

Management of Natural Resources at the Community Level: Exploring the Role of Social Capital and Leadership in a Rural Fishing Community

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Summary. — Social capital and leadership characteristics are important in resource management. We present a case study of a fishing community showing high levels of social capital quantified through social network analysis, but low willingness to report rule breaking. Furthermore, identified key individuals possess few links to financial institutions and important markets. These findings may, individually or in combination, explain the lack of common initiatives to deal with the over-exploitation of fisheries. Alternative hypotheses are also discussed and include homogeneity among key individuals leading to poor recognition of the problem of changing ecological conditions, and the structural characteristics of their relational network, which reveal one person in a very influential position.

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1. INTRODUCTION

Social capital is often suggested as having a beneficial effect on the capacity of individuals to organize themselves effectively (Coleman, 1990; Fukuyama, 1995), and together with leadership, is often seen as crucial for the initiation and maintenance of environmental conservation and management at the community level (Olsson, Folke, & Berkes, 2004; Ostrom, 2005; Pretty, 2003; Pretty & Smith, 2004). This study explores the aspects of social capital and leadership in a rural fishing community to seek explanations for why collective action for sustainable management has not occurred, despite strong indications of declining fisheries and in-shore habitat degradation, as well as increasing awareness of these problems among many fishermen and women (Crona, 2006; Crona & Bodin, 2006; McClanahan, Glaesel, Rubens, & Kiambu, 1997; Ochiewo, 2004). The focus of this study is on natural resource management (NRM) at the community level. Thus, this study touches upon concepts such as co-man-

agement (see overview in Carlsson & Berkes, 2005) and adaptive co-management (Gadgil, Rao, Utkarsh, Pramod, & Chhatre, 2000; Olsson, 2003), often put forth as instrumental in enabling sustainable NRM. Furthermore, in the context of fisheries social capital has been suggested as an important factor affecting regulation and governance (Grafton, 2005; Sekhar, 2007).

As shown above, the concept of social capital has been extensively cited as important for

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conservation and resource management. However, its defining characteristics are multi-faceted (for review see, e.g., Krishna, 2002; Lin, 1999; Woolcock & Narayan, 2000). First, the unit of analysis can vary from the individual to the group (Borgatti, Jones, & Everett, 1998; Portes, 1998). For example, Burt (2004) argued that links to different groups may enhance an individual's social capital, whereas Putnam (1993) discussed social capital at the scale of whole countries. Second, there is a lack of agreement as to what actually constitutes social capital. For example, Putnam (1993) defines social capital as "features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit." Others suggest that social capital can be defined as "resources embedded in a social structure which are accessed and/or mobilized in purposive actions" (Lin, 1999), thus leaving out collective assets such as trust and norms (although acknowledging that factors such as trust may promote social relations and *vice versa*).

Finally, social capital has been criticized for its lack of explanatory power, and several theses exist that differ primarily in their view of social capital as either an exogenous or an endogenous variable. It is seen by critics as a result of institutional performance rather than its cause, where independence cannot be verified. Adherents of this approach, represented by several disciplines (North, 1990; Schneider, Teske, Marschall, Mintrom, & Roch, 1997; Wade, 1994), argue for reversed causality such that the existence of institutions explains social capital. An intermediate position is taken by Krishna (2002), Berman (1997), and Dale and Onyx (2005), among others, who argue that social capital has some explanatory potential but that other factors also contribute to institutional performance and collective action. One such factor is agency, which is realized through the existence of agents, that is, leaders or influential actors, who activate a potentially latent stock of social capital and use it to produce a flow of benefits. In his extensive study in rural India, Krishna (2002) found that the existence of such leaders to mediate agency was necessary to activate the stock of social capital and make it productive in terms of economic development, community harmony, and democratic participation. Similarly, others have shown the importance of leaders and sense-makers for successful NRM, and the effect of good leadership in this context is an expanding field

of research (e.g., Olsson, 2003; Westley & Vredenburg, 1997).

Inspired by these findings, this study examines the issue of social capital, agency, and collective action by applying an approach similar to the approach of Krishna (2002), although modified to fit an East African NRM context. The study area is a rural fishing village along the southern coast of Kenya. The use of resources in the village is centered around a low technology artisanal marine fishery, and to some degree the use of mangroves for poles and firewood. A majority of households depend primarily on fishing for their income, while farming and small scale businesses represent alternative livelihoods for some. Fishermen are not a homogeneous group, however, but are grouped primarily based on gear type (Crona & Bodin, 2006) (Table 1). In spite of high levels of resource dependence and the realization of resource decline among many users, villagers have not been successful in regulating the in-shore local fishery. This lack of resource regulation is, unfortunately, not unique for this particular village but is rather common around the world (Ostrom, 1990).

We substituted development (as defined by Krishna, 2002) with the ability of the community to initiate action for sustainable management of natural resources in light of overfishing and resource depletion. Agency was approached from a social network perspective by using structural network measures to identify influential actors, based on the assumption that such measures offer a robust way of identifying these influential individuals in a community (for review see, e.g., Wasserman & Faust, 1994). Social capital was also approached from a social network perspective.

Table 1. *Fishermen and fishing technique*^a

Type of fishery (at the household level)	Number of individuals
Gill net	10
Speargun	3
Handline	1
Deep sea	43
Kigumi	16
Total	73

^a The distribution of fishermen according to types of fishing gear. In an earlier study (Crona & Bodin, 2006) it was shown that the type of fishing gear strongly correlated with social ties, i.e., fishermen using the same types of gear were also more socially connected to each other.

Thus we adhered to the large stream of scholars using network measures to assess social capital (see, e.g., [Borgatti, 2003](#)). Furthermore, mechanisms for conflict resolution and monitoring are often suggested as essential prerequisites for common property resource management ([Ostrom, 1990](#)), yet are rarely included in empirical studies of social capital. Here we incorporate these mechanisms into our assessment of community social capital, thereby combining the network approach ([Borgatti et al., 1998](#); [Lin, 1999](#)) with the view of social capital as also consisting of norms facilitating coordination and cooperation ([Putnam, 2000](#)). [Figure 1](#) schematically presents our underlying assumptions on the relationship of community social capital, agency, and collective action to the measured variables.

It is important to note that social capital is not the only factor explaining the success or failure of resource management in general and for fisheries in particular. Contextual differences among cases, such as culture, institutions, and type of fishery, will also play an important role. While not neglecting contextual influences, this study has three primary aims: (1) to assess selected aspects of community social capital, as outlined above; (2) to identify poten-

tially influential actors; and (3) to assess if lack of community social capital and important leadership characteristics, individually or in combination, may explain the lack of collective action. The results are analyzed in relation to the community's lack of collective action with respect to the regulation of natural resource extraction. This paper is an attempt to further operationalize the link between social capital, leadership, and agency in NRM research, and is one of the few studies to empirically quantify aspects of social capital in an NRM context, utilizing social network analysis.

2. METHODS

(a) Study area

The area of focus in this study was a rural coastal fishing village located approximately 50 km south of Mombasa in Kenya ([Figure 2](#)), and is further described in [Crona and Bodin \(2006\)](#). The village has approximately 200 households and an estimated 1000 inhabitants. Approximately 44% of households are directly involved in fishery extraction, while many others benefit indirectly since fishery-generated

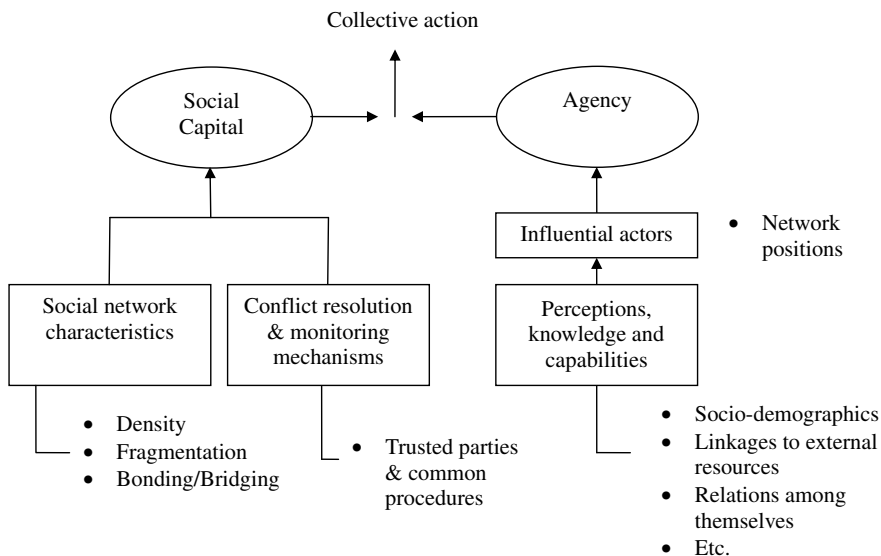


Figure 1. The figure illustrates schematically how different concepts (circles) and variables (boxes) are assumed to relate to each other. The bulleted text describes how variables are assessed in this study. Only variables and concepts discussed in this paper are outlined, although the authors acknowledge that numerous other variables may be of importance in defining social capital.

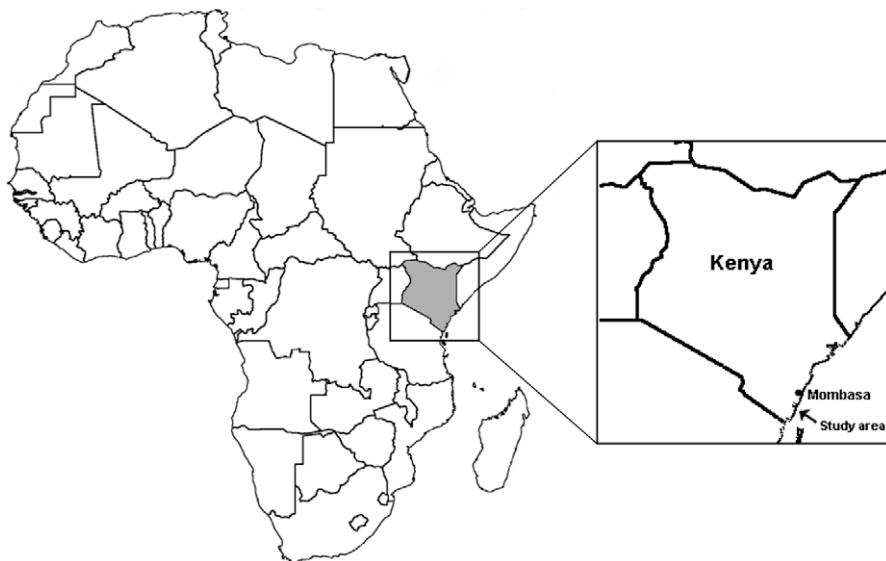


Figure 2. Map of the study area with the target community indicated in the right hand corner of the inset. The area is located on the southern Kenyan coast at 4°25'S and 39°50'E, approximately 50 km south of Mombasa.

income is spent, to a large extent, in local stores. Thus we consider the majority of the community members as dependent on marine fishery.

It is important to note that this area lies outside the Diani/Chale National Marine Park and Reserve. Consequently, the fishing grounds used by fishermen associated with this village stretch further south and are not constrained by this restricted access. Furthermore, the long-term conflicts experienced among fishing communities and other industries in the Diani area have not prevailed in the studied community, as only a limited tourism industry has developed there to date.

The population of coastal Kenya comprises of two main ethnic groups; the Mijikenda of Bantu origin and the Swahili who are of mixed Bantu, Asian, and Arabic descent (King, 2000). The Mijikenda comprise nine tribes, of which Digo is the predominant ethnicity of inhabitants in the study area. However, other coastal tribes such as Bajuni, historically associated with the Lamu region of the north coast, have migrated south and are present in the studied community. Many Bajuni families have traditionally been involved in mangrove cutting and trading, as well as fishing, accumulating substantial wealth, while the Mijikenda were primarily farmers but in the last century had diversified their livelihoods to include fisheries,

which now constitute a substantial portion of incomes (King, 2000). It is worth noting that although a minority, Bajuni families constitute a disproportionate number of the households in the upper income bracket in this community, while households of Digo and other Mijikenda descent constitute the large majority of the poorest families. More recently, a third ethnic group has emerged in the community, accounting for approximately 26% of households and consisting of semi-migrant fishermen from the Tanzanian island of Pemba, where they return on a regular basis. This migration is linked to both economic factors and kinship ties. During the high season, migrating fishermen return to the study area to fish and are often assisted with travel expenses and permits by local middlemen (fishmongers) operating out of the village. At the same time, kinship ties play a significant role in who is recruited to come along as crew for the duration of the season.

The most dramatic influx of Tanzanian fishermen occurred after the 1964 overthrow of the Zanzibar-Pemba government, resulting in large seine crews establishing more or less semi-permanent operations along the Kenyan coast (Glaeser, 1997). The majority of Pambas currently residing in the village primarily use ring nets (a variant of purse seines), operating from larger vessels and employing crews of up to 30 men.

(b) *Methodological approach*

This study assesses social capital at the level of the whole village, which we hereafter denote as the community social capital. Community social capital is assessed by (1) quantifying important characteristics of the community's social networks (Borgatti *et al.*, 1998), (2) evaluating mechanisms in use for conflict resolution, and (3) evaluating villagers' attitudes toward self-monitoring and reporting. Thus we adhere to Putnam's (2000) definitions of social capital by including both networks and aspects of norms in our assessment. We base a significant portion of the measures of social capital on the community's ability to solve conflicts and their willingness to impose self-monitoring and sanctions. This was done since the focus is on aspects of social capital enhancing

the ability for self-regulation of natural resource extraction, and both monitoring and the ability for conflict resolution have been shown to be crucially important for successful management of common-pool resources (Ostrom, 1990). The ability to solve conflicts may be viewed as an outcome of, rather than social capital itself (cf. Fukuyama, 1995; Putnam, 2000). However, as our focus was to assess the level of social capital, we did not differentiate between causes and consequences.

Structural network measures were used to identify the most influential individuals of the community based on network position (hereafter referred to as key individuals). Assessment of the key individuals' characteristics and their relation to agency is based primarily on interview data generated using a modified version of Krishna's questionnaires (2002) to fit the cultural

Table 2. *Network measurements and social capital*^a

Network measure	Description	Relation to social capital
Density or average links per node	Network density is formally defined as the number of actual ties divided by the number of potential ties in a network. However, this study used the related metric of average number of ties per individual for ease of comparison with other studies	The number of links among the villagers indicates the overall level of cohesiveness in the community and their capability of acting in common (Coleman, 1990; Granovetter, 1973). In general, the more the relations the better in regards to the social capital, although there may be an upper limit above which an increasing number of relations lead to excessive homogenization (cf. Bodin and Norberg, 2005; Oh <i>et al.</i> , 2004)
Number of components	A measure of the extent to which the network is divided into separate sub-networks (i.e., degree of fragmentation)	Indicates to which degree the community is divided into separate (non-overlapping) sub-groups. Distances between members in different components are thus infinite. We were particularly interested in the number of isolates (single-node components, i.e., unconnected villagers) as well as the size of the largest component
Ratio between within-group ties and outgoing ties among groups	The ratio between the number of ties among members of the same sub-group and the number of ties between members of different sub-groups in a given component	Captures the idea of bonding <i>versus</i> bridging social capital (Pretty & Smith, 2004; Woolcock, 2001). Bonding ties are ties within Sub-groups of villagers which may maintain a high level of intimacy and trust (cf. McPherson, Smith-Lovin, & Cook, 2001), while bridging ties are relations between members of different such sub-groups. Both kinds of ties are important in enhancing a community's social capital (Ancona, 1990; Granovetter, 1973; Volker & Flap, 2001)

^a Network measures with descriptions and comments on their relevance in assessing the social capital of groups of individuals.

context of an East African fishing community. All interactions with respondents were conducted in Kiswahili.

(c) *Assessment of community social capital*

(i) *Social networks*

The network measures used are related to the cohesiveness of the community, the degree of fragmentation, and the ratio of bonding and bridging relations of the community's social networks. Cohesiveness is measured based on the density of relations. The level of fragmentation is measured by the number of isolated sub-nets (i.e., network components), indicating to which degree the community is divided into isolated sub-groups. The ratio of relations that falls within *versus* between different sub-groups (Crona & Bodin, 2006) is also assessed. Relations within and between sub-groups will from hereon be referred to as bonding and bridging ties, respectively, to capture the idea of bonding and bridging social capital. These measures and their relevance in assessing social capital are further described in Table 2. The network under study was a combination of a social support network and an environmental knowledge network (Table 3). The social support network was chosen since it encompasses the strongest, most intimate social relations. The environmental knowledge network was chosen due to its importance in developing a common understanding of natural resources, which is essential in enabling collective action in NRM (e.g., Ostrom, 2005). In the combined support and knowledge network, relations were based on

the existence of ties in either or both the social support network and the knowledge network. Network raw data were gathered during data collection for a previous study (Crona & Bodin, 2006), but have not been previously analyzed for this purpose.

(ii) *Conflict resolution and monitoring*

The institutions in place for conflict resolution were examined by measuring the extent to which villagers identify and utilize common conflict-resolution mechanisms and procedures. Each villager was presented with a hypothetical scenario in which they encountered a conflict that they could not resolve themselves. We then asked if, and to whom, they would turn for help in resolving the issue. Furthermore, we measured villagers' willingness to monitor and, in case of rule breaking, report others. More specifically, we presented each villager with a hypothetical scenario in which they observed someone breaking a recognized rule such as fishing regulations. We then asked if, and to whom, they would report this. Care was taken to pose the scenario-based questions in the same way to all respondents.

The reason these questions were asked was that these behavioral characteristics could be interpreted as an indication of their respect for common rules and practices as well as the sense of community expressed by villagers. We acknowledge that cultural differences between researchers and respondents may affect the interpretation of the questions asked, as well as the respondents' replies. However, the authors have years of experience working in

Table 3. *Network types^a*

Network name	Type of network	Metric applied
Social support network	Discussion of important matters	
Knowledge network	Exchange of information and knowledge regarding natural resources	
Combined support and knowledge network	Network generated from a combination of ties in either/both Social support network and Knowledge network	Degree-, betweenness-, and eigenvector centrality
Gear dependency network	Dependency network, that is, who are respondents dependent upon to carry out their occupation (e.g., lease of fishing equipment)	Degree centrality
Trade network	Business network, that is, with whom do respondents trade (buy and sell) their products/catches	Degree centrality

^a Types of social networks used in this study and their assigned names. In addition, the metrics used to construct the criteria used to identify key individuals in each type of network are presented.

the case community and in Kenya; therefore, this issue should not have had any significant bearing on the results.

(d) *Leadership*

The first step in assessing agency and leadership was to identify the most influential individuals in the community. We choose to call them key individuals, instead of leaders, since the concept of leadership includes aspects other than merely the potential for being influential.

(i) *Identification of key individuals*

Key individuals were identified based on their structural positions in the community social networks. The following points motivate this approach:

(1) The possibility for social influence and leadership is closely tied to a person's structural position in a network (e.g., Wasserman & Faust, 1994). Hence, by identifying key individuals based on their structural position, we were able to select the potentially most influential individuals.

(2) By using these structural criteria, we were not dependent on a few experts' perceptions of who the most influential individuals are (Davis & Wagner, 2003), nor were we limited to relying only on formal (authorized) leaders, but instead could focus on the key individuals who were, indirectly, pointed out by the community through the network structure.

We identified key individuals based on their centrality in the different social networks (Table 3). Numerous studies agree that influence is closely related to centrality, although the connection is not unambiguous (Degenne & Forsé, 1999). However, a range of centrality measures are available, all with their specific relation to influence and possibility for leadership. Since we did not want to determine key individuals based on a single, narrow criterion, we chose to apply several network metrics. In all, we used five different criteria (Table 3). We used degree centrality (see, e.g., Wasserman & Faust, 1994), betweenness centrality (Freeman, 1979), and Eigenvector centrality (Bonacich, 1972) for the combined social support and knowledge network (Table 3). Thus we were able to account for three important, but separate, types of centrality for that specific network. The degree centrality in the Gear dependency network and the Trade network made up the two remaining criteria. The reason

for only measuring degree centrality in these last two networks is that a greater number of ties can be beneficial for an actor in these two types of networks, while the benefit of high degrees of betweenness and eigenvector centrality is less obvious in networks of dependency and commodity trading.

Key individuals were identified by assigning each villager numerical scores according to their rank for each of the five positional criteria (top position was given a score of 10, whereas ranking below the top 10 list resulted in a score equal to 0). The total number of key individuals was limited to 10, representing 5% of the population. These individuals were the top 10 villagers ranked (in descending order of importance) according to (1) the number of times they occurred on the top 10 list in any of the criteria, (2) the number of times they scored highest in any of the criteria, and finally (3) their total number of scores for all five criteria. Thus, for example, an individual appearing among the top 10 individuals for all five criteria would be ranked higher than an individual who got higher scores when accounting for all centrality criteria, but only appeared on the top 10 lists for four of the five different criteria.

In addition, our analysis also included two formally appointed leaders who were not part of the 10 ranked key individuals—the village sub-chief and the chairman of the beach committee. The village sub-chief is assigned by the government and represents the highest level of formal authority in the village, and the lowermost, grass-roots level of government. The beach chairman is the head of an elected committee of fishermen which is a “semi-formal” body to which fishermen are expected to turn regarding fisheries-related issues.

Finally, by extracting the identified 10 key individuals and the two formal leaders from the combined support and knowledge network (Table 3), we created a separate network (only consisting of these individuals) in order to estimate their level of internal communication (Figure 3).

(ii) *Key individual characteristics*

The methods presented above are primarily concerned with extracting and analyzing quantitative data gathered from the whole community. In order to collect more detailed qualitative data from the identified key individuals, semi-structured interviews were conducted. All 10 key individuals as well as the two formal leaders, the village sub-chief

such ties with anyone else among the set of respondents (i.e., they were either connected only to people outside the village (10), and/or connected to fellow villagers not being interviewed (2), or were isolated (1)). Two villagers were confined to a separate subnet (i.e., a component), and the remaining 157 villagers were confined to a single large component. For the social support network alone, the average number of ties per person is 1.3.

Estimates of the ratio of bonding (ties within sub-groups) and bridging ties (ties between members of different sub-groups) are presented in Table 4. In agreement with results from the previous analysis of the knowledge network (Crona & Bodin, 2006), we defined the sub-groups based on the respondents' occupation (Table 4). Furthermore, in this analysis we only considered relations related to the exchange of information/knowledge regarding natural resources. Only occupations with more than three members are included in this analysis. Occupations that were very broadly defined and consequently too heterogeneous to be perceived as coherent categories were also excluded. After exclusions, 116 individuals remained (see further details in Crona & Bodin, 2006). Except for the small group of farmers, bonding ties exceed 50% for all groups. The highest fraction is, however, limited to 75%, which indicates that a significant share of villagers' relations is indeed with members of a different sub-group.

(ii) Conflict resolution and monitoring

Of the 172 interviewed villagers, only 11 did not name any trusted third party they would

contact in case of being in conflict and not being able to solve it. Of all the reported third parties, we present the five most cited in Table 5. The most cited person, the elected village chairman, is followed by the government appointed village sub-chief.

Seventy villagers stated they would report others to a named person, if encountered breaking a law. The five most cited persons are listed in Table 6. Of the remaining 102 villagers who would not report others to any named persons 48 said they would either report to the police (20), to their fishing captain (11), to those affected by the rule breaking (9), or they would confront the person themselves (8). The remaining 54 villagers would not report others breaking the law to any kind of authority. It is important to note that reporting to the police is a daunting task in this rather remote village, so one can assume that only a very serious crime would result in a report. Fol-

Table 5. Citations for conflict solving^a

Person	Number of times cited by villagers
Chairman	143
Sub-chief	85
Deep sea fisherman A	17
Former sub-chief	5
Member of elders' council	5

^a The top five persons cited as alters to whom members of the community would turn for help in solving conflicts. Note that each respondent could cite more than one person.

Table 4. Distributions of social ties in the knowledge network^a

Occupation	Size ^b	Rel./ind. ^c	Rel./ind. in group (bonding ties) ^d	Ratio in./out. (%) (bonding/bridging) ^e
Seine net	16	3.1	2.0	65
Businessman	27	0.7	0.5	71
Farmer	8	0.9	0.3	33
Deep sea	45	3.6	2.7	75
Gill net	10	3.3	1.8	55
Middleman	10	2.0	1.0	50

^a Distribution of self-reported, within-group relations among occupational groups (adopted from Crona & Bodin, 2006). Note that the set of villagers (and the relations) presented in this table is limited to those belonging to the listed occupations.

^b Size refers to the number of individuals within respective occupation.

^c Rel./Ind. refers to the total number of reported relations to individuals irrespective of their occupation, divided by the number of members within the group.

^d Rel./Ind. in group refers to the number of reported within-group relations divided by the number of group members (i.e., bonding ties per group member).

^e Ratio In./Out. (%) refers to the ratio of within-group relations versus all reported relations (i.e., the percentage of bonding ties of that group).

Table 6. Citations for reporting rule breaking^a

Person	Number of times cited by villagers
Chairman	40
Sub-chief	14
Former beach chairman	8
Fisheries officer	6
Deep sea fisherman B	4

^a The top five persons cited as alters to whom members of the community would report rule-breaking. Note that each respondent could cite more than one person.

lowing this assumption, 74 ¹ of the interviewed villagers, that is, 43%, would not report rule breaking unless very serious crimes were committed.

(b) Leadership

(i) Identification of key individuals

The identified key individuals are presented in Table 7, in order of centrality. As expected, the identified key individuals clearly stand out as more centrally positioned compared to the other villagers—a general pattern that reoccurred for all five criteria. For example, the key individuals have direct social ties to 80 (49%) of the other villagers in the combined support and knowledge network. If the reported contacts' ties are also accounted for, key individuals are no more than two relational steps from reaching 132 persons, that is, 82% of the remaining villagers. Figure 3 shows the combined support and knowledge network among identified key individuals only.

Table 7. Key individuals^a

Rank order	Leader attributes			External contacts			
	Occupation	Age	Tribe	Governmental agencies			Market/suppliers ^b
				FS ^c	FO ^d	AG ^e	
1	Businessman	48	Bajuni		X		
2	Middleman	37	Bajuni	X		X	
3	Retired fisherman	76	Bajuni	X	X	X	
4	Deep sea fisherman and captain	32	Pemba	X			X
5	Chairman	59	Digo	X	X	X	
6	Deep sea fisherman and captain	36	Bondoi	X	X		X
7	Deep sea fisherman and middleman	51	Bajuni	X		X	X
8	Deep sea fisherman and captain	39	Pemba	X		X	X
9	Deep sea fisherman	40	Pemba				
10	Deep sea fisherman	38	Bajuni				X
>10	Beach chairman and Kigumi fisherman	37	Digo	X	X	X	
>10	Sub-chief ^f	41	Rabai	X	X	X	
Sum of contacts				9 (75%)	6 (50%)	7 (58%)	4 (33%) 1 (8%) 6 (50%)

^a List of identified key individuals and some of their attributes and links to external agencies which they may use for the benefit of other villagers.

^b Most of the reported contacts with markets/suppliers were related to the provision of different types of fishing-related equipments.

^c Fisheries officials.

^d Forestry officials.

^e Administrative governmental.

^f The last two individuals on the list did not qualify for the top-ten list, as ranked based on centrality criteria, but were included due to their formally appointed positions in the community.

(ii) *Key individual characteristics*

The 10 identified key individuals have similar levels of education, marital status, and religion (all are Muslim, as is the absolute majority of all villagers) as the remaining villagers, and most of them have resided in the village for more than 20 years. The only two significant differences between key individuals and other community members are related to tribal membership and occupation (see Table 8A and B). The Bajuni tribe is highly over-represented (50% of the key individuals, but only 12% of the villager population), while the Digo tribe is highly under-represented (10% *vs.* 49% of the village population). Furthermore, deep sea fishermen are highly over-represented compared to other villagers (60% *vs.* 27%). This could, although only partially, be ascribed to the fact that the network of (environmental) knowledge exchange was used in identifying key persons; thus non-fishing occupations such as local businessmen may have been discriminated against. This does not, however, explain why there are no other types of fishermen among these individuals.

The same skewed representation for tribe and occupation is also seen among the contacts of key individuals, although less pronounced.

Table 8. *Tribe and occupation*^a

Tribe	Key individuals (%)	Village population (%)
<i>Panel A</i>		
Bajuni	50	12
Bondoi	10	<1
Digo	10	49
Pemba	30	26
<i>Occupation</i>		
<i>Panel B</i>		
Deep sea fisherman	60	27
Local businessman	10	16
Middleman (fishmonger)	10	5
Chairman	10	<1
Retired chairman	10	<1

^a Tribal membership (A), and Occupations (B) of identified key individuals (Key Ind.) and of the whole population of respondents (Village Pop.).

In spite of several indicators showing a decline of the fish stocks in the area (McClanahan *et al.*, 1997; Ochiewo, 2004), and the distinct awareness of this fact among many fishermen (and women) such as gillnet, spear gun, shrimp, and seine net fishermen (Crona, 2006), only two of the 12 interviewed key individuals recognized that the current situation may jeopardize the continuation of fishery-based livelihoods. One of the two was not even a fisherman. These two individuals with a more pessimistic view of the future fisheries referred to destructive fishing methods and the harvesting of under-sized fish as the primary reasons for the current state of affairs. Among the 10 more optimistic key individuals, two indicated that even though a decline in fish catches seemed apparent, new fishing technologies such as better boats and gears would improve the situation in the future. None of the key individuals had any plans to move away from the village.

Only two were satisfied with the current management of the fisheries. Major complaints were related to the lack of regulation enforcement, but three persons also complained about the ban of seine nets that was recently re-implemented by fishery authorities. These regulations are enforced without the provision of any alternative resources such as loans to fishermen whose fishing gear became illegal or was confiscated.

Ten of the 12 key individuals thought it would be a good idea to designate more responsibility for fishery management to the village, and eight of them would also consider taking a leading part in such management efforts. However, only seven could recall any organizational attempts internally initiated in the village. The two who did not believe in transferring more authority to the village cited the selfishness of villagers and their inability to report each other.

Almost all key individuals (>90%) agreed on the formal leadership in the village, and they also tended to identify the same set of informal leaders, although no single person mentioned all of them. Only one respondent expressed great discontent with the current leadership and did not recognize any leaders at all. All key individuals reported the same procedural steps to take in case of fishing-related conflicts, and they also identified the same set of trusted persons and authorities as presented in Tables 5 and 6.

Three categories of links to external agencies were investigated. These were links to govern-

ment agencies, NGOs, and financial institutions and markets (Table 7). Between 50% and 75% of key individuals reported contacts with government agencies, with the highest proportion of links directed at fisheries officials at the local level and fewer to representatives of the forestry department and other administrative bodies (Table 7). Only 33% reported any contact with NGOs, and only one had any contact with a financial institution. While a number of key individuals in the fishing occupation had ties to markets, these consisted primarily of contacts for the acquisition of gear, as opposed to contacts for marketing/selling fish. The latter are normally handled by local middlemen.

4. DISCUSSION

(a) *Community social capital*

Social capital was assessed from a network perspective as proposed by Borgatti *et al.* (1998). Average ties per person was 3.7 for the combined social support and knowledge network, *versus* 1.3 ties per person considering only the social support network. The last figure can be compared with the outcomes of the 2004 US General Social Survey (GSS), which generated an average of approximately two ties per person (SDA Archives, see <http://sda.berkeley.edu/archive.htm>), and a similar study in urban China (conducted in 1993) yielding 3.4 ties per person (Ruan, Freeman, Dai, Pan, & Zhang, 1997). Despite slight differences in the phrasing of questions, as well as in cultural contexts, these results are interesting to compare. At first glance, these figures indicate lower levels of communication compared to other studies. However, we asked the heads of households to report their ties to others outside their households, while the other studies made no such distinction. For example, approximately 50% of the reported ties in an earlier US GSS were to kin (Marsden, 1987). Thus it is fair to assume that a significant number of reported ties in both the US GSS and China were to kin and, if accounted for, the difference between our results and the other studies decreases significantly. The comparison then indicates that average numbers of reported relations in the social support network are within the same order of magnitude for the different cases, although the average number of ties in our study area is likely in the lower range.

The analysis of network components shows that only 10 (6%) of the villagers are unconnected relative to fellow villagers. The majority of the community belongs to a large network seemingly conducive to the formation of social capital according to the line of argument supported by Putnam (2000) and Coleman (1990), where low levels of network fragmentation are argued to enhance social capital by knitting together societies and by generating trust. Furthermore, 82% of the villagers (excluding key individuals) are within one or two relational steps from the key individuals, thus indicating that fragmentation is not a major issue for this village.

Bonding social capital describes the links between people with similar objectives, while bridging social capital describes the capacity of such groups to communicate with others having different views (Woolcock, 2001). The ratio between bonding and bridging ties in the community knowledge network appears fairly balanced, with bonding ties accounting for over 50% of reported relations in all but one subgroup, yet never more than 75% (Table 4). The bonding/bridging ratio shows that ties between members of different sub-groups, in this case groups based on occupation, provide for communication that spans the whole community, even though most ties exist within sub-groups.

The large majority of villagers specifying a contact to ask for help in conflict resolution reported the same set of trusted and/or authorized persons (Table 5). Thus it seems that mechanisms are in place for solving conflicts, and that these are recognized by the majority of villagers. It is interesting to note, however, that the local fisheries officer (not shown) received less than 1% of citations despite the fact that he is the formal representative of the government in charge of all fisheries-related issues and regulation enforcement.

Looking at social capital from the perspective of attitudes toward sanctioning and self-monitoring, 59% of respondents state no specific person to whom they would report violations of rules or laws, and 43% would not report a violation at all or only if it was extremely serious and required police involvement. It thus appears that in regard to self-monitoring, and subsequently sanctioning, a great part of the community has adopted a rather "laissez-faire" attitude. We acknowledge that the unwillingness to report others may instead be attributed to the presence of strong social capital, that is,

the villagers have developed a strong norm whereby they do not report rule breaking. However, such a norm would, within the context of NRM, restrain common pool resource management (cf. Ostrom, 1990), and would, therefore, work against Putnam's (1993) definition of social capital as being mutually beneficial for community members. We refrain from interpreting non-reporting behavior as either strong or weak social capital. However, should it be strong social capital, this could serve as a vehicle for resource management provided that the norms were changed in favor of reporting rule breaking. If social capital, on the other hand, was so strong that it made such changes almost impossible, then it would serve as a good illustration of how social capital may in fact counter resource regulation issues by preserving unsuitable norms and behaviors.

Summarizing the situation, it appears that the level of social capital depends upon which aspect is under consideration. Network measures indicate a potential for relatively high levels of social capital in the village. In addition, a consensus exists among respondents regarding mechanisms for conflict resolution, yet there is low willingness to report rule breaking. Reluctance to report rule breaking could actually be reinforced by the coherent social networks spanning almost the entire village. In fact, many respondents stated that they would not report rule breaking since it would embarrass the offender, and they themselves would risk social rejection. We turn now to an examination of the identified key individuals as agents with the potential to activate latent social capital.

(b) *Agency and social capital*

Krishna (2002) demonstrated that leaders play a crucial role in activating social capital for the benefit of the community by providing villagers with the know-how to maneuver bureaucracy in order to benefit from government programs, and by facilitating collective action through coordination and conflict resolution. In addition, from a resource management perspective, leaders can provide links to agencies assisting with information and education (government or NGOs) and act as the coordinators of such efforts in order to maximize their benefit and ensure their implementation. The crucial importance of such boundary-spanning leadership in NRM has been identified by several scholars in numerous cases (e.g., Olsson, 2003; Frances Westley, personal

communication). Cross-boundary links are assessed here by the ties to external agencies possessed by identified key individuals (Table 7). The results show that they are fairly well connected to external agencies, with the exception of financial institutions and markets other than the trade of fishing gear.

Comparing these results with Krishna's (2002) findings, two aspects of social capital and leadership emerge as potential explanations for the observed lack of communal initiatives in fishery regulation despite declining fish stocks: low willingness to report rule breaking, and the lack of external contacts related to financial institutions and markets beyond the trade of fishing gear among key individuals. Our focus on NRM differs from that of Krishna (who looked at community development), and it can be argued that the connection between the lack of financial links and successful resource management is not intuitively clear. However, the lack of financial links arguably limits a leader's ability to support the integration of economic and/or market-related components into any initiative relating to common-pool resource management. Such integration may be crucial for the success of these initiatives (cf. Ostrom, 1990), for example by helping in providing investment capital for alternative sources of income and access to new markets. At the same time, it must be noted that such links to financial agencies may be held by persons other than the interviewed key individuals.

Some comments on the limitations of using Krishna's (2002) findings to explain the lack of common-pool resource regulations in the studied village are presented here. First, we studied a small rural East African village, whereas Krishna focused on rural villages in India. Second, we used different methods and measurements to assess community social capital, and we also used the data to explain a slightly different outcome variable (NRM *vs.* development). These differences in context and methods obviously reduce the explanatory power of Krishna's theories in our analysis. Although we acknowledge these limitations, we argue that there are still enough similarities to make a comparison meaningful. Rural India and rural East Africa are both developing regions, and despite using different methods to assess social capital, we argue that these measures correlate. For example, a high density of social relations is likely to correlate with individuals' degree of participation in village-re-

lated activities (measured by Krishna, 2002) (cf. Putnam, 2000). Similarly, we argue that the different outcome variables are comparable since development in rural and natural resource-dependent villages is closely linked with their collective ability to manage these resources (WRI, 2005). However, it is worth noting that the lack of comparative studies of similar communities with different management outcomes also decreases the ability to draw any general conclusions.

(c) *How well do key individuals reflect village heterogeneity?*

It is likely that the shortcomings regarding community social capital and agency described above cannot, by themselves, fully explain the lack of resource regulation. Other factors potentially contribute to the current situation. We propose and discuss some of these below.

One factor likely to raise the barrier for initiation of collective action is the lack of problem internalization (cf. Adams, Brockington, Dyson, & Vira, 2003; Haro, Doyo, & McPeak, 2005). Although many villagers are distinctly aware of declining fish stocks (Crona, 2006), interviews show that the vast majority of key individuals either do not perceive the problem of overfishing, or else they do not take the intellectual leap and recognize this as a threat to future livelihood. This gap is likely an effect of their occupational homogeneity. All key individuals who are fishermen or are directly involved in fisheries (i.e., all except the chairman, sub-chief and a local businessman) are (or have been) deep sea fishermen. As such, they mainly fish outside the reefs, generally use bigger boats moving over larger areas, and can relatively easily relocate their fishing efforts to areas further away. Thus a decline in fish stocks inshore or in the near vicinity of the bay is not perceived as a major problem by them, contrary to fishermen targeting inshore species only (cf. Agrawal, 2002). Virtually no other type of fishermen is represented among the identified key individuals. Furthermore, deep sea fishermen (as a group) are centrally positioned in the community network (Crona & Bodin, 2006). Possessing a central position in a network is linked to a greater ability to exert influence and power, as well as coordinating action (Burt, 2003). Therefore, the current situation will most likely present a barrier for other fisher

groups to initiate collective action. Thus, our findings suggest that to amass support for a management initiative, the number of people perceiving a resource problem is not the only determinant of success but also relies on the support from influential actors.

From a broader perspective, homogeneity among key persons is likely to reduce their collective ability to perceive and synthesize new information and knowledge of different kinds (see, e.g., Oh, Chung, & Labianca, 2004; Reagans & McEvily, 2003). As such it reduces their ability to adapt to new circumstances (e.g., the decline of fish stocks), potentially contributing to lowering the community's adaptive capacity (e.g., Berkes, Folke, & Colding, 2003) and the ability to respond to change and disturbances.

(d) *Coordination versus influence?*

Another factor worth consideration in explaining the lack of collective action is the network structure among key individuals. First, it is interesting to note that neither the beach chairman nor the formally appointed village sub-chief qualified for the top-10 list of identified key individuals (through centrality criteria), whereas the village chairman ranked fifth. In fact, neither the village sub-chief nor the beach chairman appeared among the 10 most central individuals for any of the five centrality criteria. Thus the sub-chief, as the only leader in the village formally appointed by the government, appears quite loosely attached to informal networks of communication of important matters and/or the exchange of information/knowledge about the natural environment. In contrast, the village chairman, who is elected but unauthorized in terms of official authorities, is firmly embedded in the village social networks. In terms of information transfer, the chairman thus has a central and powerful position and is the only link to the sub-chief (Figure 3). This may not be unusual, but it creates a situation whereby the chairman obtains a lot of power in the sense that he can (1) decide which issues to bring forward to the sub-chief (i.e., setting the agenda), and (2) become a block for information flow and agency if he does not perceive the issue at hand as important, or if it conflicts with his personal interests.

From a different perspective, possible benefits of the current structure include the fact that initiation and coordination of action can be

greatly enhanced because the chairman is firmly embedded and centrally positioned both in the community social networks and in the network of key individuals. He can thus act on behalf of the villagers, *vis-à-vis* the sub-chief, by a direct link; that is, he has the ability to link the whole community to external authorities. However, the chairman may instead be constrained in his capacity to act by these numerous social ties if a consensus for a course of action is not reached among his reported contacts (cf. Frank & Yasumoto, 1998). For good or bad, the community is seemingly highly dependent on the chairman for initiating collective action of any kind. Vulnerability, or reduction of resilience, lies in this dependency and in the impact that the personal characteristics and interests of a single person have on prioritization and decision-making. This is perhaps an inevitable side-effect associated with boundary-spanning leadership, an issue that should be accounted for when arguing for the benefits of this kind of leadership.

5. CONCLUSION

This study shows that levels of community social capital can differ, depending on which aspect is under consideration. While social network measures indicate relatively high levels of social capital, reluctance to report rule breaking was high. This reluctance could actually be reinforced by cohesive social networks and potentially counter-balance the former. The study also identified key individuals and showed them to possess links to a number of external agencies, although with a marked shortage of links to financial institutions and markets beyond the trade of fishing gear. Comparing these results with similar studies (Krishna, 2002), identified shortcomings may help to explain the lack of common initiatives in the village to deal with the over-exploitation of fisheries. However, if we look instead at the identified strengths, it is interesting to note that relatively high levels of social capital and the existence of various linkages among key individuals to different governmental authorities have not been sufficient for initiatives regarding resource management to occur.

Other factors that are likely to influence collective action for resource management were also identified. First, a marked homogeneity

of key individuals in terms of occupation and ethnicity appears to be related to poor problem internalization and recognition of changing ecological conditions within this group. Second, structural characteristics of the social network among the key individuals showed that one person occupies a very central position and possesses the only link to the formally appointed sub-chief. It is argued that these factors, respectively, affect resource management (1) by imposing a social barrier for management initiatives and reducing key individuals' ability to perceive and synthesize new information and knowledge, potentially reducing the community's ability to adapt to new circumstances; and (2) by the inherent vulnerability in depending on a single person for connections to formal government officials, as well as the impact that the personal characteristics and interests of a single person have on prioritization and decision-making. However, it is recognized that benefits may also be derived from the latter "bottleneck" by facilitating coordination of collective action initiatives.

These findings support the idea that efforts directed at enhancing NRM at the community level should take several aspects of social capital into consideration. Furthermore, leadership characteristics such as links to external agencies, homogeneity of the most influential individuals, and structural characteristics of the social network among these individuals may also contribute to a community's potential for management of natural resources. We argue that the methods applied in this study extend the framework developed by Krishna (2002) in a way that enables further investigation of the role of social capital and agency in NRM by local communities. In particular, by using methods based on structural characteristics of the community's social networks, we were able to (1) identify the most influential individuals without having to rely on the so-called informed experts, and (2) provide for less context-dependency, thus making it easier to compare different cases worldwide. The latter is crucial in researching possible general aspects of social capital and agency, and their roles in successful community-based NRM. By using a structural network approach, it is also easier to communicate findings to a broader audience of researchers who are interested in developing the concept of social capital.

NOTES

1. This figure was arrived at by taking into account the number of respondents who did not report any specific person (102) and then subtracting those who reported

either to (i) the fishing captain (11), (ii) to those affected by the rule breaking (9), or (iii) to those who would confront the rule breaker themselves (8).

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