (Comité Directeur: CD), and the Secretariat (Bureau Exécutif: BE). The AG is ASUFOR's supreme decision-making body, held annually and open to all users unless otherwise specified. All important matters pertaining to ASUFOR management are discussed at this meeting, including adoption/revision of rules and tariffs, decisions on major repair/rehabilitation work, and approval of the annual accounting report. The CD is comprised of members representing various social and interest groups in the village (e.g., women's groups, pastoralists, ethnic groups, users of different water points) elected by the users. The BE is co-opted from among the CD members. BE and CD are supposed to meet monthly to discuss and make minor decisions on issues related to organizational operation, maintenance and accounting, with the outcomes of the meetings to be communicated to users. The entire CD and BE membership is renewed biennially unless otherwise requested by the users. With these participatory arrangements, downward accountability is enhanced.[15]

The next sections will look at two specific cases from the field to see how the

[14] According to the water supply system design manual prepared by the Government of Senegal, the standard water tariff includes the cost of operation (22%), replacement (21%), spares and minor repairs (12%), major maintenance (7%), and organizational expenditures necessary to run ASUFOR (37%) (PEPAM 2006).

[15] Before launching ASUFOR on a national scale, pilot projects were carried out in a semi-urbanized district of Dakar. This experimentation revealed a remarkably positive outcome in terms of enhanced WAU financial capacity. ASUFOR savings averaged about 10,000 US dollars per site, compared to an average savings of 0 to 5,000 US dollars in the rest of the country under the previous arrangement (Direction Nationale de la Planification 2008).

collective actions for resource management have developed and changed over time by applying the analytical framework presented in Figure 2. For detailed information about these two villages, see tables attached as Appendix.

3. The case of Dialakoto Village

Established by two families of the Socé ethnic group during the latter half of the 17th century, the village of Dialakoto is located alongside the national highway connecting the regional centers of Tambacounda and Kédougou in southeastern Senegal. The village currently has a population of approximately 3,600 people, 54% male and 46% female,[16] and 277 compounds. There are nine quarters (*quartiers*) in the village, each of which is occupied predominantly by one of the three main ethnic groups. These are Socé (43%), Diahanké (40%) and Fulbé (7%); a small number of Wolof and Serer also live in the village. The village is administered by the village chief (*chéf de village*), a hereditary position held by one of the original Socé settler families, who is assisted by chiefs of the quarters (*chéfs de quartier*) designated from among the elders in each area. Average annual precipitation in this region ranges from 700 to 1000 mm which reflects a relatively humid climate on the Senegalese standard. The main economic activities of the villagers include agriculture (both food crop and cash crop production), livestock husbandry, commercial activity and emigrant labor. Religiously, all villagers are Muslim.

(1) Resource system characteristics

A motorized borehole water supply system was first constructed in this village in 1980 with donor support. In 1999, this was expanded by the same donor, creating a dual water

[16] Part of the reason for the higher number of male population to that of female in case villages is attributable to the existence of talibés, islamic disciples – basically all male children and youths – adopted by imams, marabouts and other serious followers of islamic teaching (see, for example, Villalon 1995).

supply network with two reservoirs each having 50 m^3 capacity. Public standpipes are located at 13 different points around the village and there are a few private connections, each with a water meter (installed in 1999). The supply network, however, covers only five quarters of the village, leaving the remaining four without access to standpipes.

During 2006 little water was supplied to the villagers, due mainly to a shortage of funds to purchase fuel; furthermore, the system was out of order during much of 2008 due to a breakdown of the submerged pump. Even in 2005 and 2007, when the facilities were fully operational, the pump was run at an average frequency of only twice per month during the rainy season and four times per month during the dry season. When the average volume of water pumped in these two years is divided by the total population (potential users), it amounts to only 2.8 liter per person per day and 1.5 liter per person per day, respectively which is extraordinarily little compared to the designed standard of 35 liter per person per day.

In fact, a large proportion of the Dialakoto villagers have traditionally depended on water from shallow wells for domestic consumption, both for drinking and for cooking. Around 54% of all compounds have private wells (150 out of 277 households), in addition to 19 shallow wells available for public use. This is made possible by the high level of groundwater (at a depth of -10 to -12 meters), and water is available in these shallow wells the year around.

(2) User group characteristics

It appears that people belonging to different ethnic groups find it more comfortable to live separately in this village. For example, "*Coline*" is occupied by a single clan of Socé, and "*Barrycounda*" by a single clan of Fulbé. Three quarters are predominantly occupied by Socé, four by Diahanké and two by Fulbé. This is a situation dating back to the colonial period, when a Wolof colonial administrator dispatched from the capital was once rejected by the autochthon Socé. He then attempted to marginalize them by settling people belonging to different ethnic

groups in different areas of the village. Separation among different quarters is such that there are now nine mosques (*Jaka*) where daily prayers are conducted separately, except for the Friday prayer (*Juma*) when all the villagers assemble in the largest mosque.

Moreover, the practice of labor exchange for agricultural production beyond compound members is a limited phenomenon in this village, though some cooperate within their circle of clan members. Those who do not rely on labor exchange employ paid workers (*surga*), either from within the village or migrant laborers from outside. A taboo is observed on intermarriage between Diahanké and Fulbé on one side and Socé on the other. The latter is regarded by the former as late converts to Islam, lacking seriousness in learning the Koran, which deters the parents of the former from marrying their daughters into Socé families.

Findings from a small sample survey suggest that 80% of villagers use the private shallow wells mentioned above, including those who rely on the wells of neighbors. Of these, 60% find no problem with quality, and 35% even find the taste to be sweet (*douce*). People have been sensitized to apply some form of treatment to such water, which is fairly extensively done, but the relationship between quality of water and water borne disease (such as diarrhea) is not adequately recognized by the villagers.

(3) Institutional arrangements

The first generation ASUFOR was established in November 2004, and lasted for slightly more than three years. At the time of its introduction, a membership fee amounting to 100 CFA francs per person was collected from each registered user. A volumetric water tariff of 400 CFA francs per m^3 was agreed, but the actual rate offered at public standpipes remained unchanged at 10 CFA francs per 10 liter container and 15 CFA francs per 20 and 25 liter basin. CD and BE were formed according to the standard regulations, incorporating representatives of different genders and of social and functional groups within the village. A bank account was opened to save extra money for future repairs.

The second generation ASUFOR assumed position in February 2008 with renewed CD and BE membership and under the leadership of a new president. The tariff structure was maintained, and again all official positions were filled by elections among villagers representing the different constituent groups. An appeal from the BE at the time of renewal for a round of membership fees contribution was rejected by the villagers because this had already been done when the first generation ASUFOR was established.

In both ASUFORs, one-third of the BE membership has been female, which meets government requirements. The presidency, however, has always (since 1981) been held by a male villager; a female as head of ASUFOR would not be welcomed by village elders (i.e., decision makers) who believe that such an important position should be held by a man.

(4) External environment

The government boreholes and wells office, or BPF (Brigade des Puits et Forages), responsible for providing technical and managerial support for the operation and maintenance of water supply facilities is located in the city of Tambacounda, 80 km or 90 minutes drive along the tarmacked highway from Dialakoto. BPF officials together with donor consultants were present at the ASUFOR introduction/familiarization process in both 2004 and 2008 to provide training on new institutional arrangements, election procedures, safe water and sanitation, and managerial skills. They also oversaw the election of ASUFOR officials.

In principle the monitoring of ASUFOR activities is on an as-needed basis and dependent on the availability of transport (which is normally to be borne by the villagers).

(5) Process of decision making and rule enforcement

During the tenure of the first ASUFOR president, who was a Fulbé farmer/livestock keeper, water tariff collection at fixed rate per container was applied at each public standpipe, but a volumetric tariff collection by water meter was not strictly practiced. Furthermore,

aggregation of the tariffs collected by individual standpipe caretakers was done by the president himself, without the involvement of the treasurer or any other member of BE or CD, and no accounting record was kept. Thus it was virtually impossible to know the actual financial position of ASUFOR or the ratio of tariff collection against the amount of water consumed.

The scanty data that is available shows that the first generation ASUFOR started with a zero balance in cash and deposit carryover from the previous organization, and that the amount saved as of August 2005, nine months after the ASUFOR establishment, stood at only 65,000 CFA francs, extremely little considering how the tariff is structured.[17] According to the villagers, this situation was due in part to the president's mismanagement of the funds collected, and in part to individual users' failure to pay the fixed tariff. Numerous reasons were given for user non-payment, including lack of trust in ASUFOR officials, unreliable water supply, lack of convenient standpipes (for those in quarters not covered by the network), and failure to pay the tariff by migratory pastoralists who visit during the dry season.

Despite these problems, nobody was barred from using the standpipes and no action was taken to hold the president accountable for the financial position of ASUFOR. It was only in February 2008, at the time of an AG held at a donor's suggestion, that some villagers voiced complaints about the irregular supply of water and the lack of transparency in management. Those who suspected misconduct by the president suggested that the matter be taken to court, but this idea was abandoned due to a lack of hard evidence to substantiate wrongdoing, and because the BPF, a government agency, advised that the matter be sorted out in an unofficial manner. Eventually, however, these complications did lead to the removal of the first president from his position.

[17] In the peak period of the 2005 dry season the pump was operated four times a month, each time filling two 50 m^3 reservoirs. The total volume supplied per month is estimated to be 400 m^3. If we assume all water lifted is accounted for and all tariffs collected, the total collected amount should be 160,000 CFA francs. Leaving aside the operational cost which accounts for 22% of the unit price, and 30,000 CFA francs for pump operator remuneration (see earlier note), 95,000 CFA francs could have been saved for one month of operation.

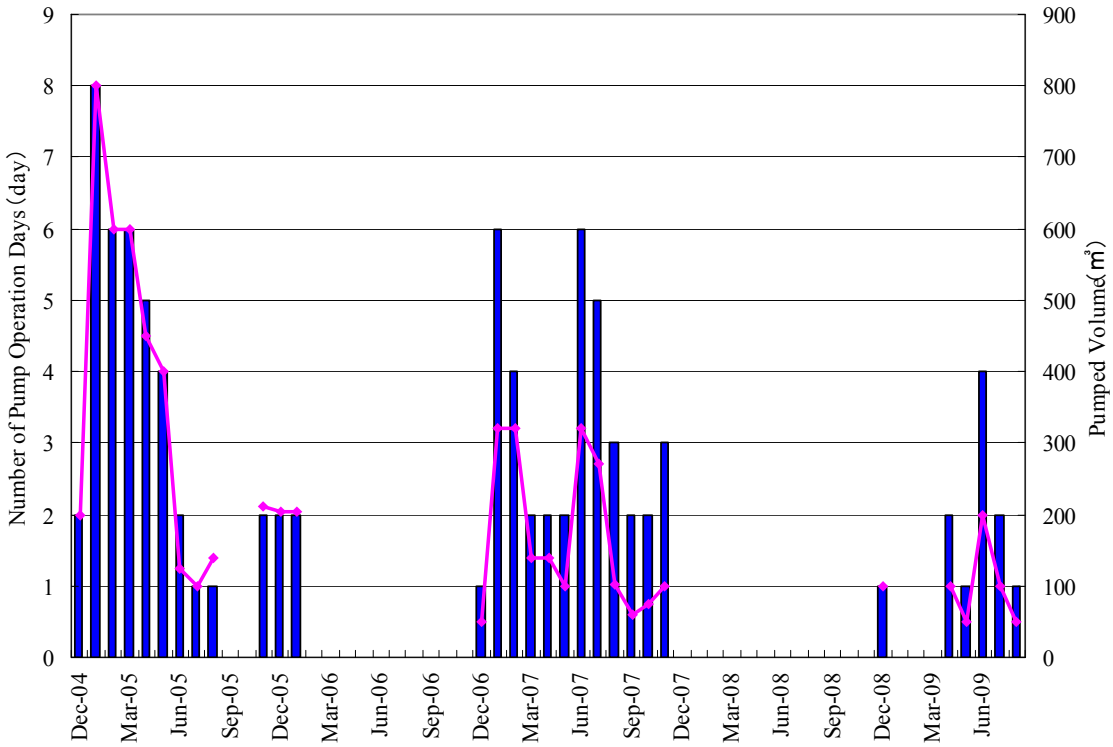
The second generation ASUFOR was installed with no funds to work with, and matters were soon made worse by a mishap. The submerged pump broke down and it took 11 months for a new one to be installed.[18] Hence throughout 2008 virtually no water was supplied. Furthermore, after the pump was restored in December 2008, there were still no funds to buy fuel, so throughout 2009 again there was no water for the villagers. The only exception was one short period when the pump was operated by a construction company who bore the fuel cost. At that time water was provided to a limited number of users living near the construction site, but again the revenue was accounted for by the president personally and no written record was kept. During this period CD members held only two meetings, both of which to discuss how to raise funds to buy fuel and neither resulting in any action.

(6) Resource management outcomes

The graph below indicates the number of days the pump operated and the volume of pumped water over the past several years. The average volume of water pumped per month was 300 m^3 in 2005 (water supplied for 10 months), 127 m^3 in 2006 (2 months) and 170 m^3 in 2007 (12 months). In 2008, the pump was out of order for much of the time and in 2009 water was not supplied due to a lack of funds.

[18] The cost of replacement was fully borne by a donor who had been assisting the village in establishing ASUFOR since 2004.

Figure 3. Number of operation days and pumped volume (Dialakoto)



The tariff collection rate is hard to capture as there is no record in this village.[19] Sporadic information regarding the balance of the amount collected is the only indicator allowing any estimation of the ASUFOR performance. In November 2004, it received nothing from the previous administration, and the balance handed over to the second generation ASUFOR in February 2008 was only 2,000 CFA francs, with uncollected payments of 27,000 CFA francs (thus -25,000 CFA francs in net total). This figure stood unchanged at 2,000 CFA francs until at least October 2009.

[19] Length of downtime (service interruption), a measure often considered as a way to measure WUA's performance in system maintenance, was not used in the analysis as it is greatly influenced by other factors, such as the availability of spare parts and repair service by public and private service providers ,which are beyond the scope of the study.

4. The case of Koar Village

Located on the banks of the river Gambia, Koar is a settlement village established in 1981 as a banana plantation project supported by a Canadian development program. Tambacounda, the regional capital, is 60 km away, or one and a half hour by a commuter bus available once daily. As of 2008, the village has a population of approximately 1,329 (57% male, 43% female)[20] and consists of 158 compounds. There are a total of seven ethnic groups – Fulbé (55%), Bambara (15%), Serer (15%), Diola (10%), Wolof, Diahanké and Bassari. The village chief is selected from among the initial settler families who are Fulbé.

The average annual precipitation in this area ranges from 700 to 1000 mm, roughly the same as at Dialakoto. With the exception of a handful of Fulbé residents who rely on livestock husbandry and faming, most of the villagers own individual plots (0.25 ha for a man and 0.125 ha for a woman) of banana fields located some two kilometers to the west. The allocation of the banana plots is the responsibility of the presidents of banana cooperatives. There are four blocks of banana fields covering a total area of 84.5 ha, each managed independently by a cooperative run by the farmers. Both men and women are eligible to cultivate the banana field plots. In addition to banana plots, villagers are allocated by the village chief some pieces of land to cultivate food crops (millet, maize, beans) and cash crops (groundnuts, cotton). In terms of religious affiliation, 95% of the villagers are Muslim while the remaining 5% are Christian. There are two mosques and one church in the village.

(1) Resource system characteristics

Before the motorized water supply system was installed in 2001, a public shallow well constructed by the government had been the main source of water in Koar, with additional water available from the river and, during the rainy season, from marshland (*marigot*). Even at

[20] In Koar, in addition to the existence of talibés, the existence of migratory male farmers who come from outside the village to work in the banana plantation contributes to the higher number of male to that of female.

present, the shallow well is still widely used by the villagers, especially for such puroposes as washing clothes and bathing (5-6 respondents out of 14 interviewees), and even for drinking and cooking (3-4 respondents out of 14 interviewees). The main facilities constituting the motorized system include a water tower with a capacity of 50 m^3, five public standpipes and a livestock water point, all equipped with water meters. For 90% of the population, public standpipes are located within a distance of 100 m. Recently one additional public standpipe and private connections to 50 households were constructed and one standpipe was abolished. The pump has a yield of 500 m^3 of water extraction per month and operates on average every other day during the dry season and once a week during the rainy season. This translates into approximately 11 liters of water per person per day.

There have been no major mechanical problems with this system since its service inception in 2001. The only breakdown to date was recorded in May 2009, when there was a problem with the starter motor of the generator, but the supply of water was not interrupted.

(2) User group characteristics

The fact that the village is a new settlement populated by people of seven different ethnic groups has two implications. One is that there is only limited kinship relationship beyond the boundary of the compound, which is basically occupied by extended family members. Labor exchange for cereal and traditional cash crop production is practiced mainly within the compound, rarely extending beyond its limits. Banana cultivation is largely an individual or household matter within the compound as land for that purpose is allocated on an individual basis. When there is a need for supplemental labor for banana cultivation, the main recourse is to hired labor (*surga*).

The second implication emanating from the village's mixed social composition is that different people hold different attitudes toward water use. For example, those villagers who migrated from more urbanized areas, including those of Serer and Wolof origin from western

Senegal (combined share in total village population near 20%), clearly show a higher preference for borehole water because their urban experience has accustomed them to this water.[21]

The majority of the Muslim villagers pray at the same mosque in the village, while a few Fulbé families, who are referred to as "those from the [nearby national] park" have their own Imam and mosque. An intermarriage taboo exists between Muslims and Christians, but not among the Muslim groups.

One unique aspect of social relationships in Koar is that all banana producing farmers belong to at least one of four banana cooperatives, each of which was created for one of the four blocks. Cooperatives are responsible for joint sales of produce, for operation and maintenance of irrigation pumps (used in the dry season), and for purchase of agricultural inputs such as fertilizers and pesticides. They sell the produce to visiting buyers once fortnightly. Farmers are required to pay an annual membership fee of between 200,000-300,000 CFA francs to their cooperative, which they pay in installments from the proceeds of their banana sales. The banana cooperatives strictly adhere to the rule of joint sales; anyone who breaks the rule (by selling to a buyer individually) is deemed to have committed "theft" and stripped of his/her right to cultivate bananas.

When asked about the water source preference for different purposes in a small sample survey (n=13) conducted by the author, a majority (10-11 respondents, or approximately 80%) showed a clear preference for borehole water for drinking and cooking. They also identified water "quality" as the main reason for this choice (10 respondents, or 77%). This response suggests a high level of awareness of "safe water" use among the Koar villagers. For regular users of borehole water, the average amount spent for water is approximately 2,000 CFA francs

[21] Based on an author's interview with a Serer male villager who migrated from Fatique (a major municipality in the western peanut basin) to this village in 1999. His wife has resided in the capital Dakar for 18 years as a household helper. According to them, the use of piped water and payment of a water tariff is quite *"normale."*

per month, corresponding to 1.3%-2.7% of their monthly household expenditure.

(3) Institutional arrangements

Since 2001, there have been three generations of water supply management committees. The first committee, under the previous CdG arrangement, was managed by a male Diola farmer who was in charge from 2001 to 2005. The second committee was installed in 2005 when the first president left the village and transferred responsibility to a male Fulbé farmer who occupied the position from 2005 to October 2007. ASUFOR was introduced in November 2007 when the village was selected as one of the program sites of a donor-assisted project to expand the ASUFOR arrangement in the Tambacounda region. The current president of the ASUFOR is a Diola housewife.

Until October 2007, the water tariff was set at a seasonal subscription fee of 1,000 CFA francs per compound, with an additional container-wise tariff of 10 CFA francs per 20 liter container. After the introduction of ASUFOR, the tariff was fixed at 400 CFA francs per m^3, with a rate of 15 CFA francs per 20 liter container used at public standpipes. CD and BE members were selected through a standard electoral process as stipulated by government regulation. Social and functional differences (including gender) are duly reflected in the composition of these committees. A bank account for savings to cover future maintenance has been in use since the beginning of the first generation CdG. At the start of ASUFOR, a membership fee of 100 CFA francs was collected from each villager.

(4) External environment

BPF officials together with donor consultants were present at the ASUFOR introduction/familiarization process in 2007 to provide training on new institutional arrangements, election procedures, safe water and sanitation, and managerial skills. The election process for CD and BE officials was overseen by government and donor personnel.

Visits by BPF officials for monitoring are infrequent. The village is located 20 km off the main road and is without mobile phone connectivity during much of the daytime. When the need arises, however, the villagers can send a BE member by commuter bus to the government office in Tambacounda.

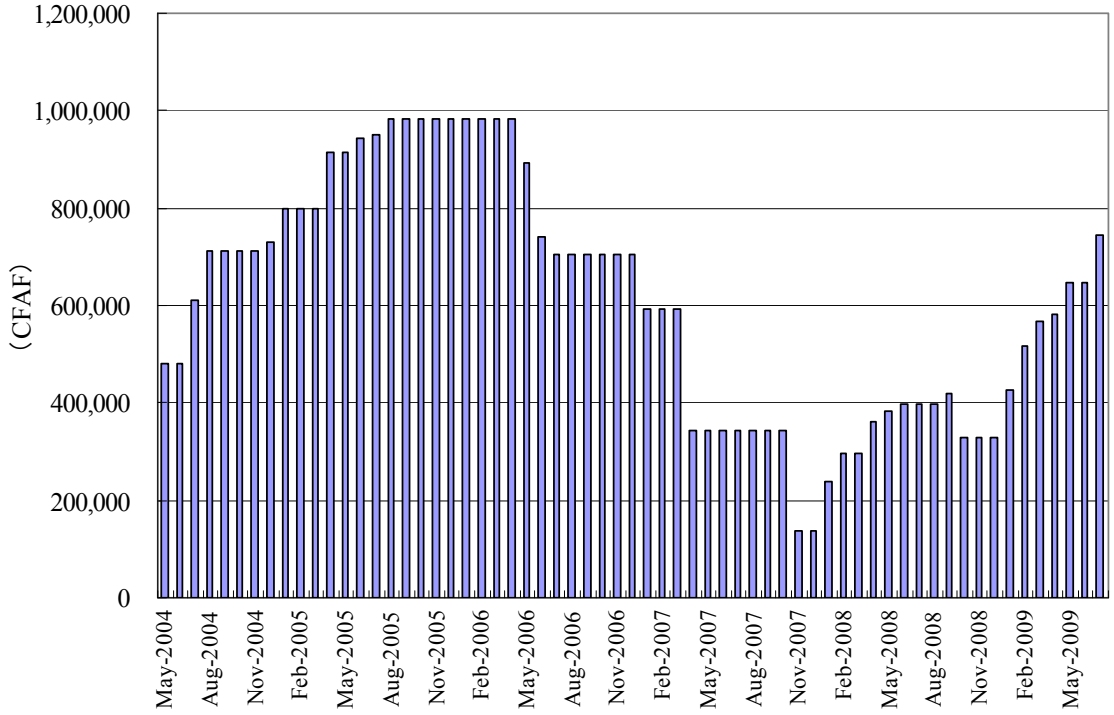
(5) Process of decision making and rule enforcement

During the term of the first CdG president, a unit price per container was used but it was not linked to water consumption volume. Reading meters and calculating fees were regarded as too complicated and cumbersome. The first president estimates that only some 50% of the fees actually was collected. This was due partly to nonpayment by users and partly to theft by public standpipe caretakers. Sanctioning of defaulters or thieving caretakers was not possible at that time because there was no means to confirm the exact amount that should have been collected. Nonetheless, the money that was collected was properly accounted for and the committee was able to save some extra each month (see Figure 4).

After the departure of the first president from the village in 2005, one of the CdG members was appointed to be the second president. No AG was held to select the new president or to report the financial position of the committee. Soon after his appointment, the second president, without consulting other committee members, began withdrawing money from the bank for his own personal use. This occurred several times between 2006 and 2007 unnoticed by anyone. It was only in the period May-July 2007, when the water supply was interrupted for three weeks by a lack of fuel rather than by a mechanical breakdown that villagers detected the irregularities in the president's behavior. Although the bank manager (a villager) subsequently banned withdrawals from the account, it was too late. Now aware of the situation, the villagers appealed repeatedly to the president to explain the committee's financial position to the CdG, but without success. He refused to hold meetings or to discuss the problem. The CdG's only recourse for restarting the water supply was to borrow fuel from the banana

cooperatives.

Figure 4. Balance of savings account (Koar)



It was in the midst of this crisis that with the help of government and donor interventions new management arrangements began to be introduced. A series of meetings was held in October 2007 to familiarize villagers with the new arrangements and to create an awareness of safe water and sanitation. In the AG, the second president was dismissed with the unanimous agreement of the villagers and replaced by a housewife known for her prominent role in a women's group. This idea of choosing a woman for president came from the villagers who said "water belongs to women's domain and should therefore be managed by a woman" and received strong support.[22] An arrangement to allow any interested party to check the bank statement was also proposed and adopted.

In an effort to remedy the fraudulent management of the previous president, the new

[22] The fact that Koar was a settlement village comprising people of different origins may have had some influence on this villagers' decision; as it appears difficult for a traditional norm with an inclination to male dominance in social affairs to prevail in this village.

management started using water meters to collect water tariffs with rigor and austerity. Three families who were threatened with suspension of their access to borehole water when they refused to pay their dues despite repeated warnings eventually agreed, apologized and paid in full. In 2008 even the private water supply of the former chief of village was cut when he fell three months behind in his dues. Additionally, three of the standpipe caretakers who were suspected of cheating by under-reporting their collection amounts against the meter readings were replaced by the president and her team.

Finally, in October 2008, with the aim of reducing the problems associated with tariff collection at standpipes and in response to strong requests from the villagers, the current ASUFOR – with some support from the government – installed an additional public standpipe in an area that had been underserved as well as private connections for 50 village compounds.

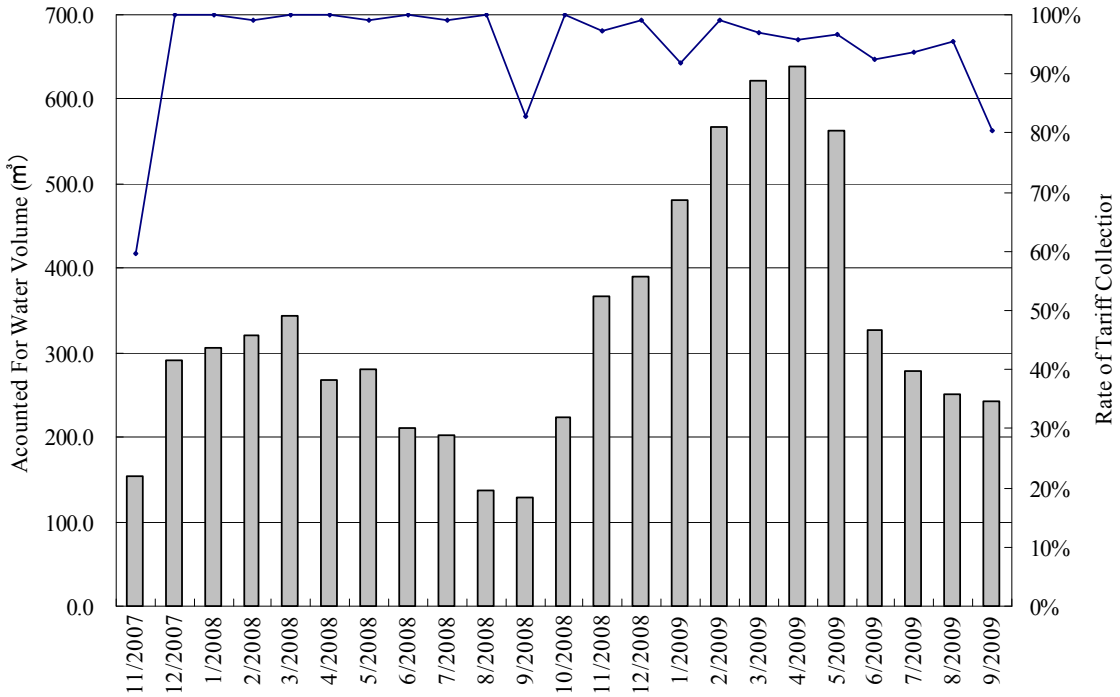
User evaluation of the management practices of ASUFOR in Koar is generally positive in terms of fairness in applying sanctions and providing water in an efficient manner. There is some concern over the transparency of financial management, however, because no AG was held in 2008 and information from CD meetings is rarely transmitted to ordinary villagers.

(6) Resource management outcomes

Figure 5 below shows the effective water volumes (the volume of supplied water as recorded by meters) and the water tariff collection rates in Koar between the period immediately following the establishment of ASUFOR and the present. As is evident from the graph, whereas the water tariff collection rate in November 2007 hovered around 60%, it improved considerably to reach nearly 100% after December 2007. The rate has remained high since that time and stands at 95% on average through 2008 to 2009. The bank balance in Figure 4 above also shows a steady increase after November 2007, from the lowest figure of 139,000 CFA francs, to 750,000 CFA francs recorded as of July 2009. With this strengthened financial capacity, in May 2009 ASUFOR was able to employ a technician from Tambacounda

to repair the alternator of the generator at a cost of 100,000 CFA francs.

Figure 5. Effective water volume and tariff collection rate (Koar)



5. Synthesis and discussion

In both Koar and Dialakoto, the village populations are ethnically diverse and mutual assistance in the form of labor exchange for agricultural production is largely limited to members of the same compound, with some exceptions where labor exchange is practiced among clan members. In both villages, in addition to borehole water, throughout the year people have access to water from alternative sources; accessibility to alternatives, however, is better for Dialakoto Village than for Koar Village. Both villages received donor-supported familiarization and capacity building training in new organizational arrangements and hygiene and sanitation. Before the introduction of ASUFOR, people did not use water meters, although in both villages a container-based quasi volumetric tariff structure was applied. The practice of non-payment was frequent and knowledge of some people's non-payment prompted others to

free ride as well. Fraudulent practices by standpipe caretakers and CdG presidents also were commonly reported. Sanctions were rarely applied to defaulters and thieves, and monitoring was sporadic.

However, in Koar people began to pay their water tariffs after the introduction of ASUFOR and at a significantly high rate, while in Dialakoto the situation remained stagnant. What accounts for this change and difference, and how can they be understood in terms of the four intervening variables considered here? The table below summarizes and compares findings drawn from these cases, classified according to our four hypothetical causal variables. For Koar, the situations before and after the ASUFOR introduction (in 2007) are examined separately due to the significant differences in tariff collection in these two periods.

Table1. Comparison of four intervening variables between Dialakoto and Koar under different institutional arrangements

	Dialakoto (under CdG/ASUFOR)	Koar (under CdG)	Koar (under ASUFOR)
Degree of Resource Dependence	Low Easy access to shallow wells (60% of households own private shallow wells) Positive evaluation of quality and taste of shallow well water	Medium Existence of villagers who migrated to the area accustomed to using borehole/ piped water Earlier migrants from nearby villages have low level of hygienic awareness	High Majority (80%) of respondents prefer boreholes Among borehole users, a majority (77%) find value in water quality Sense of dependence heightened by recent crisis of mismanagement
Predictability of Flow of Benefits	Low Water supply suspended for much of the past two years and unstable in preceding years Taps are vandalized and water pipes are disconnected	High Stable water supply realized since 2001 due to absence of serious breakdown, except when the supply was interrupted by shortage of funds in 2007	High Stable water supply realized since 2001 due to absence of serious breakdown, except when the supply was interrupted by shortage of funds in 2007
Possibility of Applying Effective Sanctions	Difficult Without the use of water meters, standpipe caretakers lack pressure and incentive to collect exact amount for volume sold Difficulty in forcing migratory pastoralists to pay their dues	Difficult Without the use of water meters, standpipe caretakers lack pressure and incentive to collect exact amount for volume sold	High Standpipe caretakers under pressure and given incentive to collect exact amounts by water meter and performance-based remuneration Ease of cutting off supply to private connection users by sealing stopcocks Actual sanctions applied to defaulters including former village chief
Possibility of Holding Trust	Low Difficulty in village-wide communication between nine separate quarters occupied by different ethnic groups and clans Social cleavage based on difference along religious lines Dissatisfaction among villagers without distribution network coverage	Medium Communication among villagers exists thorough banana cooperatives Lack of transparency in CdG management	Medium Communication among villagers exists thorough banana cooperatives Lack of feedback from CD to villagers and non-holding of AG for two years
Outcomes	Poor No balance on hand Rejection of second round contribution	Medium Tariff collection rate: 50-60%	Positive Tariff collection rate: 95% Bank balance amounting to 750,000 CFA francs

The above synthesis of findings shows remarkable differences in most of the variables between the two villages.

Degree of resource dependence

In Koar, it appears that there is a higher level of dependence on borehole water as compared to Dialakoto. A majority of Koar villagers use borehole water at least for direct human consumption; i.e., drinking and cooking. One reason for this higher dependence might be the "heterogeneity" of the villagers. Immigrants from the western part of the country (most belonging to Serer and Wolof ethnic groups) seem to have a greater awareness of hygiene and sanitation, and their presence in the village (20% of the total population) may have influenced the overall level of hygienic awareness among villagers.

More importantly, the dependence on borehole water was reinforced by the crisis experienced during the tenure of the second CdG president. Not until the water was interrupted did the villagers start to complain about the supply and its management. At that time, when the benefit they enjoyed was felt to be at risk, people began to appreciate the importance of the safe water provided by the motorized water supply system. As in the case of Indian canal irrigation villages analyzed by Wade, the perception of resource dependence may be heightened when a benefit enjoyed is threatened (Wade 1988a, 192) and this heightened sense of dependence can enhanced awareness of the collective benefit of cooperation, creating a situation in which cooperation makes sense.

In Dialakoto, by contrast, the dependence on borehole water was low from the very beginning. This was despite the familiarization training conducted by the government and donors both times ASUFOR was instituted (2004 and 2008). People continued to give preference to private shallow wells within the compounds over public standpipes outside the compounds. Here attention is directed to a difference in the kind of benefit expected from water: "a labor-saving and time-saving benefit" which is obtainable from private shallow wells, and "a health expenditure saving benefit" which is obtainable from using "safe" water

from boreholes. The preference of the Dialakoto villagers is apparently the former. If the net benefit – calculated by deducting the cost of use – also is considered, this choice which is free for daily use would appear even more attractive.

Predictability of flow of benefits

The expected value of collective benefits from cooperation can be discounted by the probability of the flow of such benefits. Evaluation of the past record of benefit flows can be extrapolated into future expectations which will serve as a factor discounting the present value of the benefits expected from cooperation. In Koar, such a discounting factor was kept to a minimum through much of the time by a stable water supply. For nearly seven years after the installation of facilities, people experienced only limited disruption of their water supply, apart from when money was diverted by the former president. In Dialakoto, however, the perceived probability of a reliable supply of water (from the motorized systems), would have been very low in the eyes of the villagers based on the past record of poor actual service delivery and dilapidated facilities.

As we recall, in Dialakoto the poor water supply record was one reason given by the villagers for their rejection of ASUFOR's appeal for a second round of contributions to buy fuel. This suggests that technically induced poor service delivery leads through low tariff payment to poor water supply management. This in turn feeds back to exacerbate the already poor service delivery. Here is observed a vicious cycle between technical and management deficiences.

Possibility of applying effective sanctions

The capability of applying effective sanctions seems to have significant relevance to what transpired in Koar before and after ASUFOR. This sanctioning was assisted by a technology coupled with an incentive mechanism for standpipe caretakers.[23] In both villages

[23] In Senegal, most standpipe caretakers are drawn from women. This is partly because it is generally believed that women are more honest and incorruptible than men in (petty) monetary transactions and partly because they spend more time at home; hence they can attend nearby standpipes better than men.

examined, which are relatively large, the high cost of monitoring makes it hard to believe that the monitoring of tariff collections at each public standpipe in various corners of the village is properly carried out at all times. Moreover, those who are in management positions do not have the time, means and incentive to carry out such monitoring. Ill-intentioned standpipe caretakers could still steal money out of the amount collected, or not collect even the amount due. Against this background, strict water tariff collection was difficult, even in Koar.

One innovation brought by ASUFOR was the application of a volumetric tariff collection method using water meters. Under the volumetric tariff system, standpipe caretakers face the possibility of sanctions, encouraging them to collect money according to the volume of water provided which is calculable by the reading of the meter. Caretakers are also given incentives (positive sanctions) to do this, as they are remunerated with a fixed rate commission calculated according to the total collection amount (normally 10%). Under this arrangement, standpipe caretakers press users to pay. Failure by users to pay the correct amount to caretakers leads to barring them from fetching standpipe water, and failure by caretakers to collect the correct amount from users leads to out-of-pocket compensation for the difference. The effectiveness of this sanction mechanism may be one reason for the sharp increase in the tariff collection rate in Koar soon after the adoption of ASUFOR, as most other conditions were unchanged.

For households with private connections, sanctions are even stronger (again, as found in Koar) due to stopcocks which come with water meters. By closing and sealing the stopcocks, sanctions for non-payment can be enforced with relative ease and at low cost. Such action actually was taken in Koar when the village head failed to pay his dues.

In Dialakoto, by contrast, unit tariff per container had been used for quite some time but the water meter had not. This partial implementation failed to support effective sanctions as it lacked means to hold caretakers accountable for the collected amount.

Possibility of holding trust

Both the villages studied are relatively large and ethnically heterogeneous. The compound is the core social unit, and the custom of voluntary labor exchange is rarely practiced beyond its limits. Strong ties such as traditional norms or kinship relationships that bind villagers were difficult to observe. There was serious social cleavage between some ethnic groups along religious lines. Certain corners of the villages complain about unfair treatment by ASUFOR executives who do not provide a water supply network in their areas of residence. In a situation like this, it is hard for trust to emerge among villagers, as trust is often associated with communication (Coleman 1990), reciprocal relationships, and networks of social exchange (Putnam 1993). Hence, it is not surprising to find that trust has not emerged among the people of Dialakoto.

In Koar, however, despite the diversity of origin of the villagers, there appears to be a greater possibility that trust will emerge. We are reminded here that almost all the Koar villagers belong to one of the four banana cooperatives, and some even belong to more than one. Although production activities in the banana fields are carried out individually, the sale of produce to merchants is a joint venture occurring every two weeks. On the sale day, banana cooperative officials (who are also villagers) weigh bunches of banana, take note of the weight and compute the sales amount under close observation by their peers. They also discuss management issues pertinent to their cooperatives, including revenue and expenditure status directly related to the monetary contributions made to support the running of the organizations. Hence channels of communication are established among most of the villagers through the activities of their banana cooperatives. This is useful for gathering necessary information and assessing the trustworthiness of others.

One of ASUFOR's institutional objectives is the creation of channels of communication among users by means of CD and AG as well as by holding ASUFOR executives accountable. Unfortunately, in both villages, meetings are not held as required by

the agreed by-laws, even though the CD may have been created according to standard regulations and with a highly representative statutory composition. In Koar, CD meetings have been held several times, but feedback from CD members to ordinary villagers does not occur as intended. In Dialakoto, meetings are seldom held at the BE and CD levels, let alone the AG.

Considering these facts, it may be difficult to infer that the level of trust among villagers in Koar increased consequent to the introduction of ASUFOR, contributing to significant improvement in that village's institutional performance. It is still possible, however, to attribute the institutional difference between Koar and Dialakoto to differences in the element of trust nurtured by cooperative economic activities.

Conclusions

In the present study, some of the intervening variables that causally link contextual variables and institutional performance have been examined. The analysis has demonstrated that collective action is possible even when some of the facilitating conditions normally associated with successful commons management are missing, thus confirming the importance of focusing on intervening variables to arrive at a better understanding of causal mechanisms of collective action and to better manage resource management situations.

From our comparison of two villages - Dialakoto and Koar under CdG - it appears that, even during the pre-ASUFOR period, there were considerable differences in the conditions related to at least three of the four variables presented as hypotheses: resource dependence, predictability of benefit flow, and possibility of holding trust. These differences seem to constitute the backdrop, or contextual conditions, against which the different institutional performances unfolded in Dialakoto and Koar prior to the introduction of ASUFOR.

Firstly, from the very beginning there was a clear difference in the levels of resource dependence between the two villages. These levels were affected by such things as resource characteristics (availability of alternative shallow wells), user group characteristics (existence

of people with different levels of hygienic awareness), and difference in the type of benefits expected from a resource (i.e., health expenditure saving benefit vs. time and labor saving benefit).

Secondly, the reliability of the water supply systems also differed. In fact for Dialakoto reliability was totally lacking. This factor should influence the amount of prospective benefit expected from cooperation.

Thirdly, there was a difference in the potential for trust among resource users in these two villages, in part because participation in banana cooperatives may have created channels of communication between villagers without which sufficient information cannot be accumulated to develop trust in others. Under these conditions, even before the introduction of ASUFOR, a certain level of collective action among villagers in Koar had been established, while in Dialakoto there was little such collective undertaking.

These points may be useful for understanding the differences between these two villages before the introduction of ASUFOR, but they are not sufficient for explaining the drastic change in performance observed in Koar after the introduction of ASUFOR because, in fact, conditions in Kaor remained mostly unchanged. The introduction of ASUFOR in Koar contributes little to an understanding of the change in that village before and after November 2007. On the contrary, the major events driving the change that occurred between these two periods were the crisis of the second CdG president and the adoption of a volumetric tariff system.

The crisis of the second president –interruption in the water supply – increased interest in borehole water, which already was high in Koar, and created momentum for acceptance and enforcement of new rules. As Wade pointed out, collective action becomes more readily acceptable when the existing interests of resource users are threatened because their prospective net colletive benefit is enhanced by the threat (Wade 1988a, 192). A resource must be used; otherwise people have little interest in managing it, as we saw in the case of Dialakoto.

But that alone is not sufficient to realize cooperation for resource management, as we saw in the case of Koar before the introduction of ASUFOR. In order for collective action for resource management to emerge, resource dependence must be raised to a higher level by some risk or hazard that threatens to disrupt continued enjoyment of the resource. Only then do people realize the importance of and benefit from cooperation.

Sanctions on free riders which had not been possible in either village began to be felt by Koar villagers through their actual imposition by the crisis-motivated ASUFOR executives (BE) and also as an effect of the volumetric tariff system. With regard to the former, it is noteworthy that defaulters began to be sanctioned soon after new people were installed in management positions. It would have been effective if people had been only aware that under the new management there was potential for sanctions imposition. With regard to the latter, the crucial point was the use of the water meter. This technology, which clearly indicates the amount of money to be collected, combined with a performance based remuneration system, motivated standpipe caretakers in both positive and negative ways to collect the exact amount due. In the absence of such a system, caretakers apparently felt free to collect whatever they could or at the pleasure of the user, leading easily to shortfalls, corruption, and free-rider proliferation.[24]

In this regard, the fixed unit price per container, as practiced in Dialakoto and pre-ASUFOR Koar, is not adequate for improving the tariff collection rate because it is not associated with a mechanism that allows the sanctioning of defaulters. In other words, it may not necessarily be the volume-based payment that counts here, but rather it is the capability of monitoring the collectors that makes the difference.

Against the background of relatively favourable *initial* conditions, at least in terms of three variables in Koar, it is assumed that two changes – one in terms of resource dependency

[24] Note that the three standpipe caretakers in Koar who were identified as cheating in their duties were actually dismissed.

caused by the crisis experienced under the second president, and the other in terms of the possibility of sanctioning effected by the introduction of ASUFOR - in combination resulted in the sudden improvement in Koar's tariff collection rate. One of the important lessons of the foregoing examination is that collective action is not a static phenomenon; it is dynamic and can change over time. In the case of Koar, the crisis experienced by the villagers enhanced their level of resource dependence and led to the adoption of new institutional arrangements, this in turn allowed the imposition of sanctions on free riders, which eventually were enforced by the crisis-motivated management.

The very dynamism of collective action suggests that cooperation can be weakened or lost over time unless it becomes institutionalized through shared norms and trust among resource users, and/or with continued application of monitoring pressures from external agents. The gradual decrease in Koar's tariff collection rate over 2009 may suggest that its cooperative momentum is losing steam.

The present analysis is limited in that it is based on a comparative description of only two cases. Furthermore, the evidence presented is mostly circumstantial, allowing only inferential interpretation. Due to these limitations, further research is necessary, including research with large-N samples, to test whether the intervening or mediating variables identified here are statistically related to the emergence of cooperation among resource users.

Despite its limitations, the analysis of actual cases with a focus on intervening variables may be useful as a step for elaborating the causal mechanisms linking resource system conditions, resource users, institutional arrangements and external agents to institutional performance. These efforts may be of value to development policy makers and intervention practitioners when they face the field operations tasks of designing institutions and interventions, since they can do little actually to change the characteristics of resources and resource users. They may be better positioned to manage the situation by focusing on the intervening variables examined in this paper instead of looking simply for ideal communities

equipped with facilitating conditions, e.g., resource scarcity, small size of user group, identitiy homogeneity of among resource users. Facilitating conditions – which are considered as independent and moderator variables in our causal model – help actualize collective action by performing such functions as providing sanctions and building trust.

Policy measures that address intervening variables include the following: the promotion of hygiene and sanitation awareness programs to enhance resource dependence on use; the introduction of technological innovations, such as water meters, to lower the cost of applying sanctions; and the application of monitoring pressure, from such external agents as governments or peer organizations, on resource management bodies to improve the potential for trust among users through accountable and transparent management practices. The important thing to note is that these intervening variables can be influenced through various means and processes – external policy interventions, contextual conditions and the process of decision making and rule enforcement.

Appendix: Detailed Information on Surveyed Villages and Resource Management

Overview of the Village

Name of Site	Dialacoto	Koar
Administrative location	Dialacoto rural community, Missirah division, Tambacounda department, Tambacounda region	Missirah rural community, Missirah division, Tambacounda department, Tambacounda region
Geographical location	13° 18' N, 13° 16' W	13° 19' N, 13° 33' W
Altitude	40 m	20 m
Average precipitation	700 - 1000 mm	700 – 1000 mm
Population (2008 census)	3,567 persons	1,329 persons
Number of compounds	277	158
Average size of compound	12.9 persons/compound	8.4 persons/compound
Main ethnic groups in the village	Socé (43%), Diahanké (40%), Furbé (7%), Serer, Wolof	Furbé (55%), Bambara (15%), Serer (15%), Diola (10%), Wolof, Diahanké, Bassari
History of village	- Established in late 17th century by two families of Socé - Rule by Wolof Chief of Canton rejected in 1901 - Non-Socé settlers created new communities now called *quartiers*	- Banana plantation opened by OFADEC (Canadian aid program) in 1981 (Koar I) - Banana plantation expanded in 1983 (Koar II), 1985 (Koar III) and 1997 (Galilée) - Farmer managed cooperatives (UGAK) established in 1987
Pattern of residence	Each quarter(*quartiers*) predominantly occupied by one of the ethnic groups or clans; their location of residence politically maneuvered by Chief of Canton under colonial rule	Mixed
Main economic activities	- Food crop production (millet, maize, beans) - Cash crop production (groundnut, cotton) - Livestock keeping - Commerce - Emigrant labor (*emigrés*)	- Banana cultivation (plot size: 0.25ha for men, 0.125ha for women, total hectorage: 84.5 ha) - Food crop production (millet, maize, beans) - Cash crop production (groundnut, cotton) - Livestock keeping

Main sources of cash income	- Sale of groundnuts/cotton (after rainy season) - Commerce (for merchants, year around) - Sale of Livestock (for owners, when necessary) - Transfer of money from emigrants (occasionally)	- Sale of bananas (every 2 wks) - Sale of groundnuts/cotton (after rainy season) - Sale of Livestock (for owners, when necessary)
Estimate of monthly expenditures	60,000 – 100,000 f	75,000 – 150,000 f
Religious affiliation	Muslims: 100%	Muslims: 95% Christians: 5%
Number of *Jaka/Juma*	9 / 1	2 / 2

Resource System Characteristics

Name of Site	**Dialacoto**	**Koar**
Availability of alternative water source for human consumption	150 shallow wells in private compound (percentage of ownership 54%) 19 shallow wells for public use	1 shallow well for public use in the centre of village
Availability of water during dry season	Borehole: Available Shallow well: Available	Borehole: Available Shallow well: Available
Year of construction of motorized water supply system	1980 1999 (construction of second reservoir and expansion of network)	2001
Type of water abstraction and reservoir	Motorized borehole (*forage motorizé*) Ground reservoir/Water tower (*chateau d'eau*)	Motorized borehole (*forage motorizé*) Water tower (*chateau d'eau*)
Capacity of pump	30 m³/h	30 m³/h
Capacity of reservoir	50 m³ x 2	50 m³
Type and number of water point	Public standpipes (13) Private connections (8) Livestock water point (1) (all equipped with water meters)	Public standpipes (5) Private connections (50) (installed in 2008) Livestock water point (1) (all equipped with water meters)
Working conditions of the facility	Main facility: Working (pump replaced in 2008) Network: Pipe network cut-off at two points Water point: Most taps are vandalized or keys missing	Main facility: Working Network: Working Water point: Working

Average volume of water pumped	302 ㎥/month (2005) 2.8 liter/person/day 21 ㎥/month (2006) 0.2 liter/person/day 162 ㎥/month (2007) 1.5 liter/person/day 8 ㎥/month (2008) 0.07 liter /person/day 62 ㎥/month (2009) (supply mainly to construction site)	500 ㎥/month (Nov. 2007 – Sep.2009) 11.1 liter/person/day

Resource User Characteristics

Name of Site	Dialacoto	Koar
Users of water supply system	Villagers of Dialacoto Migratory Furbé pastoralists (*Aga*) (dry season only)	Villagers of Koar Villagers in three surrounding villages for livestock (dry season only)
No. of satellite village	nil	3 villages but non-connected
Source of social order	Head of Quarters (*Chéf de Quartiers*)	Elders / Imam
Intra-village relationship	- Agriculturists (Socé and Diahanké) dependent on Furbé for livestock keeping and the latter dependent on the former for feeding livestock on harvested fields during dry season - Alienating sentiments by Diahanké/Furbé against Socé due to latter's low level of devotion to Islam	- All banana farmers belong to one of the 4 banana cooperatives - Agriculturists dependent on Furbé for livestock keeping and the latter dependent on the former for feeding livestock on harvested fields during dry season - Alienating sentiments against "those from the national park" for having some mystical power and praying separately
Practice of free labor exchange for agricultural production	Basically among compound members Some clans of Socé and Diahanké practice labor exchange within the boundary of each clan For Furbé, hired labor (*surga*) is the main form of supplementing shortage of labor	Basically among compound members only Hired labor (*surga*) is the main form of supplementing shortage of labor
Taboo on intermarriage	Diahanké → Socé × Furbé → Socé ×	Muslim → Christian × Christian → Muslim ×
Place of prayer	Monday-Thursday: At nine different *Jaka* located in each quarter Friday: All pray at *Juma*	Monday – Friday: All pray at the "First Mosque" except for seven families "from the national park" who pray at the "Second Mosque"
User attitude toward water	(sample survey to 20 households in 5 quarters equipped with public standpipes) - 80% (16) use private shallow well (20% (4) public shallow	(sample survey to 13 households drawn from major ethnic groups in the village) - 81-85% (10-11) use borehole for drinking and cooking

	well) - 60% (12) find water in private shallow well clean or acceptable (20% (4) find it dirty) - 35% (7) find water in private shallow well "sweet (*douce*)" (45% (9) find it "no good taste") - 45% (9) do not recognize water as one of the causes of diarrhea - 100% (20) practice water treatment (80% chlorine (*eau de javel*), 20% filter)	purposes, while 62-69% (8-9) use borehole for washing and bathing (figures vary between dry and rainy season) - 77% (10) point out "quality of water" as a reason for using borehole, while 15% (2) choose "close distance" as a reason for selecting borehole
Average amount of expenditures for water	nil	1,963 f/month (n=11: regular users of borehole)

Institutional Arrangements

Name of Site	**Dialacoto**	**Koar**
Current form of management	ASUFOR	ASUFOR
Year of establishment of management organization	1984 : Comité de Gestion (CdG): (1984 – 2004: 10 presidents under CdG) 2004.11 – 2008.2: 1st ASUFOR 2008.2 – Present: 2nd ASUFOR	2001 – 2005: 1st president of CdG 2005 – 2007: 2nd President of CdG 2007 - Present: 3rd President
Tariff charging method Tariff rate	Volume of consumption (400f/㎥) 10f/10ℓ, 15f/20ℓ-25ℓ	Volume of consumption (400f/㎥) 15f/20ℓ for members (35f/20ℓ for non members)
Previous tariff charging method Tariff rate	Per container (10f/10ℓ, 15f/20ℓ-25ℓ) (for some 1000f/season as lump sum payment)	2001-2007: 1000f annual fee + per container (10f/20ℓ) (35f for non-member)
Membership fee	100 francs per person	100 francs per person
Composition of management organizations	CD: member 27 (average age: 43, literacy in French: 26%, male 70%/female 30%, all nine quarters represented, 67% for farmers/30% for housewives/3% for pastoralists) BE: member 9 (male 5 - female 4)	CD: member 27 (average age: 41, literacy in French: 21%, male 52%/female 48%, surrounding villages and all ethnic groups represented according to their numbers, 30% for banana farmers, 26% for pastoralists, 33% for housewives) BE: member 9 (male 4 – female 5)
Characteristics of the present president	Male (Socé) Carpenter Member of Rural Community Council	Female (Diola) Housewife Active role in women's group

External Environment

Name of Site	Dialacoto	Koar
Government office responsible	BPF Tambacounda	BPF Tambacounda
Distance to nearest BPF	80 km (on national highway)	60 km (40 km on national highway, 20 km on laterite road)
Means of communication	bus mobile phone	bus mobile phone (out of network for most of the time)
Support from BPF/donor	Mobilization/sensitization/training support provided by government/donor at the time of ASUFOR establishment and renewal	Mobilization/sensitization/training support provided by government/donor at the time of ASUFOR establishment
Monitoring by BPF/donor	AG in 2004 and 2007 overseen by BPF and donor	AG in 2007 overseen by BPF and donor
Frequency of monitoring	As need arises	As need arises

Process of Decision Making and Rule Enforcement

Name of Site	Dialacoto	Koar
Notable events in the history of management	- More than 10 presidents took office since 1984, but little transfer of fund realized each time - 1st President of ASUFOR replaced after 2 years for alleged corruption - Women's appeal for president position was denied by village elders - Appeal for fresh user contribution denied by majority villagers in 2008.2 AG	- Unlawful withdrawal of fund from bank during 2nd President in 2006 - Suspension of water supply for 3 weeks during 2007 - Villager demanded a woman to take charge of ASUFOR assisted by male member - An arrangement to allow anyone interested to inspect bank balance was proposed and agreed during AG in 2007
Frequency of AG/CD/BE meetings	AG: 2008.2 (but not in 2009) CD: 2 times since 2008.2 BE: none	AG: 2007.11 (but not in 2008) CD: 7 times since 2007.11 BE: every month
Use of water meter	Not used	Used Tariff collected according to the reading of meter

Application of sanctions	No record available as water supply is suspended	- Public standpipe users: Strong warnings given to 3 defaulters in 2007 - Private connection users: Supply to former Chief of Village suspended in 2008 - 3 standpipe caretakers have been replaced in 2009 for improper actions
Users' evaluation on other users' payment	No opinion as water supply is suspended	Medium (3.2 on average in 5 point scale in sample survey administered to 13 respondents)
Evaluation on ASUFOR management	Mostly negative or indifferent	Generally positive but concern with lack of transparency (4.5 on average in 5 point scale in sample survey administered to 13 respondents)

Resource Management Outcome

Name of Site	Dialacoto	Koar
Tariff collection rate	Not available	2007.11: 59.5% 2008: 98% 2009 (up to Sept.): 93.6%
Amount of bank balance	None (though bank account maintained)	745,185 f as of 2009.9
Record of repair in the recent past	2008.2 (submerged pump) replaced with donor assistance	2009.5 (alternator) repaired by ASUFOR at the cost of 100,000 f

source: field survey conducted in both village by author in October, 2009

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Abstract (in Japanese)

要約

従来のコモンズ研究を通じて、共用資源利用者間の集合行為は極めて複雑なプロセスを辿るものであること、またその過程に影響を及ぼす要因は、資源や利用者集団を取り巻く自然、社会、経済条件によって大きく異なることが明らかにされてきた。しかし共用資源管理制度形成のための支援を行う場合、常に好条件の場所を選ぶことはできない。本研究では、共用資源管理に伴う集合行為の背景にある因果関係を、特に「媒介要因」－自然・社会・経済的文脈要因と結果としての集合行為とを結びつける中間要因－に着目して明らかにする。事例として、西アフリカセネガルの動力式村落給水施設の住民管理運営制度をケースとして取り上げ、①資源依存度、②便益発生の予測可能性、③制裁適用可能性、④相互信頼可能性、の４つの媒介要因を軸に２サイト間の比較制度分析を行った。結論として、資源の希少性、利用者集団の小規模性・均質性等一般に集合行為成立に有利とされる条件が存在しない場合でも、媒介要因が充足される場合には集合行為は成立する可能性があることが確認された。このことは、共用資源管理制度の分析と制度形成支援にあたって、自然、社会、経済、政策等の文脈的条件とともに、媒介要因に着目することの重要性を示唆するものである。

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Working Papers from the same research project

"Management of W ater User 's A ssociations and Formation of Collaborative Local Society in Rural Africa"

JICA-RI Working Paper No. 24

Linking Resource Users' Perceptions and Collective Action in Commons Management: An Examination of Water Supply Systems in Southern Senegal

Atsushi Hanatani and Kana Fuse