Who Decides? Investigating Decision Making Dynamics of Community Water Projects on Mount Kenya

Authors: Jampel Dell'Angelo[1,2,*], Paul McCord[2], Charles Muriuki[3], Tom Evans[2]

*jdellangelo@sesync.org

[1] National Socio-Environmental Synthesis Center (SESYNC) – University of Maryland
[2] The Ostrom Workshop – Indiana University
[3] Jomo Kenyatta University of Agriculture and Technology

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Introduction

Experimental methods have been largely used in social-ecological systems and common-pool resources research and through time have developed with methodological innovations and contributed theoretical advancements (Poteete et al. 2010; Anderies et al. 2011). Critical questions for SES governance have been addressed with lab experiments (Janssen et al. 2010) and behavioral economics static experiments, integrating the logic of the Institutional and Development Framework (Kiser and Ostrom 1992), have addressed foundational dilemmas of CPRs theory (Ostrom et al. 1994). Experimental approaches to the commons were first developed in social-psychology (e.g Stern 1976) but the currently dominant individualistic-cognitive paradigm has diverted the attention of that field from small group research questions (Kerr et al. 2014).

In the specific field of water governance, there has been a considerable amount of research that applied experimental approaches in relation to the institutional dynamics in irrigation systems (e.g. Janssen et al. 2011, Anderies et al. 2013), or groundwater governance (e.g. Meinzen-Dick et al. 2014). Despite this work there is arguably uncharted territory that could benefit from insights from social psychology and small group research in order to better address decision-making questions at the community level.

However experimental approaches alone can be too abstract and disconnected from reality. In other words, they might provide interesting generalizable theoretical results but might not be specifically relevant for the communities and the actors where the research is conducted. Moreover, the assumptions that are often implicit in methodologically rigorous design, however narrow, could be debated (Smith 2010). Less narrow and more creative approaches that combine different research epistemologies emerged (e.g Cardenas et al 2003). Moreover, in order to understand CPR dynamics it is fundamental to include in the spectrum of analysis the broader social-ecological context (Anderies et al. 2011).

In order to assess cross-scale resilience of households and communities reliant on irrigated agriculture, we have developed a multi-method approach for characterizing institutional dynamics as a platform for cross-site analysis of human-water governance. This approach combines household surveys, institutional analysis and social psychology dynamics in small group decision-making. Much work has demonstrated that informal rules often outweigh what would be dictated by formal rules (i.e. constitutions, by-laws). But we have found it is critical to articulate the role of internal dynamics within management committees in order to understand the nature of how individual preferences and decisions evolve and manifest in group decision-making processes. As part of this mixed method research approach we implemented a procedure of ‘small group unconventional field experiments’, which at the cost of reduced methodological rigor, decreased the level of abstraction, addressing real decision making dilemma faced by the community water projects managers in the study region. Considering the experiment taxonomy of Harrison and List (2004) (for a synthetic review see Anderies et al. 2011), our approach could be classified between the ‘framed field experiments’ and ‘natural field experiment’ typologies.

We examine a set of Community Water Projects (CWPs) among four different river basin Water Resource Users Associations (WRUAs) in Kenya where management committees play a central role in water allocation and management. The research involved 95 community water project managers from 20 different CWPs management committees and investigated the internal dynamics of group decision making that are effectively in place. Specifically our research studied the level of coherence between individual decision preferences and group decisions, as well as the factors that influence the final decisions as a result of small group decision making internal dynamics.

Study area

The study area is located on the northern and north-western slopes of Mount Kenya, the leeward side of the mountain (Figure 1). This region demonstrates both a steep climatic and "social gradient." The water projects nearest Mount Kenya, on average, receive greater annual precipitation totals, but rainfall events are variable throughout the study area. The "social gradient" is one in which the CWPs nearest Mount Kenya are populated predominately by members of tribes that have historically practiced sedentary farming while the CWPs furthest from Mount Kenya are populated primarily by pastoral tribes. Water projects are nested within Water Resource Users Associations (WRUAs), which have a range of influence coinciding with the boundaries of individual subcatchments (Figure 1). The CWPs withdraw water, via intake pipes, from either one of the region's major rivers or from natural springs, as is the case with the CWPs in the Ngusishi WRUA.

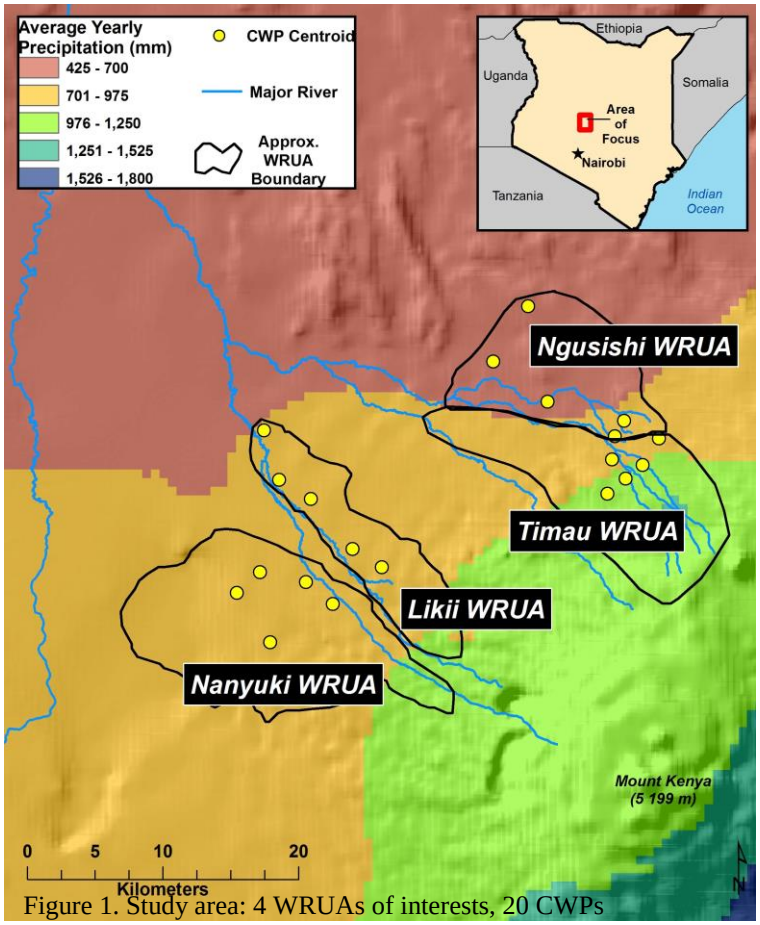

Figure 1. Study area: 4 WRUAs of interests, 20 CWPs

WRUAs are associations of water users formalized by the 2002 Kenya water act with the objective of integrating local users in water management. The Mount Kenya WRUAs are usually composed of different categories of actors, including (1) CWPs, (2) large-scale commercial farms/horticulturalists, and (3) other members, such as municipal water projects and

wildlife conservation organizations (Figure 2.). These actors are given government issued permits for a specified amount of water from a single river/stream.. Large-scale commercial farmers/horticulturalists are primarily flower farms exporting goods to foreign markets, although some farms have large areas under wheat or potato production. Community water projects instead are composed of groups of households connected to a piped water network within the community for domestic use and/or irrigation purposes. Membership with a water project is usually obtained by paying a one-time membership fee to contribute to the expense of building the piped water network and a monthly fee to support its maintenance (Dell'Angelo et al. 2013).

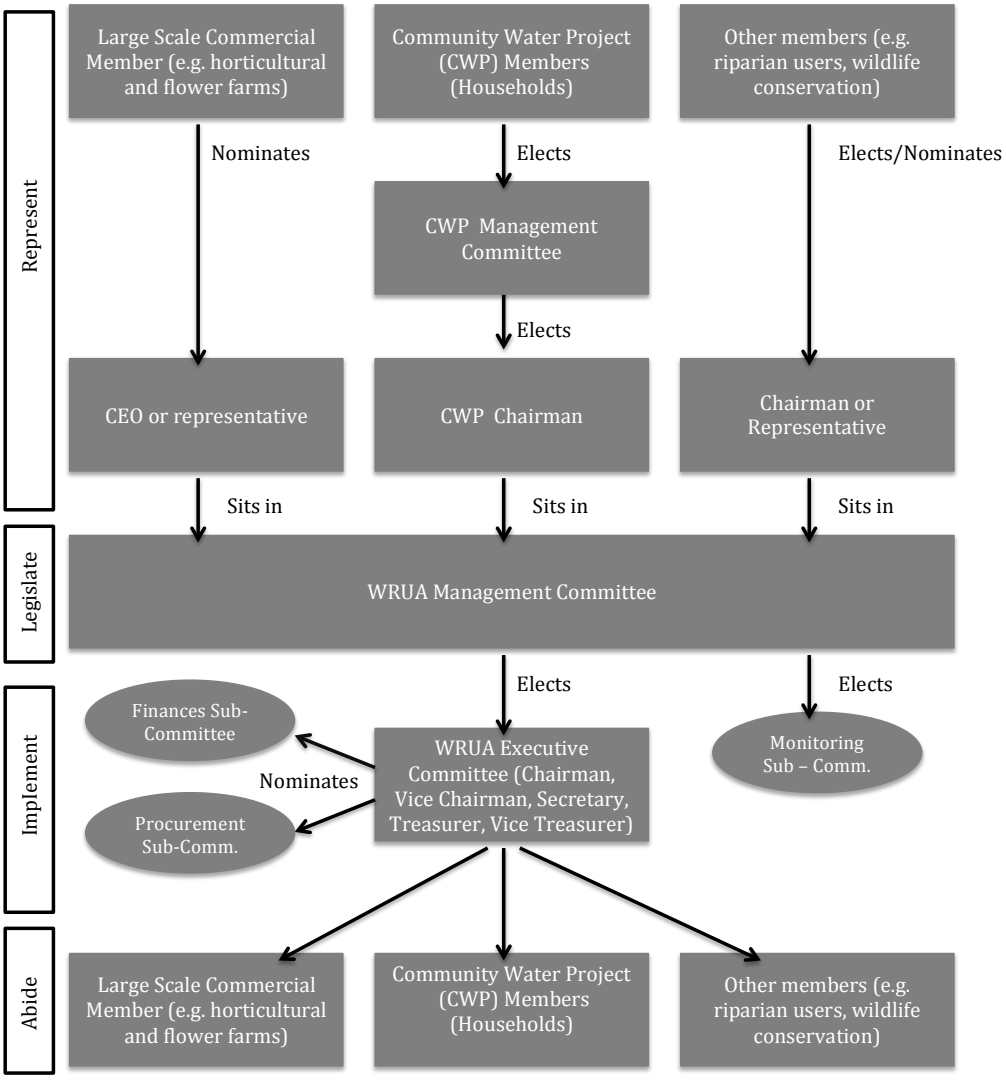

Figure 2. Water Resource Users Association (WRUAs) general structures

More specifically the action arena of our interest, in this paper, is each Community Water Project's management committee which is usually composed of 7 to 11 officers elected among the project's members. The CWP management committee generally has a chairman, a vice chairman, a secretary, a vice secretary, a treasurer and

additional non-executive members. The management committees works on a two to three year mandate and are elected democratically by all members of the project.

Methods

In this research we adopted a multi-method approach in order to grasp the multidimensional components of community water project dynamics and functioning. Data from different dimensions where collected during fieldwork in the summers of 2013 and 2014 from an interdisciplinary team of researchers and research assistants.

Method	Data gathered
Small Group Field Experiments	95 participants and individual questionnaires; 20 management committee group discussions and decisions
Household Survey	752 questionnaires
Managers Survey	69 questionnaires
Mapping	25 community water projects
Household water flow measurement	415 household (Aug. 2013 – Jan. 2014)
Journaling	25 households
Focus Group	1 (17 participants)

Table 1. Multi-method approach

Specifically in relation to the small group field quasi-experiments we have developed a procedure that mixes, in an original way, different features of small group research (Ref). For each community water project, we invited 4-6 management committee members, with the requested participation of the chairman and two other executive officers, to join a fictitious management committee meeting. In the first stage we delivered individual anonymous questionnaires to each participant. The questionnaires asked nine decision-making questions concerning fundamental aspects of CWP management issues. The questions addressed decisions related to drought scenarios, disconnection and addition of members, introduction of monitoring technologies such as meters, fee changes, management of rotation schemes and labor collaboration. Each of these questions proposed a decision-making scenario and ‘yes’ or ‘no’ answers were indicated. In addition, the questionnaire asked for other individual characteristics such as age, gender, education level, years served as manager in the committee, and years of membership in the project.

In the second stage chairmen of each management committee were handed an

agenda produced from a subset of five of the nine questions included in the questionnaire and asked to conduct a management committee meeting to deliberate on the five different scenarios listed above. The management committee was asked to follow the typical internal decision making rules of the committee and decide on the five different scenarios as if it were a real management committee. During the group discussion the researchers would observe the meeting and take notes without interfering with the meeting. In this second stage, the chairman would generally raise the question and the committee would discuss and then deliberate following their typical decision rules (by consensus, majority, etc). Stage 1 and stage 2 of the small group decision-making experiment allowed for observation of the differences between the individual preferences and the group decision. In this way it is possible to observe and identify the extent of the importance of the group dynamic. In order to concentrate the information for each management committee member and study the level of coherence between individual answers and group decisions, we defined a D score for the level of agreement/disagreement in each management committee and a C score for the level of coherence. In other words, for the D score we assigned a value from -1 to +1 where -1 means that at the individual level every member responded NO to a specific question while +1 means that every member responded YES to a specific question in the questionnaire. A D score of 0 indicates that 50% of the members in the committee responded yes to a specific question while 50% responded NO.

In the case of the C score, the dynamic being measured is the coherence between the individual responses for every question (measured by the D score) and the group decision. For example, if for each question every individual answered YES and in the subsequent group discussion the group deliberated for a YES as the committee decision, then the score would be +2. In this case there is maximum coherence between the individual answers and the group decision. In the case that the individuals all answer NO to a specific question and the group deliberation on that same question returned a NO decision, then the score would be a -2. This is a case of maximum coherence but on a negative answer. Minimum coherence instead scores -1 in the case the individuals all answer YES but then the group decision for that same question is NO. In the opposite case, where individuals all answer NO and the group decision is a YES, the returned score would be a +1 for that specific question. When the individuals vote non homogenously the C score would have values between -1 and -2 and between +2 and +1.

Formally:

Define

- $N =$ number of individuals in a group
- $x_1, x_2, \ldots, x_N$ the responses of each individuals $x_i = -1$ for NO and $x_i = 1$ for YES
- $x_G =$ the group response, $x_G = -1$ for NO and $x_G = 1$ for YES

Then

$$D(x_1, x_2, \ldots, x_N) = \frac{1}{N} \sum_{i=1}^{N} x_i = \frac{1}{N} [x_1 + x_2 + \ldots + x_N]$$

and

$$\begin{aligned} C(x_1, x_2, \ldots, x_N, x_G) &= \frac{1}{2} \left[\frac{1}{N} \sum_{i=1}^{N} x_i + x_G \right] + x_G \\ &= \frac{1}{2} \left[\frac{1}{N} [x_1 + x_2 + \ldots + x_N] + x_G \right] + x_G \end{aligned}$$

Results

The characteristics of these user groups vary with respect to their infrastructural characteristics as well as the biophysical setting in which they are situated (Table 2). Likewise, the rules-in-use concerning membership and water rationing are two examples of the variety of institutions in place within the CWPs (Table 2). This includes decisions concerning whether or not to expand membership, the financial burden placed on individuals allowed to join the CWP, and the strategies for distributing water to members during periods of water scarcity.

Formal institutions contained in the projects' bylaws for example do not vary largely between different projects and between different WRUAs. For this reason investigating institutional structures and formal rules in the different CWPs through relying only on manager interviews and surveys has some limitations. What happens in the management committees, which we consider as the fundamental 'action situation' (McGinnis 2011) of the CWP governance structure stays in a black box. The group decision-making experiment procedure that we developed, instead, more directly interrogates the manager decision preferences and at the same time creates the conditions for group deliberation. In this way, we were able to study both individual manager preferences and deliberation dynamics. In Table 2 it is possible to observe that there are substantial differences between the different projects which feed into different social-ecological outcomes; for example, the decision of allowing a new member to join a CWP (which is positive in 12/20 CWPs) has very strong social and biophysical implications overtime. Similarly, CWPs deal with different infrastructural traits; for example, the number of lines range from 24 to 2 lines, and the number of members range from 800 to 10.

Table 2. **Community water project (CWP) social-ecological context variables**

CWP name	WRUA name	Age of CWP	Total pipeline length (km)	Number of lines	Average yearly rainfall (mm)	Average elevation (m.a.s.l.)	Number of members	New members allowed to join CWP	Membership fee (Ksh)	Household-level water receipt during dry periods
CWPL1	Likii	12	6.545	24	747.8	1904	150	Yes	35,000	na
CWPL2	Likii	17	2.043	4	770.0	1939	39	No	100,000	~ 3 d/w
CWPL3	Likii	11	9.467	8	695.5	1845	87	Yes	16,000	na
CWPL4	Likii	32	4.736	2	850.0	2065	125	Yes	70,000	2 d/w
CWPL5	Likii	13	9.699	3	835.1	2036	366	Yes	50,000	2 d/w
CWPN1	Nanyuki	20	36.119	25	756.1	1837	250	Yes	64,000	~ 3 d/w
CWPN2	Nanyuki	27	22.078	14	817.8	2027	600	Yes	84,000	na
CWPN3	Nanyuki	10	17.612	20	776.1	1960	50	Yes	34,200	~7 d/w
CWPN4	Nanyuki	19	37.375	20	791.0	1991	800	Yes	50,000	1-3 d/wk
CWPN5	Nanyuki	25	15.808	27	841.2	2075	403	Yes	20,000	~1-2 d/w
CWPNG1	Ngusishi	15	2.836	6	657.8	2224	180	Yes	50,000	~ 3 d/w
CWPNG2	Ngusishi	6	10.074	8	634.2	2126	280	Yes	60,000	~ 3 d/w
CWPNG3	Ngusishi	15	22.157	8	589.6	2125	150	Yes	50,000	2 d/w
CWPNG4	Ngusishi	16	2.576	3	799.4	2424	10	No	4300	na
CWPNG5	Ngusishi	8	0.835	5	775.9	2429	44	No	2600	~7 d/w
CWPT1	Timau	31	10.671	11	939.0	2623	395	No	13,500	~ 1 d/w
CWPT2	Timau	30	5.600	12	1027.5	2629	386	No	100,000	~ 1 d/w
CWPT3	Timau	28	3.948	2	1108.8	2655	210	No	60,000	~7 d/w
CWPT4	Timau	32	1.756	3	971.4	2519	66	No	36,000	2 d/w
CWPT5	Timau	15	2.399	4	830.0	2521	28	No	14,500	~2-3 d/w

While some management and biophysical differences can be captured through questionnaires and interviews, the variety of decision making dynamics that manifest in the management committee 'action arenas' are difficult to predict before implementing our experimental procedure.

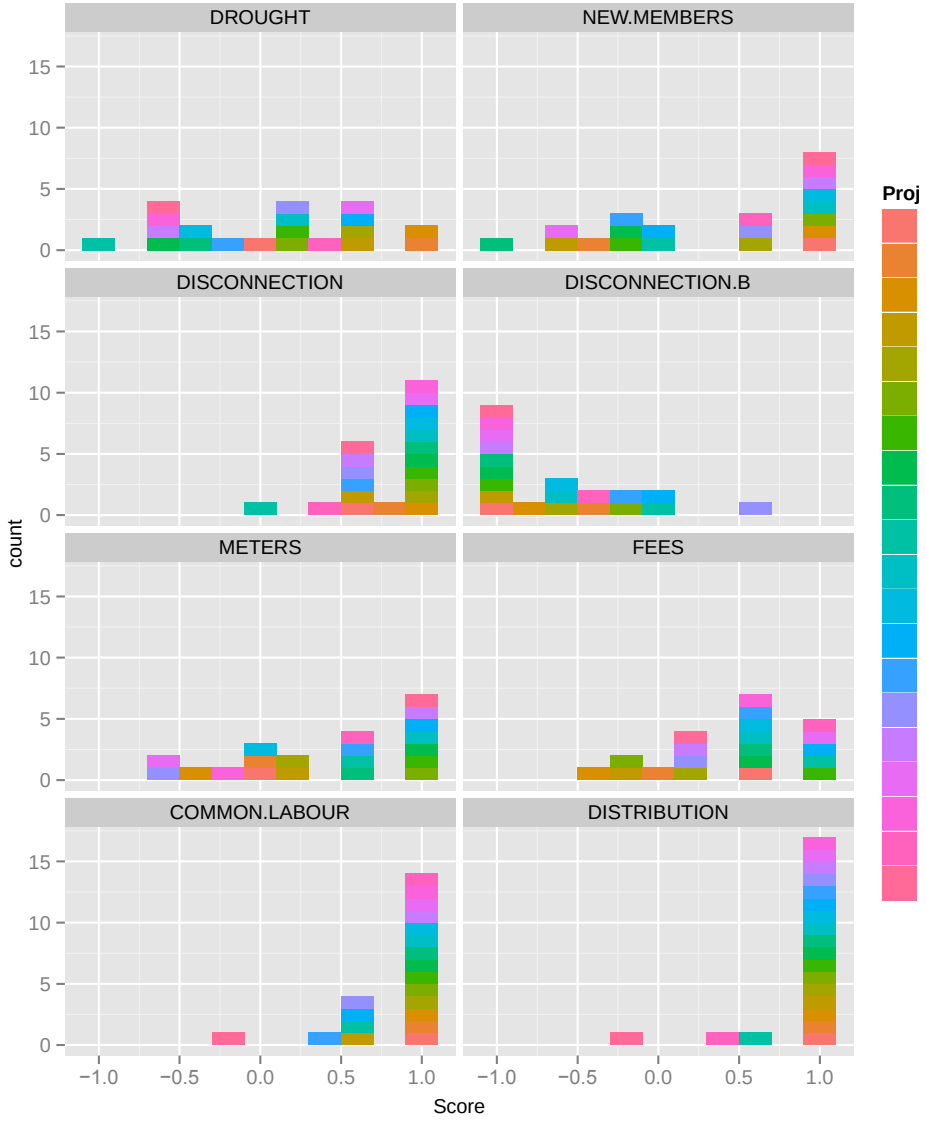

Figure 3: D score of agreement/disagreement

The first result of our small group quasi experiments is a 'D' score of agreement/disagreement for eight different YES/NO questions relevant to the management decisions of the CWPs. The eight questions addressed: (1) rationing scenarios related to drought conditions (DROUGHT); (2) adding or not adding a new member (NEW.MEMBERS); (3a and 3b) two cases of disconnection under different conditions, one for repeated violations of the project's rules (DISCONNECTION),the other for delays in payments due to health conditions (DISCONNECTION.B); (4) introduction of household level meters (METERS); (5) increase of fees for network

upgrade (FEES); (6) organization of common labor for network improvements (COMMON.LABOUR); and (7) reorganization of internal rotation schedules to address water availability disparities among different lines in the project (DISTRIBUTION). In Figure 3 it is possible to observe that each project (represented by the different colors) has different levels of individual agreement for the specific questions. For example, the responses for question 1 (DROUGHT) were relatively evenly distributed, with two management committees returning all YES answers and one management committee returning all NO answers, while the remaining CWPs were distributed between these extremes. Also, by aggregating the individual answers across the management committees of the different projects for this specific question, it is possible to observe that 50 individuals replied YES and 46 individuals replied NO. A different response instead can be seen in question 6 (COMMON.LBOUR). In this case 14 of the 20 management committees returned all YES answers. In this case, at the aggregated level across the management committees, 86 individuals marked YES and 8 marked NO.

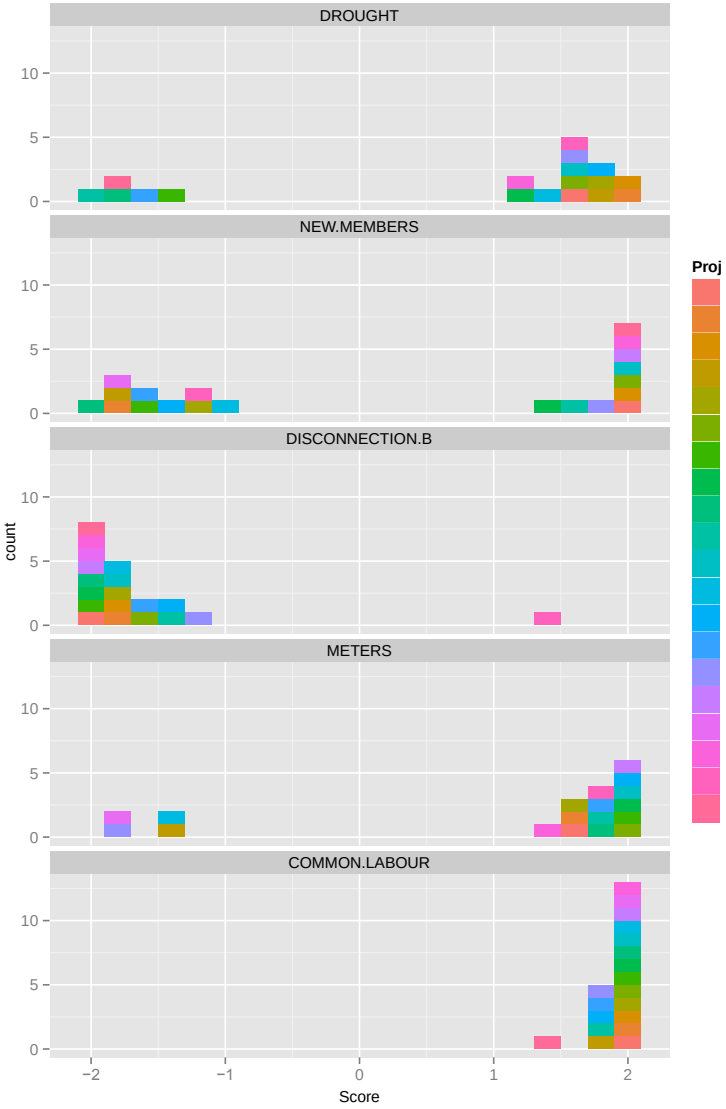

Figure 4. C score of coherence.

After the individual questionnaires, we conducted stage 2 where the management committee had to deliberate as a group (following their typical decision making procedures on a subset of questions). The results, graphically reported in Figure 4, show how the level of coherence for the five questions included in the subset. In this case it is possible to see that, for a question such as COMMON.LABOUR, a majority of management committee scored +2. This means that in a majority of cases the degree of individual YES corresponded with a YES as final group decision. In other words, the 14 projects that had a D score of 1 (i.e. 100% of individual answers were YES) confirmed YES as a group decision. The second most coherent group response, but in this case for a NO response, was in the case of DISCONNECTION.b where 8 management committees had a score of -2. Differently, in the case of the DROUGHT question, it is possible to observe that the group dynamics altered consistently the individual preferences. In this case twoprojects went from a majority of NO individual level answers to a YES group decision. One project did the opposite going from a majority of YES responses at the individual level to a NO response as a group. Eight projects confirmed a YES as a group decision but had only a relative majority of YES responses at the individual level. The NEW.MEMBERS scenario is also a case where group dynamics had a strong effect and reshaped the individual level preferences. In this case, five projects out of 20 went from a prevalence of either YES or NO at the individual level to the opposite decision at the group level.

Concluding Discussion

Since Hardin's 1968 'Tragedy of the Commons' common-pool resource theory has significantly advanced with both theoretical and empirical contributions. Institutional analysis approaches to commons governance have played a major role in this research arena (Ostrom 1990, Lam 1999, Vollan and Ostrom 2010, Dietz 2003); however, attention on the internal dynamics of commons governance could be enhanced. One of the reasons why studying the internal dynamics of CPRs governance is methodologically challenging is that often the rules and institutions that statically describe the functioning of a community based system of management get transformed during the process. In the case of the community water projects studied in our research, for example, archival research and interviews and questionnaires with CWP managers show a certain degree of institutional homogeneity among the different WRUAs. This reflects the fact that when the CWPs were formalized the Kenyan government promoted blueprints for establishing the CWPs and their management rules. As a matter of fact, looking at the different CWPs from the design principles perspective (see Cox et al. 2010) we would find that the governance rules and conditions are very similar.

Nevertheless, if we move from the broader contextual variables and look at the microsituational variables (Poteete et al. 2010) we find that there is a world of action that happens inside the black box of the management committee meeting. But understanding what happens in this fundamental 'action situation' of the CWPs is particularly complicated. Management committees are held every 3 or 4 months and more

fundamental questions such as the ones addressed in our experimental procedure might be considered only in the project's general meetings which happen on a yearly basis. However, general meetings happen at a different stage of the year across different projects. An ethnographic approach could probably get at similar dynamic decision making aspects but this would probably be restricted to a smaller number of projects or would necessitate extending the research across a longer time period. It is therefore understandable why experimental approaches have been considered particularly powerful in dealing with dynamic features of decision-making processes engaging communities with dilemmas and scenarios. The limiting factor with experimental approaches, though, is that in order to preserve the methodological rigor defined by the academic community, they often have been strongly disconnected from reality, projecting reductionist *homo economicus* assumptions in contexts where the problem is not profit maximization (Smith 2010, Anderies 2011).

Our approach, which built on two preceding years of extensive data collection and establishment of long-lasting research collaborations with the community water projects members, has borrowed notions from experimental approaches both within behavioral economics and social psychology but moved beyond traditional protocols. Less methodological rigor but stronger connection to the broader social-ecological context provided results that are more meaningful for the communities involved in the research. This was particularly clear in the moment in which mid-term results were returned to the communities. Project managers were particularly interested in discussing the relevance of our scenarios to their current management processes and to compare these with other community water projects.

At this preliminary level of analysis this work shows that on relevant decision making scenarios there is a variety of agreement and disagreement related to different kinds of questions in different projects. Moreover, the individual preferences can be transformed through group decision-making dynamics where, according to the different decision rules, the management committees are used to deliberate on issues that might have a certain level of disagreement. In particular, our work, at this stage, shows that the level of coherence that there is between individual preferences and group decisions varies across different projects and on different topics. This is a result that has been possible to reach only by 'entering' the 'action arena' with an experimental approach, and it shows that the level of analysis and comprehension of CPR decision making dynamics could go well beyond a superficial identification of institutional features. Moreover it is fundamental to acknowledge that the tendency to treat CWPs as homogenous entities in the larger picture of river basin water governance is misleading. Internal dynamics could be the strongest determinant of decision-making, particularly in times of increased water scarcity. Our work will continue in the direction of investigating the internal dynamics of processes of CWP governance, and we will push forward the analysis to identify the different factors that play a role in these processes.

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