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Fisheries co-management institutions in Southern Africa: a hierarchical analysis of perceptions of effectiveness

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Abstract: A random sample attitude survey concluded a ten-year research effort on fisheries co-management that was carried out in Malawi, Mozambique and Zambia. The survey responses were analysed using a two-level hierarchical model that allowed conclusions about village-level institutions to be based on individual-level survey responses. The present paper describes the surveys background, methodology, and conclusions. Three of these conclusions are very clear from the survey results. The first is that co-management that is more responsive to the community is more effective. The second is that co-management institutions made up mainly of fishers are more effective than ones that incorporate a broad range of stakeholders. The third is that local conservation efforts being seen as making a positive contribution to village life is unrelated to their being seen as rule enforcement mechanisms.

Keywords: Community-based natural resource management, fisheries, hierarchical models, Southern Africa, traditional authorities

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1. Introduction

Agencies responsible for the management of aquatic ecosystems in Southern Africa have had to work on large scales because their primary mandate has been fisheries management. Fisheries are fugitive resources that force these agencies to address the management of long rivers and large lakes and swamps as units. To do this, these agencies look for help from communities, fishers, village headmen and traditional authorities. The resulting 'fisheries co-management' programmes are arrangements where responsibility for resource management is shared between the government and user groups. This sharing of information and authority ranges from governments making decisions based on a minimal exchange of information with fishers to governments delegating authority and the fishers keeping them informed about progress (Sen and Raakjær Nielsen 1996).

In Africa, the tendency has been towards a more top-down form of co-management where the community group is mainly concerned with helping to enforce government created rules on how and when to fish, such as confiscating illegal nets and monitoring closed fishing seasons. In many cases, the programmes have involved Departments of Fisheries and NGOs carrying educational and motivational events in the area. The community groups have also sometimes pushed for limiting the access of outsiders to local fisheries.

In this set of papers, we are examining the question of scaling-up commons conservation practices and these co-management programmes can provide valuable lessons about operating on broad scales. Single fisheries co-management programmes have involved as many as 50 or 60 villages ranging across substantial numbers of different traditional authority units. In the case of the Mweru-Luapula programme in Zambia, for example, 13 chieftaincies are involved in the fisheries co-management programme.

This paper reports on a formal, random sample survey carried out within six large scale co-management programmes on seven water bodies: the Lake Mweru and the Luapula River that share a single programme, and Lake Kariba in Zambia, Lakes Chilwa, Chiuta and Malombe in Malawi and the Atlantic Ocean in Mozambique. In all cases, these programmes have consisted of replicating around the water body village management committees (VMCs) that are nested within district level committees. They were all initiated by government fisheries agencies working with NGOs or donors, and involved traditional authorities.

The research reported here is one product of the ten-year (1993–2003) Worldwide Collaborative Research Project on Fisheries Co-management (WCRPFC). The WCRPFC did empirical research on fisheries co-management in both Asia and Africa. During the first five years, Phase I of the project focused on descriptive case studies of co-management experiences. It produced a large number of research products; culminating in an edited volume reviewing global experiences with co-management (Wilson et al. 2003) and a policy brief (Raakjær Nielsen et al. 2004).

The WCRPFC African team met in Cape Town in 2000, reviewed the case study work from Phase I and identified three general hypotheses that would guide the remainder of the research effort in the three countries. The workshop decided to adopt a two segment strategy to evaluate these hypotheses. Each country would begin with a qualitative phase using in-depth interviews involving programme leaders across wide areas and using textual analysis tools to test the hypotheses. The hypotheses are described in the next section. The qualitative work found that the first hypothesis was supported in all three countries, while the second and third hypotheses were generally not supported (Wilson et al. 2009).

The final step of the WCRPFC was a random sample survey of households, fishers and VMC members that attempted to capture quantitative information able to evaluate aspects of the hypotheses. As discussed in detail below, kinds of systematic, quantitative comparisons of institutions are always a huge challenge and the fact that there is any possibility of this at all begins from the serendipitous fact that we have a fairly large number of remarkably similar institutions. In each country the co-management had been organised by a central department of fisheries. They each used the village management committee approach. The fisheries, cultures and economic conditions are fairly similar. Finally the models of stakeholder involvement and initiation followed a similar model, involving

national departments of fisheries (DoFs), NGOs, and traditional authorities and other local leaders.

2. Background on the hypotheses

1. If co-management programmes involve traditional authorities and government departments, district councils and NGOs that are seen to be trustworthy, transparent in their operations, and operating cooperatively and equitably, the programmes will be stronger.

Hypothesis 1 reflects some fairly general understandings about the need for CBNRM institutions to operate in responsive and transparent ways (Agrawal and Ribot 1999). The major problems usually stem around issues of enforcement and the appropriate roles of various parties. Local co-management groups often emphasise their role as enforcers of government rules and routinely demand increased enforcement powers from the Departments of Fisheries (DoF). The WCRPFC qualitative research found the perceived behaviour and levels of corruption of the local DoF officers to vary widely.

Central to this hypothesis is the role of local elites and how to deal with the possibility of their capture of benefits generated by commons management. The question of elite capture has been addressed in the commons literature for some time (Sanford 1983). One critical group is the 'Traditional authorities' (TAs) (Ribot 1998). TAs play some role in all of the co-management programmes we studied, although the degree to which they cooperate with the DoF varies. The term TA covers many kinds of institutions, but they are mainly offices based in ethnic groups, and they have taken on greater powers in natural resource management in Southern Africa in the past 20 years. Often they are more respected by the fishers than formal government authorities. In Zambia, the fisheries co-management programme on Lake Bangweulu that chose not to involve TAs collapsed as soon as the NGO support was withdrawn, while the nearby Mweru-Luapula programme that did involve the TAs carried on after donor support was withdrawn. In Malawi, however, a co-management programme that had TAs on the management committee was less successful than one composed of elected fishers (Hara et al. 2002). The qualitative work of the WCRPFC found support for this hypothesis in all three countries. Instances of opportunistic behaviour weakening the co-management programmes were widespread. Most critical was a perception that government officers, TAs and VMC members were benefiting directly from the confiscation of fish and gears.

In fisheries co-management, issues around local elites are not restricted to the TAs. In Zambia, there have been issues with local governments' fish levies that are not used in a transparent manner. Conflicts between gear owners, boat owners

and crew are common and these conflicts spill over into the VMCs. In Malawi, a disconnect between the crew and the co-management programme, indeed even a sense that the VMCs ignore the fishers, has been an important reason for programme failure (Donda 2001; Hara et al. 2002).

2. Having a greater mixture of stakeholders represented in management committees will lead to stronger co-management.

The criticism that participatory approaches to both NRM and development in general exclude the poor and women has been heard for many years (Gow and Vansant 1983; Black-Michaud and Johnson 1986; McCall 1987). VMCs are often made up of wealthy boat owners and frequently women are excluded (Lopes and Gervasio 1999; Haraldsdottir 2000). A common recommendation for addressing these problems of gender and class has been to expand the make-up of the VMCs. However, hypothesis 2 was generally not supported by the WCRPFC qualitative research because many, but certainly not all, respondents indicated that VMCs work better when they are primarily made up of fishers.

3. More in-migration in fishing areas will lead to stronger co-management.

The seasonal and longer migration of fishers is the most common reason for conflicts in fisheries (Wilson 2003; Allison and Badjeck 2004). These conflicts are most commonly expressed in terms of historical fishing rights and/or the use of 'destructive' fishing techniques by the migrants. Some case studies, especially in Malawi (Hara et al. 2002) have found instances where getting government help in excluding outsiders has been an important motivator of effective co-management programmes. This is a problematic area. The idea of the 'tragedy of the commons' is often applied rather loosely in resource management and used by many groups as a rationale for restricting the access of other people to the resource. A major review of African inland fisheries by Jul-Larsen et al. (2002) suggests that where water levels fluctuate, as is commonly the case both generally and in the specific water bodies we are examining, an increase in the number of fishers actually does little or no damage to the resource. It is the introduction of capital intensive technology and large-scale markets that threaten real resource depletion. This means that people making sporadic use of fisheries as a part of a mainly agricultural food security strategy are not a threat to resource conservation. If fisheries co-management works best when it is motivated by a desire to exclude outsiders then great care would be needed to ensure that it is not actually increasing the overall levels of poverty. In the qualitative work, however, hypothesis 3 was not strongly supported. While there were instances where migration was an important motivator for co-management participation there were others where it was not important, and even some where it seemed to undermine the programme.

3. Methods

The survey reported on here was carried out with 1164 respondents in Malawi, Mozambique and Zambia between February 2003 and December 2004. It was carried out in villages where there were operating VMCs, meaning that the VMC had met at least once in the preceding year. Data was gathered on a total of 58 VMCs on seven water bodies: Lakes Mweru (10 VMCs) and Kariba (7) and the Luapula River (8) in Zambia, Lakes Chilwa (13), Chiuta (4) and Malombe (6) in Malawi, and the Indian Ocean (10) in Mozambique. The survey was done with 16 people from each village. Four VMC members were randomly selected from the membership list. Four households were selected at random from a list of all village households provided by the headman. Eight fishing boat owners were randomly selected from a census of physically present boats carried out by the interview team at an appropriate time of day when fishers could be expected to have their boats on shore. A village information sheet was filled out, which contained basic information about all the boats found in the fishing boat census and about the overall membership of the VMC. The analysis presented here is based on a smaller sample of 574 people in 39 areas where seven or more respondents asserted that they were familiar with the operations of the VMC. VMC boundaries sometimes include more than one village. The sampling strategy was based on the demands of the hierarchical model to have a large sample on second level, i.e. having many VMCs is as much or more critical than many respondents.

Even with programmes, fisheries and cultures as similar as these are, a systematic, quantitative comparison of institutions faces tremendous hurdles. The most basic challenge is the measurement of non-trivial characteristics of institutions in ways that are authentically comparable. The direct measurement of many important institutional characteristics is beyond our abilities, let alone our budgets. We say that transparency is important, but can one really measure something like 'who gets to look at the books' in a way that the 'who' and the 'books' are the same thing across a large enough sample to analyse one relationship while holding the others constant? The answer is no and therefore social scientists use designs like the multi-site, multi-method case study as the best substitute.

The alternative we are using here is to measure and compare individual perceptions of institutions. At first glance this seems a poor substitute for direct observations of behavioural patterns. Perceptions are subjective opinions, not concrete facts. Opinions that sound superficially similar can differ, even between two people on the same committee, let alone between a housewife in Zambia and a beach seine owner in Mozambique. But this approach has some very important characteristics to recommend it. Most importantly, we are comparing things that are in exactly the same form: answers to the same questions posed, in principle, in exactly the same ways by interviewers. Beyond this, the techniques used to measure perceptions have been used for a long time

in many different contexts and the statistical properties are very well understood. Responses to attitude-scale questions like those used here have been shown both mathematically and empirically to be exceedingly robust to the fact that there will be differences between how the questions are understood, e.g. how one person's 'five' may not be the same as another's (Nunnally 1978). Secondly, in a very real way perceptions of institutions reflect what institutions actually are, i.e. shared meanings. The perception of an institution's transparency is, or at least is very closely associated with, what makes transparency an important institutional characteristic.

Even given these arguments we have one more critical hurdle to pass before comparing institutions through perceptions of their characteristics. Perceptions are an individual level phenomenon while the VMCs operate at the level of one or several villages. To make this leap, we employ a multi-level hierarchical linear model (HLM) (Snijders and Bosker 1999; Osborne 2000). This is an analytic approach that has been used successfully in such diverse areas as examining differences in house prices based on the characteristics of both houses and neighbourhoods (Hamnett 1983) and health behaviour in both individuals and communities (Dunca et al. 1993). It has been used very commonly in educational research where it is important to distinguish between students, classes and schools (Bock 1989). In all cases the idea is to separate the influence of the various levels. What HLM does is to partition the variance in responses between the individual level respondents and the VMC to which they are referring (See Figure 1). All of the analyses below use a 'random intercept' model that measures the impact a variable has on the intercepts of the regression lines of different VMCs.¹

Table 3 reports the results of a multi-level regression on a standardised variable measuring the perception that the work of the VMC has led to there being more fish. One of the variables is a standardised measure of the degree to which a VMC is perceived as responsive to the village. The significant 0.09 means that an increase in perceived responsiveness of one standard deviation lifts the intercept, i.e., the average perception of more fish with the other variables held constant, by 0.09 standard deviations. We have included in Table 3 a report of standard linear regressions at both the individual level and VMC-level averages to give the reader an idea of the different results that would be obtained if the problem of partitioning response variance between the individual and VMC levels was ignored.

While we think a good case can be made for the validity of this comparative strategy, the end result is still far from perfect. The interviews took 45 minutes to an hour and some respondents no doubt became tired and careless about pointing to the right place on the strange 'ladders' described below. Practical constraints meant that the surveys were carried out by employees of our partners, all of which

¹ More complex models that examined differences in line slopes among VMCs were not found to increase model fit in any analysis.

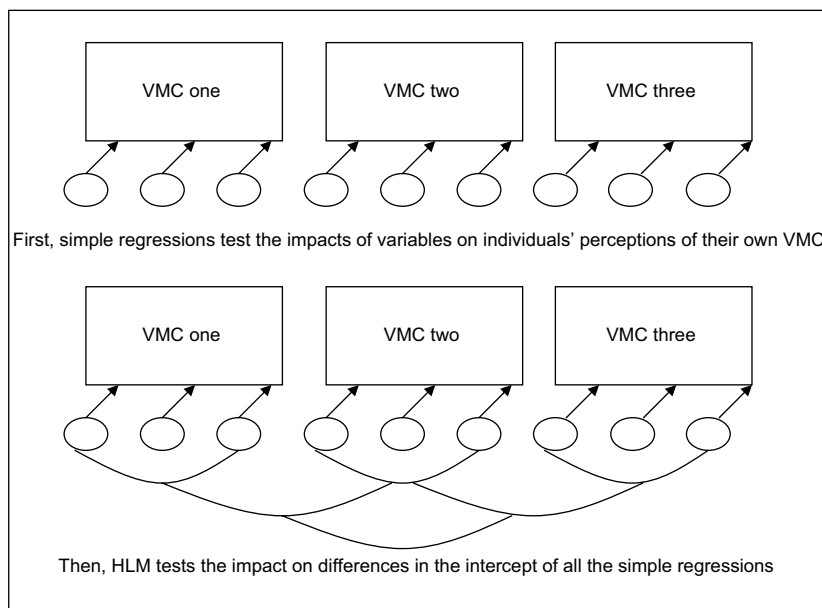


Figure 1: The basic idea of hierarchical linear modelling.

were government participants in the co-management programmes. They were given several days training, but are not professional survey enumerators who can be counted on to ask the questions in the exact same way every time. Using even low level government employees may engender a desire in some respondents to say what they think the government wants to hear. Most serious of all, perhaps, is that villagers were being asked opinions about village headmen and TAs while knowing that the headmen were (unavoidably) involved in helping to organise the survey. Most of these questions were fairly neutral, but a few were evaluative of these officers' job performance. Respondents could not be expected to be critical in this situation, and, indeed, responses clustered around the positive ends of the scales. These responses were normalised for the analysis and hopefully captured some of the real differences.

We present these results, however, believing that in spite of these problems they make a valid contribution to our knowledge of these issues. The main reason is that, with two partial exceptions, the results are coherent and clearly interpretable in terms of our qualitative knowledge, both from the other WCRPFC research and from the general literature on fisheries co-management in Africa. Survey research in rural Africa is always plagued by measurement problems, but it has its place in institutional analysis as a complement to qualitative comparisons and case studies. When so used, it allows us to show with some precision how widely some important patterns encountered in case studies are found. The case studies, in turn,

make it possible for us to interpret what we are measuring and the meaning of any correlations we are finding.

3.1. Variable measurement

3.1.1. Dependent variables

The analysis is carried out with four dependent variables. The dependent variables are responses to the following four questions:

Do you think that there are more fish now because the VMC has been working?

Do you think the village is better off or worse off because of the VMC?

How has the number of people punished for violating fisheries rules changed because of the work of the VMC?

How has the number of people violating the fisheries rules in this village changed because of the work of the VMC?

Responses to the first questions were one of three choices: the VMC has made no difference, a little difference or a lot of difference in the amount of fish. The other three questions, as do the remainder of the attitude questions used in the analysis, used visual ladders and respondents were asked to point at a step in the ladder corresponding to a number from one to six with an appropriate term in the local language defining each end and the middle of the ladder. For example, the ladder used for the second question ran from *very much worse* at the bottom, through *the same* in the middle to *very much better* at the top.

3.1.2. Independent variables

The analysis is based on four types of independent variables. The first is a set of individual characteristics of respondents that are used purely as control variables. The second is a single variable that measures the perception of the VMCs responsiveness to the village. The third is a set of six measurements of perceptions of the transparency and the degree of support for the co-management programme of three important institutions: the relevant traditional authority, the village headman, and the Department of Fisheries. The fourth type is a set of VMC level characteristics: the degree to which the area of the VMC is characterised by migratory as opposed to sedentary fishers; the percentages of fishers; the percentages of traditional authorities; and, the percentages of women within the membership of the VMC.

The **individual characteristics** controlled for are if the respondent is a fisher, a VMC member, the respondent's age, education, migration status, wealth and gender. Education was measured by the number of years of education entered. Wealth and migration status were measured by more complex scales:

The wealth scale was created by standardising and summing these four items:

- a) The response to this question:
Do you or your spouse have any cash savings that you can call on in an emergency?
NO YES => If you were forced to live on this savings how long would it last?
A week, a month, several months, a year, more than a year.
a response of NO scored 0, a week scored 1, a month scored 2, several months scored 3, a year scored 4, more than a year scored 5.
- b) A scale based on the number, roof material and floor material of the respondent's houses was created by giving one point for each of the respondent's houses having a cement floor and one for each house having an asbestos roof.
- c) One point if the respondent was receiving regular cash remuneration from someone living elsewhere, zero if he or she was not.
- d) Whether and what kind of vehicle the respondent owned was scored as: None 0, bicycle 3, motorcycle 10, car 15, truck 20.

The result is, as one would expect, a highly skewed variable with many poor people sloping off to a small number of relatively wealthy people.

The measurement of the degree to which people in rural Africa are not native to the place where they are being interviewed is very complex. The migration scale we use consists of six items:

- a) The response to the question:
Q1. Is this village your ancestral home?
If the answer is 'yes' the respondent was scored 0 on this and all other migration scale questions, – hence 0 on the overall scale – if the answer was 'no' the respondent scores 1 for this question.
- b) The response to:
Q2. Where is your permanent residence? a) this village b) a nearby village c) another village in this district d) outside this district.
A response of a or b was scored 0. A response of c was scored 1 and d was scored 2.
- c) The response to the following qualified by the response to Q2:
Q3. [Do any of your wives/Does your husband] stay at your permanent residence? a) no b) yes.
A response of c on Q2 and b on Q3 was scored 1, a response of d on Q2 and b on Q3 was scored 2.
- d) The response to the following again qualified by the response to Q2:
Q4. When did you last sleep at your permanent residence? a) last week b) last month c) several months ago d) over a year ago.
A response of c on Q2 and b on Q4 gets 1, d and b respectively get 2, c and c get 2.5, d and c get 3, c and d get 3.5 and d and d get 4.

- e) Q3 and Q4 are also combined. If Q3 was b then a b on Q4 was scored 1, a c on Q4 was scored 2 and a d on Q4 was scored 3.
- f) Finally, the response to the following question:
- Q5. During the past 12 months how many times did you stay (sleep for more than two weeks) anywhere outside this village?
- A response of 0 was scored 0, 1 or 2 scored 1, 3 or 4 scored 3 and 5 or more scored 4. If the respondent answered a or b to Q2 they also score 0 here.

The resulting variable is highly skewed in that 60% scored 0. The remaining 40%, however, distributed fairly normally with a mean of 5 and a maximum value of 14.

The scale measuring **VMC responsiveness** is a standardised linear combination of responses to the following four questions:

How carefully do you feel the village management committee listens to people like you?

How carefully do you think that the village management committee listens to women?

How carefully do you think that the village management committee listens to farmers?

How carefully do you think that the village management committee listens to fishers?

The combination of these four items yields a reliability coefficient of 0.74, high enough to treat these four items as measuring an underlying perception of VMC responsiveness to the village. In constructing the attitude scales, we took as sufficiently high reliability coefficients a simple correlation of 0.5² for two items or more or a Chronbach's Alpha of 0.7 or higher for three or more items.

Scales measuring **perceptions of institutions** were developed in several different ways from questions taking the following form:

Q1. How much do you think the Department of Fisheries supports the Village Management Committee?

Q2. How much do people in this village know about who gives the Department of Fisheries advice?

Q3. How much do people in this village know about how the Department of Fisheries makes decisions?

Q4. How carefully does the Department of Fisheries listen to the Village Management Committee?

Q5. How fairly do you think that the Department of Fisheries treats the people in this village?

² In one case, we decided to move ahead with a 0.47 as this was the combination we used for the other institutions, and we felt that being flexible with our rule of thumb was better than the alternative of using such highly correlated single questions separately.

These questions were asked about each of the institutions we are considering here. A measure of perception of DoF support was built from Qs 1, 4 and 5 with an alpha of 0.72. A measure of the perception of DoF transparency was built from Qs 2 and 3 with a correlation of 0.50. A measure of the perception of the village headman's support was built from Qs 1 and 4 with a correlation of 0.58. A measure of the perception of the headman's transparency was built from Qs 2 and 3 with a correlation of 0.47. A measure of the perception of the TA support for the VMC was built from Qs 1 and 4 with a correlation of 0.72. A measure of the perception of the TAs transparency was built from Qs 2 and 3 with a correlation of 0.63. We included Q5 only for the Department of Fisheries as perceptions of the general treatment of the village by the other two authorities would be much more diverse than just fisheries.

Finally, the **VMC level characteristics** were measured by data gathered specifically for that purpose. A description of the make-up of VMC membership was prepared for every village, and this was used for measuring the percentage of fishers, percentage of women and percentage of traditional authorities on the VMC. The percentage of fishers included both those who were full time fishers and those who were both fishers and farmers. Percentages of other stakeholders – government officers and fish traders – were also examined, but not found to have any influence on results. We also characterised the overall level of the migration in the village by a weighted average of the VMC-wide average of the migration scale described above and the percentage of the fishing boats in the census of boats at the VMCs landings that were described as ones that 'come and go' rather than being ones that are 'always here'. We decided to weight the average of the migration scale more heavily than the boat census information (0.75/0.25 respectively) because this was a richer information base than a one shot picture of the landing beaches which were unavoidably going to be taken at different times of the year. In the event, however, this decision did not have any impact on the analysis.

4. Results

Table 1 reports the simple correlations between the dependent variables.

The first result of interest is the clear distinction between the two types of dependent variables. First, the two 'general effectiveness' variables – 'do you think there are more fish' and 'do you think the village is better off' correlate with one another ($r=0.29$, $p=0$) and not with the two variables related to enforcement. The two enforcement variables also correlate ($r=0.40$, $p=0$) with each other, indicating that respondents associate punishments and violations directly with each other, suggesting that punishments are often seen as indicators of violations. Second, they have three predictor variables in common: percentage of fishers on VMC, VMC responsiveness, and perception of DoF support for the VMC. With the exception of the importance of the headman's support, as headmen are in many cases part of the TA system, the traditional authorities have very little to

Table 1: Correlations between dependent variables.

		More fish	Better off	Punishments	Violations
Do you think that there are more fish now because the VMC has been working?	Pearson correlation		0.29**	-0.04	-0.02
	p		0	0.32	0.62
Do you think the village is better off or worse off because of the VMC?	Pearson correlation	0.29**		-0.06	-0.07
	p	0		0.18	0.09
How has the number of people violating the fisheries rules in this village changed because of the work of the VMC?	Pearson correlation	-0.04	-0.06		0.40**
	p	0.32	0.18		0
How has the number of people punished for violating fisheries rules changed because of the work of the VMC?	Pearson correlation	-0.02	-0.07	0.40**	
	p	0.62	0.09	0	

**Correlation is significant at the 0.01 level (2-tailed). N=574.

do with this general effectiveness. The enforcement variables are almost a mirror image of this. With the exception of the fact that VMC responsiveness increases the level of perceived violations of management rules, the enforcement variables are entirely linked to perceptions of headmen and TAs.

Table 2 reports the results of the regressions that were used to control for respondents' individual characteristics. The individual level variables explain very little of the variance of the dependent variables, none at all in the case of the perceptions of violation and punishment. We feel it is important to control for these variables in order to aid interpretation, and all of them have some impact on at least one of the dependent variables. The remainder of the analysis takes the standardised residual values of these regressions as the measure of the dependent variables.

Table 3 reports the results of the analysis on the first dependent variable, the perception that the VMC has increased the amount of fish. For illustrative purposes the results of two non-hierarchical models, one based only on the individual level and one based only on the VMC level (averages) are reported. These two models sometimes contradict one another, with the VMC level model finding nearly everything significant. The two lowest rows report the portions of the overall model variance that are found on the individual and VMC levels, the significance found on both levels indicates that the hierarchical model is the appropriate one.

For the hierarchical model only those variables that were found to be significant are reported. The models were built by testing small groups of variables separately and retaining those which showed significant impacts. The variables measuring percentages in particular went through a number of separate tests because they are

Table 2: Individual level linear regressions on the four dependent variables.

Respondent characteristic	Do you think that there are more fish now because the VMC has been working?		Do you think the village is better off or worse off because of the VMC?		How has the number of people violating the fisheries rules in this village changed because of the work of the VMC?		How has the number of people punished for violating fisheries rules changed because of the work of the VMC?	
	Beta	p	Beta	p	Beta	p	Beta	p
Is a fisher	-0.06	0.12	-0.03	0.48	-0.09	0.04	-0.04	0.36
Is a VMC member	0.15	0	0.12	0	0.03	0.50	0.06	0.20
Wealth scale	0.08	0.04	0.01	0.77	-0.01	0.74	-0.04	0.37
Migration scale	0.03	0.45	0.10	0.02	0.05	0.21	0.02	0.61
Education	-0.07	0.01	-0.15	0	-0.04	0.32	-0.01	0.84
Age	-0.20	0	-0.07	0.11	-0.08	0.06	0.06	0.20
Female	-0.11	0.01	-0.07	0.12	-0.04	0.31	-0.06	0.19
Adjusted R ²	0.12		0.03		0.01 (model is not significant)		0 (model is not significant)	

Table reports standardised regression coefficients from a simple linear regression on basic respondent characteristics. N=574 missing values were substituted by variable means.

Table 3: Two-level hierarchical model for perception of more fish with contrasting single-level models.

Do you think that there are more fish now because the VMC has been working?	Individual responses		VMC averages		Two-level hierarchical model	
	Beta	p	Beta	p	Intercept change	p
Percentage of fishers on VMC	0.10	0.04	-0.01	0.70	0.01	0
Percentage of women on VMC	-0.05	0.33	-0.17	0		
Percentage of traditional authority representatives on the VMC	-0.28	0	-0.38	0	-0.02	0
VMC overall migration level	-0.16	0	-0.35	0	-0.17	0
VMC responsiveness	0.13	0	0.36	0	0.09	0
Perception of DoF support	0.05	0.26	-0.10	0.06	0.08	0.02
Perception of DoF transparency	0.09	0.05	0.33	0		
Perception of headman's support	0.05	0.28	0	0.98		
Perception of headman's transparency	-0.05	0.35	-0.11	0.04		
Perception of TAs support	0.02	0.70	0.21	0		
Perception of TAs transparency	-0.02	0.78	-0.13	0.04		
VMC level error variance					0.17	0
Individual level error variance					0.63	0

Hierarchical model N=533 individuals and 39 VMCs. All variables are centred on their mean, with the attitude variables being standardised scales. The number of respondents per VMC ranges from 6 to 26 with an average of 13.6. Twenty-one responses are missing from one of the questions used to construct the responsiveness scale, 11 from the questions used to construct the perception of DoF support scale and five are missing from both. Individual N=574 using mean substitution for missing values. VMC average regression N=39. These grey-shaded 'results' are for illustrative purposes only.

neither logically nor statistically independent. However, there were no ‘borderline cases’. All of the independent variables either clearly did or clearly did not make a difference in the level of the intercept, the only possible exception being the impact of VMC responsiveness on the number of rule violations reported in Table 4. This result is somewhat less significant than the other results and has an initially peculiar direction.

Finally, Table 4 reports the results of the hierarchical model for the remaining dependent variables.

5. Discussion of results

5.1. Hypothesis 1

If co-management programmes involve traditional authorities, government departments, district councils and NGOs that are seen to be trustworthy,

Table 4: Two-level hierarchical models continued.

	Do you think the village is better off or worse off because of the VMC?		How has the number of people punished for violating fisheries rules changed because of the work of the VMC?		How has the number of people violating the fisheries rules in this village changed because of the work of the VMC?	
	Intercept change	p	Intercept change	p	Intercept change	p
Percentage of fishers on VMC	0.005	0				
VMC responsiveness	0.18	0			0.08	0.04
Perception of DoF support	0.14	0				
Perception of headman’s support	0.10	0.02				
Perception of headman’s transparency			0.17	0		
Perception of TAs support					-0.20	0
Perception of TAs transparency			-0.14	0		
VMC level error variance	0.06	0	0.10	0	0.17	0
Individual level error variance	0.78	0	0.87	0	0.63	0

Hierarchical model. All variables are centred on their mean, with the attitude variables being standardised scales. Better off question: N=530 individuals and 39 VMCs. Number of respondents per VMC ranges from 6 to 25 with an average of 13.6. Twenty-one responses are missing from one of the questions used to construct the perceptions of VMC responsiveness scale, ten from the questions used to construct the scale of perceptions of DoF support, three from the questions used to construct the perceptions of headman’s support scale, one from both the headman and DoF scales and three from all three scales. Violation question: N=533 individuals and 39 VMCs. Number of respondents per VMC ranges from 6 to 27 with an average of 13.6. Twenty-one responses are missing from one of the questions used to construct the responsiveness scale, 11 from the questions used to construct the perception of TAs support scale and five are missing from both. Punishment question: N=554 individuals and 39 VMCs. N per VMC ranges from 6 to 29 with an average of 14.2. Five responses are missing from one of the questions used to construct the transparency scale for the TA, five from the questions used to construct the transparency scale for the headman and six are missing from both.

transparent in their operations, and operating cooperatively and equitably, the programmes will be stronger.

The results support Hypothesis 1 if one accepts the, we think reasonable, idea that a perception of VMC responsiveness is a good measure of whether or not the VMC is seen to be, in general, 'operating cooperatively and equitably'. For the general effectiveness variables the impact is stronger than either DoF or headman's support. The support of those two institutions is also important, especially DoF which has a significant impact on both of the general effectiveness variables. We can argue that this suggests that operating cooperatively is indeed important, but we cannot extend this to the ideas of trustworthiness or transparency. These things seem to achieve their major impact through their absence.

The TAs support has a very strong impact, but only in one place – in the perception of the degree to which people are violating fisheries rules. TAs are important for enforcement, but enforcement is not linked to either conservation or the VMCs general contribution to village life. Indeed, when the number of TA representatives on the VMC increases the perception that the VMC is being effective in fisheries conservation actually decreases. On the other hand, the VMCs seem to have little to do with enforcement, except that increased responsiveness is associated with increased levels of rule violation. Indeed, this is initially an anomalous result that suggests that those VMCs that are regarded as responsive to the village are not the ones that focus on violations of government rules.

The results in relation to transparency are murky, or at best complex. Transparency is linked to punishment and only to punishment. In relation to the qualitative results this makes some sense. The issue of transparency arose consistently in relation to the proceeds from the punishments, i.e. the use of the confiscated fish and fishing gear. These results suggest that the TA demand found in some of the qualitative research, that the proceeds from punishments should come to them, is widespread. Hence TAs that are associated with a less intense campaign to collect the funds for themselves, and perhaps therefore are seen as more transparent, are less involved with punishment. On the other hand, in the case of the headmen, who much more than the TAs are the ones involved with the day-to-day confiscations and decisions about the use of the proceeds, transparency may be associated with a more active public involvement in rule enforcement. The punishment question is also linked only to the characteristics of the headmen and TAs, reflecting the fact that in most cases the VMCs do not have any direct enforcement power, but rely on other authorities.

5.2. Hypothesis 2

Having a greater mixture of stakeholders represented in management committees will lead to stronger co-management.

Hypothesis 2 is not supported. Rather the opinion expressed in many of the qualitative interviews that VMCs are more effective when they have more fishers is supported for both of the general effectiveness dependent variables. The coefficients of 0.007 and 0.005 in this case should be read as the increase in standard deviations in the average of the dependent variable, controlling for the other variables in the analysis, of an increase of one in the percentage of VMC members that are fishers. The percentage of TA representatives has a negative impact on the perception that the VMC is being effective in fish conservation. The coefficient for the percentage of TA representatives is, of course, read the same way. TA representatives could be the TA himself, a sub-chief, in many cases a village headman, or one of various kinds of traditional councillors. The percentage of women on the VMC has no impact on perceptions of any of the dependent variables. The conclusion is that VMCs are seen as more effective when they are made up mainly of fishers. It should be born in mind that these results control for whether or not the respondent is a fisher.

5.3. Hypothesis 3

More in-migration in fishing areas will lead to stronger co-management.

Hypothesis 3 was based on the idea that increased conflict with outsiders will create a greater motivation to support the VMC. This is not supported. The only impact that a fishing area that attracts more migrating fishers has is that it decreases the perception that the VMC is being effective in fisheries conservation. This may be read as support for the alternative hypothesis that homogeneity increases the effectiveness of co-management institutions. However, the variable may be more a measure of greater fishing pressure rather than a measure of conflicts. The database has some other options for operationalising conflicts, ethnic heterogeneity for example or perceptions of disagreement, which may be the basis of further research. However, conflicts are very local and contextual situations, and finding an authentic comparative measure of the degree of conflict remains a challenge.

6. Conclusions

Three fairly strong conclusions can be drawn from this research. The first is a general confirmation of what has long been an insight from qualitative research that a more responsive management institution is also seen as a more effective one. This is clear from the positive impact of the VMC responsiveness scale on both general effectiveness variables. The second is that co-management institutions that are made up mainly of fishers are seen as more effective than ones that try to incorporate a broad range of other stakeholders. The percentage of fishers on the committee has a clear positive correlation with both general effectiveness variables.

The third is that seeing local conservation efforts as generally effective and making a positive contribution to village life is not related to seeing co-management institutions operating as rule enforcement mechanisms. This is seen first in the fact that these two sets of dependent variables do not correlated with each other. Second, they are correlated with different sets of variables. These two perceptions seem to be attached to both different characteristics of co-management operations and their relationship to different kinds of supporting institutions. General effectiveness is related to the make-up and responsiveness of the VMC, and the support of the Department of Fisheries and the headmen. Rule enforcement, on the other hand, is associated with the role of the TAs, and to some extent the headmen.

We suggest the following programmatic lessons that can be drawn from this research for the consideration of those working with co-management institutions. Clearly, in applying these lessons general conclusions from cross-national research should be evaluated in light of local considerations.

- The village management committee should be made up primarily of active fishers.
- The main role of the traditional authorities is related to punishment. Seen in the light of our qualitative work, the results suggest that they play a legitimating role that allows the VMC to carry out its work. Traditional authorities have an important role to play in granting legitimacy to co-management activities, but their relationship to the management committees should be an indirect one. The traditional authorities should support, but not control the co-management enforcement activities. A possibly important role for the government is to ensure transparency of punishments and that confiscations of gear do not become a source of income for the VMC members or anyone else.
- Village management committees should be empowered to make decisions about management measures with the visible backing of the Department of Fisheries. This is based on the importance of perceptions of DoF support for both of the general effectiveness variables. Enforcement powers and activities should be linked to this relationship. Procedures for enforcement, including the use of the proceeds from fines and confiscations, should be formal and standard across the different national fisheries.

Further research is indicated in several ways. Work on individual countries needs to be carried out using this, and other data, to investigate hypotheses about what might be important in a particular country or water body. This includes examining the roles of NGOs and district level governments. Another area needing further work is the role of local elites, especially the issue of boat and gear owners versus crew members. Information needed to address these issues was not gathered here and would make an important further contribution.

We believe this analysis has contributed to the study of the commons by demonstrating the use of an important tool. Very often the most comparable information we can get on commons institutions is answers to the same questions on attitude surveys. It is critical that we find statistically valid ways to use this kind of information in comparative research. The results presented here are very narrow in scope, but they do allow some fairly clear claims to be made about the how the roles of Traditional Authorities are generally perceived across a wide area and about the impact of the makeup of local fisheries management committees. The methods themselves are also fairly simple, accessible to any scholar with knowledge of regression techniques. It is our hope that these methods can find wide use if future commons research.

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