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IFPRI Discussion Paper 00730

November 2007

## **Measuring and Accounting for Community Capabilities in Kordofan, Sudan**

Khalid El Harizi, International Fund for Agricultural Development  
and  
Heather Klemick, Independent Consultant

Development Strategy and Governance Division

## **INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE**

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## ABSTRACT

Parallel to the growing attention being devoted to the relationship between empowerment and development, an increasing number of tools are being developed to measure empowerment and determine the link between these two phenomena. This paper details the methodological processes used to construct, test and possibly refine one such instrument, the Community Capability Index, an innovative tool to measure community capabilities in the domain of natural resource governance. Empirical reference is made to research conducted in 85 villages in North and South Kordofan, Sudan. Following this, the paper presents findings from analyses of the determinants of community capabilities, including geographic, economic, and institutional variables. The results suggest that in Kordofan a number of factors influence capabilities. Possessing a village market, proximity to the nearest town, and access to credit are economic variables that have a significant and highly positive effect on community capabilities. Regarding the environment, capabilities are found to be greater where there is more rainfall, but access to groundwater from lower-quality aquifers and cracking clay soils have negative impacts on capabilities. War shocks, as might be expected, have a negative and significant effect. Particularly interesting is the generally weak correlation found between capabilities and wealth, along with strong correlations between institutional and social dimensions of community capabilities and participation in donor-funded projects. This combination suggests that development interventions must take into account the non-identity of poverty reduction and empowerment processes, at least when the targeted agents are communities rather than individuals or households. The findings reveal areas for further investigation into the relationship between the determinants and dimensions of capabilities, and the potential significance of the relationship for some dimensions suggests context-specific interventions to strengthen the relevant capabilities.

**Keywords:** Capabilities, Sudan, IFAD, Community Capabilities Index



## 1. INTRODUCTION

A focus on community empowerment and capabilities, whether separately or in combination, is becoming rather common in recent development literature, whether academic or practice-oriented (see for example Narayan 2005; Stern, Dethier, and Rogers 2005; Alsop, Bertelsen, and Holland 2006; and, for the centrality of capabilities in a certain kind of development thinking, Sen 1999). This is largely due to the growing popularity of a holistic understanding of development as a process that requires the empowerment of vulnerable stakeholders, rather than merely quantitative improvements on conventional indicators like income, literacy, productivity, or nutrition. Most donors now agree that promoting development requires empowering those who are supposed to be not only its beneficiaries but also its agents, although there is a certain lack of clarity about what exactly this may entail, let alone how to go about it. Theorists and practitioners of natural resource governance, community-driven development, and resource-based conflict management have perhaps particularly stressed the importance of empowerment for developmental impact and sustainability (see for example Castro and Nielsen 2003; Buckles 1999; Hamilton and Dama 2003; and Means et al. 2002). In addition, the non-instrumental value of empowerment as a developmental goal in its own right has been articulated in the literature on livelihoods, human rights (including the right to development), gender equity, and the role of good governance for development (see for instance Sen 1999; Moser and Norton 2000; Eyben 2003; and Alsop 2005).

In parallel with growing attention to the interplay between empowerment and development, efforts to develop tools to operationalize this interplay by reference to community capabilities have also multiplied since the 1990s. For example, tools like the World Bank Social Capital Assessment Tool have become quite widespread, and the World Bank and other donors have also been supporting research and debate about the conceptual and methodological challenges of measuring empowerment. In spite of some progress on this front, it is generally recognized that addressing these challenges still requires experimentation and theorization before we can measure and compare empowerment processes and capabilities for different agents, in different domains, and over time. In addition, although research is increasingly revealing the existence of linkages between empowerment and certain conventional development indicators (especially in the realm of natural resource management and with respect to gender), it is generally recognized that more research is needed also to explore determinants of empowerment and community capabilities.

The project out of which this paper grew is located in this area of current research and debate. Between 2003 and 2006, the International Fund for Agricultural Development (IFAD) and IFPRI jointly sponsored the project, *Empowering the Rural Poor under Volatile Policy Environments in the Near East*

*and North Africa Region*, with the participation of the national agricultural research systems of Morocco, Sudan and Tunisia. The project included community-level research on empowerment and capabilities in 85 villages in North and South Kordofan, Sudan. The main objectives of this project were to develop a conceptual model of empowerment and, following this, devise scientific tools to measure empowerment. The model that was developed conceived of empowerment as an expansion of the capabilities of an agent, whether individual or community. In turn, capabilities were understood as the achievements potentially available to an agent endowed with changing values, assets, skills, and attitudes, facing an opportunity structure that also changes over time. Measuring empowerment or disempowerment was thus conceptualized as a function of measuring capabilities pertaining to patterns of interaction between agents and opportunity structures in specific domains (El Harizi 2003).

The project brought an original contribution to the debates on how to measure empowerment on at least two levels. First, it developed tools to measure capabilities and investigate empowerment processes, moving beyond asset-based notions of agency and capabilities and an institution-based notion of opportunity structures, and examining the interplay of assets, attitudes, skills, and institutions in constituting agents as well as their interaction with opportunity structures. Second, the project brought a significant contribution to present debates by relating measures of capabilities to certain conventional predictors and indicators of development, such as wealth, population density, access to physical infrastructure, financial services, and others. The investigation of predictors of capabilities and empowerment has illuminated the problematic nature of conventional distinctions between these concepts, without thereby suggesting that necessary conceptual distinctions be abandoned.

This paper is based on the analyses conducted under the project described above and it discusses primarily the process of developing a tool, the Community Capabilities Index (CCI), to measure the capabilities of communities as collective agents in the realm of natural resource management. It largely focuses on the methodological process used to test and possibly refine this tool in the context of field research in Kordofan. The first section of the paper presents the method followed for the construction of the CCI along with a summary of the results from the community capability survey conducted under the IFAD-IFPRI project. Section 2 provides results of tests on the robustness of the CCI. The tests included assigning alternative weights to the indicators constituting the CCI, constructing different capability indices, and looking at the correlation between the original and alternative indices to determine the sensitivity of the CCI to different specifications. In Section 3, the paper examines the determinants of community capabilities, considering geographic, economic, and institutional variables as possible predictors. Of particular interest are the effects of participation in an IFAD-cofinanced development project, and we use a treatment-effects model to estimate the impact of this participation controlling for nonrandom selection into the project. Following this is a discussion of the impact of the CCI on an index

of achievements, which we examine using a two-stage model to control for endogeneity. Finally, the report presents a succinct review of CCI predictors by using two different, but complementary methodologies, namely regression and CART analysis. The results generated from the employment of these two methodological approaches suggest some pathways to increase communities' capabilities in different circumstances, while also questioning some common assumptions about the links between capabilities, poverty, and asset endowments.

## 2. THE COMMUNITY CAPABILITIES INDEX: BACKGROUND AND RESULTS FOR SELECTED COMMUNITIES IN KORDOFAN

Marking the research approach of the IFAD-IFPRI project was a significant reliance on inductive and participatory methodologies. This was in accordance with the model of empowerment developed for the project, where capabilities are the product of recursive interaction between an agent and the opportunity structure in which it mobilizes its characteristic mix of assets, skills, and attitudes in pursuit of valued objectives. Since the task of measuring capabilities thus also becomes a function of changing relational contexts, a measure of inductive research was seen as the best approach to devising tools and indicators.

To develop the tool to measure capabilities, a research team operating in Sudan conducted a survey and several rounds of progressive testing in which target agents played a key role. The project chose village communities as the agents for investigation, as they were understood to be the primary local actors in natural resource management as well as referents of local donor-funded development initiatives. The survey was carried out in 2004 to measure the communities' capabilities for autonomous governance in the realm of natural resources, as well as to identify patterns of variation in capabilities across communities. Eighty-five communities were randomly selected to participate from North and South Kordofan, both of which are regions characterized by volatility in their policy environment and ecological conditions. This volatility has often resulted in varying degrees of conflict, which has in turn exacerbated volatility.

The survey was designed to allow communities to evaluate their capabilities according to a set of categories or factors that an expert panel had devised.<sup>1</sup> The panel initially suggested six weighted categories of capability, to be measured with 45 indicators, to create an index with a maximum score of 100 points (see Table 1 below). The survey collected data for these 45 indicators and on other variables regarding access to services (for example, education, health, and credit), agricultural activities, natural resource access and management, conflict, labor migration, social capital, and collective action.<sup>2</sup> Community members, both men and women in a group, responded to questions by drawing on their own perceptions and experiences. As a result, some communities may have rated similar situations differently. However, this did not invalidate the scientific relevance of the results since the notion of capabilities in the model used is partly subjective in nature.

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<sup>1</sup> The seven-member panel included the project leader, a senior national consultant for rural development, an official from the Ministry of International Cooperation, a gender specialist, the manager of an IFAD-funded project, a monitoring and evaluation specialist, and a representative from local planning units.

<sup>2</sup> Some parts of the Sudan Community Capability Survey Questionnaire were adapted from the questionnaire of the World Bank's Social Capital Assessment Tool.

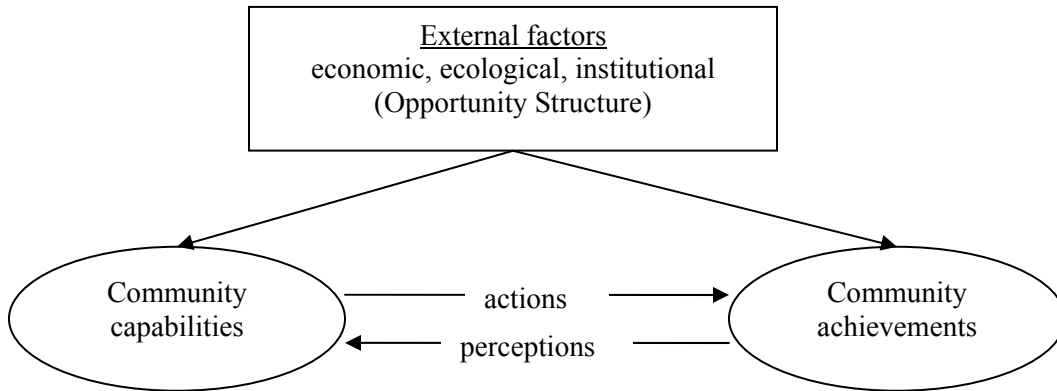
**Table 1. Capability categories and weights**

<b>Category</b>	<b>Weight</b>
Level of autonomy (agency)	20 points
Ability to take initiative	15 points
Ability to manage village funds	16 points
Ability to organize	14 points
Ability to manage communal lands	15 points
Level of achievements	20 points

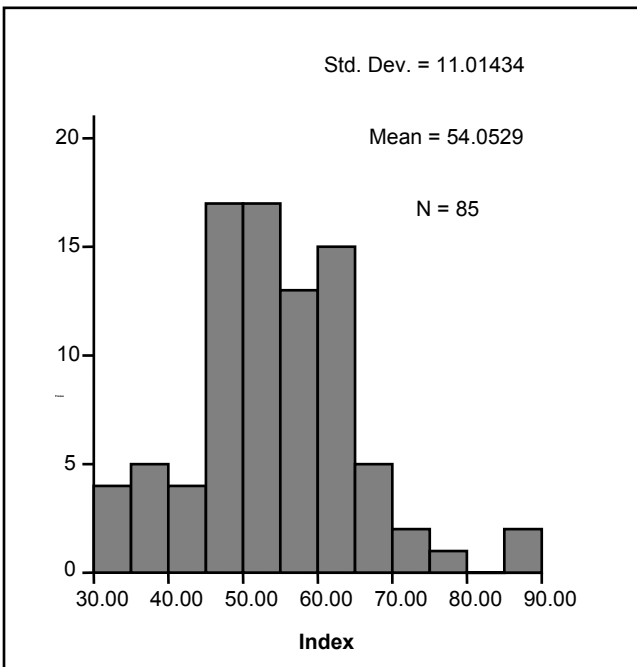
The definition of capability in the empowerment model, based not only on assets but also on skills, attitudes, and perceptions of the agent, guided the panel's choice of indicators and categories. For example, the categories *ability to manage funds* and *ability to manage communal lands* are each comprised of key skills constituting capabilities. *Ability to take initiative* and *ability to organize* were on the other hand seen primarily as dependent upon an index of the group's attitudes or perceptions regarding of its potential for success in natural resource management. Finally, *level of autonomy or agency* with regard to natural resources, which was conceptualized as a measure of a community's ability to define goals and to pursue them, was understood as a category based on an index of a community's control over its assets. Additionally, these categories in the CCI captured some of the properties at the level of community attributes widely considered important for the success of common property resource management (i.e., salience of the resource, a common understanding among members, a low discount rate for the resource, the even distribution of interests among across users, trust, autonomy, and prior organizational experience) (Ostrom 1999).

The initial design of the CCI included the level of community achievements as a category, and the initial survey collected data on it. However, as the model of empowerment evolved, the conceptual distinction between capabilities and achievements became more clear, requiring the two to be separated for measuring capabilities. The data on achievements can be used in the future to investigate the relationship between capabilities and achievements. El Harizi 2003 hypothesizes a feedback relationship between capabilities and achievements. In his account, achievement gaps drive adaptive responses and stimulate an enlargement of capabilities, with the latter positively influencing the former notably when achievements constitute improvements in an agent's well-being or realizations of its goals. The dynamics of this relationship are illustrated in Figure 1 below, and we will return to it in section 2.5. Enhancements in capabilities can in principle enable better achievements, but there is no automatic causality between capabilities and achievements. Empowerment is thus a process set in place when this feedback relationship is positive. An important goal of research on capabilities is in fact to identify what conditions may induce a positive relationship and trigger an empowerment process.

**Figure 1. The feedback relationship between capabilities and achievements**



**Figure 2. Community capability distribution**



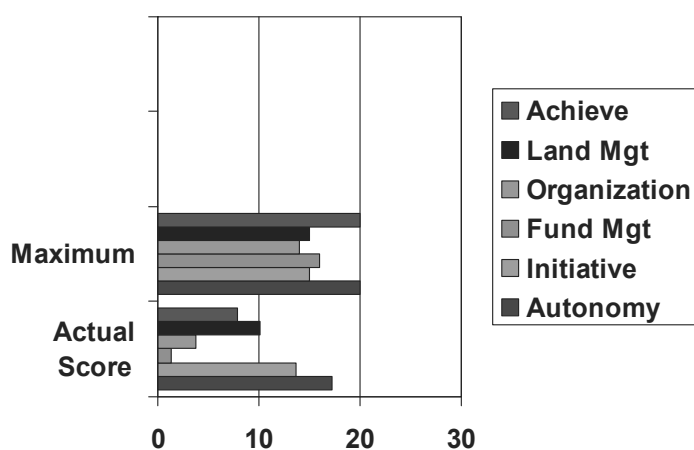
Results from the survey show variation across the 85 communities in their capability for autonomous governance of natural resources.<sup>3</sup> Figure 2 illustrates that the CCI score distribution of the communities is approximately normal, with the average being 54 points. The breakdown of scores by capability category further shows that the communities generally have rather strong levels of autonomy and of ability to take initiative, while their abilities to manage funds and organize and their levels of

<sup>3</sup> More detailed results from the survey are in the Rural Communities Capability Assessment Survey reports by G. Shields and B. Fadlalla, as unpublished documentation for the IFAD-IFPRI project.



achievements fall far short of the maximum (see Figure 3). Bivariate analysis indicates that the CCI scores are significantly correlated with, and vary according to, region (North or South), access to primary schools, participation in an IFAD program, and village size. Summary statistics for the 85 communities are presented in Table 2.

**Figure 3. Maximum and actual scores by category**



**Table 2. Key indicator averages for 85 communities**

Variable	South Kordofan (39 communities)	North Kordofan (46 communities)	Total (85 communities)
CCI score	57 points	52 points	54 points
Village size	100-249 households	50-99 households	50-99 households
Primary school access	72%	46%	58%
Village market access	23%	15%	19%
Participation in IFAD project	15%	21%	18%
Pastoralist	0%	26%	14%
Distance from nearest town	51 km	87 km	70 km

### 3. ROBUSTNESS TESTS AND ANALYSIS

We use a number of empirical approaches to test the robustness of the CCI. In particular, we construct alternative CCIs using factor analysis and examine the correlation between the original and the alternative CCIs.

#### 3.1. Robustness of Indicator Weights

As mentioned, the panel assigned weights both to the six categories in the original index and to each indicator used to construct the categories, based on their presumed importance. With the category of achievement having been excluded from the measurement of capability, the first step we take in assessing the robustness of the CCI is to test the robustness of the weights assigned to the 24 indicators of the other categories. We perform a factor analysis on each category to determine whether its group of indicators adequately represents a single underlying aspect of community capability. Factor analysis indicates the level of correlation among the indicators in each category and generates new “factors”, in other words, variables that may be used to create alternative categories and thus indices. As a further indicator of robustness, we measure the correlation between each factor thus identified and its respective category index as constructed with the original weights.

Tables A.1-A.5 in Appendix A give the results of factor analysis for the five categories. Since each category represents one significant factor (with an eigenvalue  $> 1$ ) the analysis supports the hypothesis of the expert panel that the 24 indicators represent five underlying factors or categories.

Factor analysis results for the level of autonomy or agency are shown in Table A.1. Indicators that the panel identified for this category included ability to determine rules of access to natural resources, legal recognition of village development committees, community control of water yard revenues, government recognition of communal lands, neighbors’ recognition of communal lands, and use or challenge of community tenure in communal lands by outsiders. The first factor explains 98 percent of the variation in the six indicators. However, most of the indicators have a high uniqueness ( $> 0.7$ ), and half of the indicators do not load significantly onto the factor/category, suggesting that there is no sufficient correlation between these indicators to conclude that they represent a single *level of autonomy* factor. Control of water yard revenues, government recognition of communal lands, and use or challenge of communal lands by others are the three of the six indicators that load strongly onto this factor, but government recognition of communal lands and use or challenge of community tenure by others do not have the expected signs (the sign is negative for the former and positive for the latter). In addition, there is no significant correlation between this factor and the level of autonomy index constructed with the pre-

assigned weights. This implies that the level of autonomy category index is not robust to different specifications.

Table A.2 shows the factor analysis results for the category *ability to take initiative*. A single significant factor explains 70 percent of the variation in the relevant indicators, which are ability to diagnose problems, ability to prioritize needs, ability to mobilize resources, and ability to find solutions. All of these indicators load strongly onto the factor, supporting the argument that *ability to take initiative* constitutes a single constituent or category of capabilities for governance of natural resources. Furthermore, the ability to take initiative as a factor is significantly and very highly correlated with the index of initiative constructed with the predetermined weights, suggesting that the factor is robust to different specifications.

*Ability to manage funds* consists of three indicators—ability to mobilize savings, ability to lend, and ability to fully recover loans. As seen in Table A.3, these indicators all load strongly onto one significant factor, supporting the rationale for a single *ability to manage funds* category. This factor is also highly and significantly correlated with the funds management index using the expert-assigned weights, indicating the robustness of that factor.

The fourth factor, the ability to organize, is represented by two indicators, the number of groups or associations, and the level of organizational experience. Both indicators load strongly onto one factor with approximately equal weight, as shown in Table A.4. The high correlation between these two indicators and between the organizational factor and the index constructed with pre-assigned weights suggests that the organizational ability of a community as a capability factor is robust to alternative specifications.

Factor analysis results for *ability to manage communal lands* are given in Table A.5. A single significant factor explains 69 percent of variation among the nine indicators, which are: (i) ability to exclude outsiders from communal resources using fees, (ii) excluding outsiders using communal guards, (iii) excluding outsiders using other means, (iv) placing time restrictions on members' use of communal lands, (v) placing restrictions on the number of users or animals on communal lands, (vi) using other means to restrict use of communal lands, (vii) use of sanctions for enforcement, (viii) use of mediation for enforcement, and (ix) effectiveness of compliance with rules. Indicators i, ii, iii, iv and vii all load strongly onto this factor, although “excluding outsiders through other means” has a negative sign. Indicators v, vi, viii and ix have very high uniqueness (> .95) and do not load strongly onto the factor. Still, a high and significant correlation of the factor with the land management index constructed with pre-assigned weights suggests that *communal land management ability* is a factor robust to different specifications.

Factor analysis on the five panel-determined categories generally supports the hypothesis that the 24 indicators involved represent five distinct aspects of community capability for the surveyed communities, namely autonomy, initiative, ability to manage funds, ability to organize, and ability to manage communal lands. Correlation between these factors and the original category indexes is high and significant in all cases except for level of autonomy, on which only few of the indicators are found to load strongly. Factor analysis further suggests that the remaining factors (excluding *level of achievement*) are robust to different weights on the indicators, since these are highly correlated in each factor. One way to address the lack of robustness of the level of autonomy factor would be to reassign its indicators to other categories that they may better represent. We explore this approach in the next section. As an alternative, scoring coefficients from each factor analysis could be used to suggest alternate weights for the indicators in each category if the five original categories are retained to construct the CCI.

### **3.2. Robustness of Categories Within the CCI**

To explore alternative categories of community capability that might emerge from the data, we perform a factor analysis on all 24 indicators. This approach is expected to be particularly useful to address indicators that did not load strongly onto a category, such as those that were initially suggested for the *level of autonomy* category. Before performing the factor analysis, we add two indicators to the list of 24 variables, namely a community's organizing to address a need or problem within the past three years, and the presence of major land conflicts requiring arbitration within the past five years. Though they had not been included in the original CCI, after the initial survey we hypothesized that these may be significant indicators of capabilities. Furthermore, two indicators from the original list are dropped because in retrospect they appear to be more indicative of level of achievements than of capabilities. These are a community's ability to determine the rules of access to natural resources and the effectiveness of compliance with such rules. Factor loadings generated by promax rotation are reported so as not to impose orthogonality among factors, since it is reasonable to expect the factors constituting an index of capabilities to be correlated. The results are in Tables B.1-B.6.

This round of factor analysis on the original CCI reveals five significant factors, which collectively explain 97% of variation in the indicators. In the final specification of the index, only 18 of these indicators are retained, as reported in Table B.1. We drop indicators with high uniqueness that do not load onto any factor (notably restricting the number of users or animals on communal lands, restricting use of communal lands by other means, and use of mediation for enforcement), as well as those that appear in retrospect to be too vague to be clearly interpreted (for example, excluding outsiders from communal lands using other means).

The five significant and alternative factors emerging from the analysis can be identified based on the indicators that load most strongly onto each. The indicators ability to mobilize resources, ability to find solutions, number of groups and associations, level of organizational experience, and organizing to address a need or problem in the past three years were found to load strongly (factor loadings > 0.35) onto a factor that was understood as *mobilization*. Loading strongly on a second factor were the ability to mobilize savings, ability to lend, and ability to recover funds, suggesting a *money management* factor. Government recognition of communal lands, neighbor recognition of communal lands, challenge to or use of communal lands by outsiders, and major conflicts over land requiring arbitration in the past three years loaded strongly on a third factor (with the last two loading negatively as expected). This factor was labeled *land tenure security*. A fourth factor was comprised of the ability to diagnose problems and the ability to prioritize needs, which we named a *common vision of problems*. Finally, government recognition of communal lands, exclusion of outsiders from communal lands through fees, exclusion of outsiders from communal lands using guards, placing time restrictions on members' use of communal lands, and enforcement through sanctions load strongly onto a fifth factor, namely *communal land management*.

We conduct further factor analysis to derive the weights on the indicators in each of these newly identified categories. In order to obtain these weights, we run separate factor analyses on the indicators within each new category. The resulting scoring coefficients are rescaled so they add up to one and are used as weights. The original and rescaled scoring coefficients are presented in Tables B.2-B.6.

The five new factors-categories we identify in the analysis, namely *mobilization*, *money management*, *land tenure security*, *a common vision of problems*, and *communal land management*, provide an appealing alternative to the five original CCI categories. The new categories are consistent with the definition of capabilities and the main features of the empowerment model, because it remains possible to see the interplay of assets, skills, and attitudes or perceptions in each category. Factor analysis confirms the robustness of these categories, and rescaled scoring coefficients can also be used as weights for indicators for each factor. The 18 indicators used for the factor analysis constitute a streamlined set of variables that can be used to create alternative CCI categories (except in the case of *level of achievement*). By assigning weights to these five categories, a restructured CCI can be created, which may then be used to test the robustness of the original CCI.

### **3.3. Robustness of Category Weights**

We assign alternative weights to the five original and five new categories. Following this, these weights are used to construct several alternative CCIs. Correlations between the alternative CCI and the original one are used as an indicator of CCI robustness to different specifications.

Since the weights assigned to the categories are inherently subjective, the team considered both equal weights and an alternative weighting scheme in addition to the panel-assigned weights. To choose alternative weights, the five categories in each CCI, original and alternative, are aggregated into three more general aspects of community capabilities: *social mobilization*, *land management*, and *money management*. *Social mobilization* encompasses the mobilization and a common vision of problems categories from the new CCI, or *the ability to organize* and *ability to take initiative* categories from the original index. Land management includes communal *land management* and land tenure security from the alternative CCI, or *level of autonomy* from the original index. The category of *money management* was not merged with others. The intuitive ranking of the importance of these three aspects (social mobilization first, land management second, and money management third) for community capabilities was the basis for assigning alternative weights to each category. The results of this (partly subjective) process are listed in Table 3.

In conferring new weights to the original and alternative sets of categories, we assume an essential correspondence between the two sets. In fact, the ability to manage money and the ability to manage communal lands appear as categories in both sets, and they contain essentially the same indicators. Furthermore, *land tenure security* in the new set is similar to *level of autonomy* in the original index, and the new category, *common vision of problems*, is similar to the old category, *ability to take initiative*. Finally, *ability to mobilize* in the new CCI contains many of the same indicators as *ability to organize* from the original CCI.

**Table 3. Proposed weights on alternative CCI categories**

<b>General category and total weight</b>	<b>Alternative category</b>	<b>Weight</b>
Social mobilization (40%)	Mobilization	30%
	Common vision of problems	10%
Land management (30%)	Land tenure security	15%
	Communal land management	15%
Money management (30%)	Money management	30%

Using the two sets of categories and alternative weighting schemes, we construct six alternative CCIs (see Tables 4 and 5):

- CCI1: The original CCI (minus the category *level of achievements*), using predetermined weights on both indicators and categories
- CCI2: The five new categories, adapting the pre-assigned weights
- CCI3: The five original categories, using equal weights
- CCI4: The five new categories, using equal weights
- CCI5: The five original categories, using alternative weights
- CCI6: The five new categories, using alternative weights

**Table 4. Alternative weights for CCIs using five original categories**

<b>Category</b>	<b>CCI1</b>	<b>CCI3</b>	<b>CCI5</b>
Level of autonomy	0.25	0.2	0.15
Ability to take initiative	0.1875	0.2	0.1
Ability to manage funds	0.2	0.2	0.3
Ability to organize	0.175	0.2	0.3
Ability to manage communal lands	0.1875	0.2	0.15

**Table 5. Alternative weights for CCIs using five alternative categories**

<b>Category</b>	<b>CCI2</b>	<b>CCI4</b>	<b>CCI6</b>
Land tenure security	0.25	0.2	0.15
Common vision of problems	0.1875	0.2	0.1
Money management	0.2	0.2	0.3
Mobilization	0.175	0.2	0.3
Communal land management	0.1875	0.2	0.15

As shown in Table 6, the original CCI is highly and significantly correlated with all the alternative CCIs constructed with various weights and approaches.

**Table 6. Correlations between CCI1 and alternative CCIs**

<b>Alternative CCI</b>	<b>Correlation coefficient (p-value)</b>
CCI2	0.7904 (0.0000)
CCI3	0.9964 (0.0000)
CCI4	0.8091 (0.0000)
CCI5	0.9513 (0.0000)
CCI6	0.8454 (0.0000)

Results show that the original CCI is robust to different weights and specifications and correlation among indicators is sufficiently high to infer that they represent common underlying aspects of community capabilities that can be categorized in various ways. There is thus a degree of subjectivity in deciding on the most appealing specification, but results should not substantively change with the specification chosen.

### **3.4. Streamlining the CCI**

Based on the analyses in sections 2.1-2.3, we revise the structure of the original CCI to create a new index that is robust to different specifications. To this end we use the alternative categories that, based on their robustness and interpretability, the factor analysis in Part B suggests to represent the different aspects of community capabilities. These are also categories that consist of fewer indicators. We weight the

indicators in each category according to the rescaled scoring coefficients reported in Table B.2 and weight the categories using the scheme listed in Table 5. The analysis in the remainder of the paper relies on this streamlined CCI, which appears in Table 7 below.

**Table 7. A streamlined CCI**

<b>Category</b>	<b>Indicator</b>	<b>Weight</b>	<b>Points</b>
Mobilization	Mobilize resources	0.24	1
	Find solutions	0.36	2
	Total # of groups/associations	0.17	4 (.5 pt each; max is 8)
	Past organizational experience	0.17	2 (0-little; 1-some; 2-substantial)
	Community has organized to address a need or problem in past 3 yrs	0.06	1
Money management	Mobilize savings	0.04	1
	Lend	0.42	4
	Fully recover loans	0.54	5
Land tenure security	Communal land recognized by government	0.16	2
	Communal land recognized by neighbors	0.16	2
	Communal land challenged/used by others	-0.46	4 (if answer no)
	Major land conflicts requiring arbitration in past 5 yrs	-0.21	2 (if answer no)
Common vision of problems	Diagnose main problems	0.5	5
	Prioritize needs	0.5	5
Communal land management	Excludes outsiders from communal land/water through fees	0.39	4
	Excludes outsiders from communal land/water through guards	0.2	2
	Time restrictions on members' access to communal land	0.23	2
	Enforcement through sanctions	0.19	2



## 4. DETERMINANTS OF COMMUNITY CAPABILITY

To explore the variables that may determine the differences in scores on the CCI, we employ regression analysis. We also examine the effect of these variables on the individual categories. An instrumental-variables approach is then used to examine the effect of the CCI on the level of community achievements. Finally, we use CART analysis as an alternative but complementary method to identify predictors of community capabilities. The latter process is only briefly discussed in this paper for reasons of space.

### 4.1. Determinants, or Predictors, of the CCI

We regress the streamlined CCI on a series of variables to determine the relative contribution of each of these to predicting community capabilities. As possible determinants of community capability, we consider economic, environmental, and institutional factors, as well as weather, disease, and war shocks. Environmental variables in this analysis included rainfall, soil type, and hydrology (agroecological zone and vegetation class were excluded from the final regression due to high co-linearity with rainfall and their resulting lack of significance). The distinction between North and South Kordofan was initially important in bivariate analysis, but it is not significant in the multivariate regressions due to co-linearity with other variables and is thus excluded from the final specification. Local economic conditions are factored in with several indicators, such as distance from the nearest town (with a squared term to account for possible non-linearity), presence of a village market, access to credit from an agricultural development bank, and main source of livelihood (pastoralism or cultivation). Formal and informal institutional variables shaping the opportunity structure of communities as well as their characteristics as agents are represented by the following variables: participation in an IFAD-funded project, female circumcision practice (as an indicator of socio-cultural development and/or of attachment to certain customary social norms), and village size.

As Table 8 illustrates, the covariates included in the final specification perform well in predicting the variation in the CCI, as indicated by the adjusted R-squared of 0.69. In addition, it appears that economic indicators are highly significant in predicting the score. The regression coefficients indicate the magnitude of these effects. For instance, community capabilities decrease with distance from the nearest town (at a decreasing rate, as indicated by the squared term) by over a quarter of a point per km. Communities with village markets have significantly higher CCI scores (by around 9 points), all other factors being equal. Villages with access to credit from an agricultural development bank, in this case the Agricultural Bank of Sudan (ABS), have on average an 18 point higher score. Village size is also positively correlated with CCI ranking. Finally, participation in an IFAD-cofinanced project has a large and significant effect on the score, raising it by 9 points. However, this coefficient must be interpreted

with caution due to the non-random selection of villages into IFAD-funded programs, and the effect of this variable is further explored below using a treatment-effects model.

**Table 8. Regression of community capability on economic, geographic, and institutional factors<sup>4</sup>**

Alternative CCI	Coef.	Std. Err.	t
Village size	1.941311	<b>.9508537</b>	<b>2.04</b>
Community practices pharonic circumcision	<b>-1.647965</b>	<b>2.827036</b>	<b>-0.58</b>
Participation in IFAD project	9.288003	<b>2.590997</b>	<b>3.58</b>
Presence of village market	8.65354	<b>2.635366</b>	<b>3.28</b>
Pastoralism is main source of income	<b>4.586479</b>	<b>3.196164</b>	<b>1.43</b>
Distance from town in km	-.2560434	<b>.0636957</b>	<b>-4.02</b>
Distance from town in km squared	.0007101	<b>.0003342</b>	<b>2.12</b>
Access to ADB credit	18.36231	<b>3.410486</b>	<b>5.38</b>
Level of rainfall	7.600822	<b>2.841314</b>	<b>2.68</b>
Presence of non-cracking clay soil	-5.825267	<b>3.264281</b>	<b>-1.78</b>
Presence of cracking clay soil	-13.3575	<b>4.184609</b>	<b>-3.19</b>
Access to aquifer a2	-9.504313	<b>3.433795</b>	<b>-2.77</b>
Access to aquifer a3	<b>-.47831</b>	<b>6.456409</b>	<b>-0.07</b>
Access to aquifer c2	<b>-4.156632</b>	<b>3.185528</b>	<b>-1.30</b>
Community has experienced major price or market shock in past 5 yrs	<b>-3.361073</b>	<b>2.356885</b>	<b>-1.43</b>
Community has experienced major conflict in past 5 yrs	-8.285429	<b>2.858711</b>	<b>-2.90</b>
Constant	43.24201	<b>7.827023</b>	<b>5.52</b>

Number of observations 85; Adjusted R-Squared 0.69

Environmental variables also appear to be very important in determining CCI scores. In particular, the score increases by around 8 points with every increase in rainfall class.<sup>5</sup> Scores are moreover significantly lower, by 9.5 points, in areas with access to groundwater from an A2 aquifer as compared to an A1 type, which is a much higher-quality water source.<sup>6</sup> Cracking clay soils are also associated with a lower score by 13 points. This finding may be surprising *prima facie*, since cracking clay soils have high production potential. However, they are also difficult to cultivate without the

<sup>4</sup> Entries in bolded characters are those that appear statistically most significant.

<sup>5</sup> Rainfall is indicated by average annual class, with 1=100-200mm, 2=200-400mm, 3=400-600mm, 4=600-700mm

<sup>6</sup> The most important aquifer in Sudan is A1. It is found north of the 13° latitude in the eastern part of the country, while in the west it extends north of the 10 [PL. CLARIFY]. In spite of its huge resources, the aquifer has not been exploited intensively, mainly because of the depth of the ground water table, which makes pumping prohibitively expensive. The A2 aquifer is one that instead mainly exists in the deposits of the Um Ruwaba Formation. The depth of the water table varies from 10m in the south to more than 150m in Northern Kordofan. The A3 aquifer consists of alluvial deposits from *wadis* and rivers. Ground water quality is rather good, and the water table is at shallow depth (0-10 m). The most extensive unit in the area is C3. It consists of the rocks of the basement complex and its acid intrusions. Groundwater occurs only in fracture and faults zones and it originates in the North and center of the country with recharge from *wadis* and rivers. Groundwater quality can vary widely, but it becomes poorer northward. In many places C2 contains saline stagnant water.

appropriate technology, so that their presence may exacerbate production problems in areas with minimal access to technology. Non-cracking clay soil also has a weak negative effect on capabilities.

Whereas female circumcision practice and main source of livelihood (pastoral or cultivation) are found not to be significant determinants of the CCI score, war shocks are found to have a negative and significant effect, causing a drop in capabilities by 8 points. Economic and institutional variables, such as wealth, inequality, and availability of educational and health services, were expected to shape community capabilities. However, it was recognized that including these as independent variables would likely yield biased coefficient estimates due to a high potential for endogeneity (notably due to reverse causality). We therefore examine the relationship between community capabilities and these variables by looking at simple correlations, which indicate the strength of existing relationships without controlling for other factors or indicating the direction of causality. These correlations are reported in Table 9.

**Table 9. Correlations between CCI and key economic and institutional indicators**

<b>Indicator</b>	<b>Correlation coefficient (p-value)</b>
Primary school availability	0.5149 (0.0000)
Clinic or hospital availability	0.4653 (0.0000)
Wealth	0.1469 (0.1798)
Inequality	0.2152 (0.0479)

Scores on the CCI are found to be positively correlated with primary school and clinic or hospital availability. Correlation with wealth is also positive, but not significant, indicating that community capabilities do not automatically result from wealth. Furthermore, while it makes intuitive sense that wealth and services will bolster community capabilities, it may also be true that capabilities lead to greater income and educational or health services. In fact, many of the initiatives surveyed communities took over the past three years involved the construction of schools or clinics (see Table 10). More surprising may be the positive correlation between CCI score and inequality. However, since wealth and inequality are significantly correlated with each other, the CCI-inequality may reflect the CCI-wealth relationship.<sup>7</sup> Without exogenous variation in wealth, inequality, or services, it is difficult to reach conclusions about the strength of these relationships or the direction of causality. In Section 3.3, this analysis is expanded as we run regressions of these same variables and the individual CCI categories to see if these community characteristics have the same effects on the different aspects of community capability.

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<sup>7</sup> The correlation (p-value) between wealth and inequality is 0.3432 (0.0013)

**Table 10. Community activities over the past three years**

Activity	Number of villages involved as their primary initiative
School construction	33
Water maintenance/improvement	27
Health care/facilities improvement	4
Mosque construction	5
Other	8
None	8

#### 4.2. Treatment Effects: Controlling for IFAD Participation

IFAD initiated co-financing of community-driven rural development programs in North and South Kordofan in 2000 to support the process of government decentralization. The objectives were to improve the livelihoods of rural pastoralists and traditional farmers, to bring men and women into the development process, and to bolster community-level groups and local governments. To meet these goals, a series of activities were implemented in social and economic development and conflict resolution. In particular, literacy and mobilization training, microfinance, provision of agricultural starter packs, improvement of local water sources, and support to peace-building were given priority based on needs that local communities identified. Since the inception of the programs, the participating communities have seen a marked improvement in various domains, from literacy to women's access to finance.

Fifteen of the 85 villages included in the Community Capabilities Survey were participants in IFAD-cofinanced rural development programs. Since IFAD's decisions on where to implement projects are typically based on a number of factors that may be correlated with community capabilities, we use a treatment-effects model to control for the endogeneity that may exist in the relationship between participation in a program and the CCI score.<sup>8</sup> IFAD criteria for village selection include high population density, accessibility, grain availability, poverty level, migration patterns, and motivation or willingness to participate, among other factors. The variables included here in the selection equation to match IFAD targeting criteria are village size (as a proxy for population density), distance from the nearest town (for *accessibility*, and both village size and distance from the nearest town have squared terms to allow for non-linearity), main income source (pastoralism vs. cultivation) and seasonal migration within rural Kordofan (as opposed to elsewhere in Sudan) to reflect migration patterns. Controlling for wealth and motivation was difficult, particularly given the non-availability of time-series data.

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<sup>8</sup> The treatment-effects model jointly estimates a system of two equations: the first is the outcome of interest (in our case, the CCI), while the second is selection into the treatment (here, participation in an IFAD-funded program). The model takes any correlation between the error terms of the two equations into account and includes a "correction" term in the outcome equation to control for selection bias, yielding an unbiased coefficient on the treatment variable.

Table C.1 shows the results from the treatment-effects estimation.  $\rho$  represents the cross-equation error correlation. The error correlation between the CCI and IFAD equations might be expected to be positive, since communities' level of motivation and organization may positively affect both selection into an IFAD-funded program and community capabilities. However, negative correlation is also possible, since IFAD generally targets poorer communities, while poverty is thought to decrease community capabilities. We were not able to control for either motivation/organization or wealth without introducing further endogeneity so both of these factors are reflected in the error terms of both equations. The results show that correlation between the two equations is negative but not significant, possibly because motivation, wealth, and any other unobservable variables work in opposite directions and cancel each other out.

Although it may be premature to conclude that non-random selection does not bias the coefficient of IFAD participation in the CCI equation, the statistical evidence indicates that the two equations are independent and can be consistently estimated separately. Therefore, results from the earlier analysis still hold: IFAD participation positively and significantly affects community capabilities, increasing the CCI score by 9 to 11 points. Research results also suggest that IFAD-funded projects significantly contribute to community capabilities and that this kind of projects may be one important path to enhancing them among poorer communities.

#### **4.3. Determinants of Community Capability by Category**

In this section we explore economic, environmental, and institutional factors affecting community capabilities in greater detail, by looking at their effect on each of the alternative CCI categories separately. The goal is to identify the channels through which these factors shape capabilities.

Table 11 gives the results of the regressions on the independent variables on the one hand, and the CCI and its individual categories on the other. Only the significance levels and directions of the effects are included in the table for ease of interpretation (full regression results are in Appendix D). The adjusted R-squared gives a measure of fit for each regression. As discussed in section 3.1, the variables that we find to principally explain scores on the original CCI include village size, participation in an IFAD project, access to a village market, access to ABS credit, proximity to the nearest town, rainfall, cracking clay soils, access to groundwater through the relatively poor quality A2 and C2 sources, and war shocks.

**Table 11. Regressions of alternative CCI and categories on economic, geographic, and institutional factors**

Factor	CCI <sup>9</sup>	Capacity for Mobilization	Money management	Land tenure security	Common vision of problems	Communal land management
Village size (index)	++	++				
Pharonic circumcision (y/n)						--
IFAD (y/n)	+++	+++				
Village market (y/n)	+++	+++				
Pastoralist (y/n)					++	
Credit access from ABS	+++		+++			
Distance from nearest town (km)	---	--		-		--
Distance from nearest town squared (km)	++			+		+
Rainfall	+++		++			++
Cracking clay soil (y/n)	---			--		--
Non-cracking clay soil (y/n)	-					
A2 aquifer	---	---				
A3 aquifer		---		+		++
C2 aquifer		---		++	+	
Shocks – price			---			+++
Shocks – war	---	--		---		
Constant	+++	+++		+++	+++	+
Adjusted R2	0.64	0.62	0.37	0.31	-0.05	0.66

Regarding the determinants of individual categories, village size, participation in an IFAD project, village market access, and rainfall class are found to positively affect *mobilization*, and distance from the nearest town and access to the A2 aquifer relative to A1 one affect it negatively.<sup>10</sup> Largely predicting *money management* are access to ABS credit and price shocks. *Land tenure security* is negatively associated with cracking clay soils, distance from the nearest town, and war shocks. The available data does not adequately explain the determinants of *common vision of problems*, as the R-squared of -0.05 reveals. Pastoral activity as the main income source and access to the C2 aquifer are the only variables with predictive power in this regard. *Communal land management* ability decreases with distance from the nearest town and the presence of cracking clay soils, but it increases with rainfall and price shocks. The presence of Pharonic female circumcision also appears to have a negative impact on *communal land management* ability, but the meaning of this relationship remains unclear: while Pharonic circumcision is correlated with wealth and pastoralism, these variables do not provide an intuitive

<sup>9</sup> +++, --- : p < 0.01, ++, -- : p < 0.05, +, - : p < 0.1.

<sup>10</sup> A similar trend can be observed for A3 and C2 aquifers, although of a lesser magnitude (a drop of 4 points). However, the coefficient was not found to be significant.

explanation for the link with *communal land management*. A further unpacking of this variable as a proxy for attachment to traditional socio-cultural institutions and possibly for limited access to education and health services is warranted in order to investigate the meaning of this correlation. Further investigation is also needed to explore the significance of the positive correlation between price shocks and *communal land management*, possibly by recourse to qualitative tools to detail characteristic or recurring types of price shocks in the research area.

Individual category regressions are particularly useful because they indicate how certain explanatory variables influence community capabilities overall. For instance, village size has a positive effect on the CCI mainly through influencing a community's mobilization capabilities, which may be explained by the likelihood of larger villages having more organizations and offering greater networking opportunities compared to smaller ones. Greater proximity to the nearest town also leads to increased mobilization, possibly because it brings the same benefits as village size. But proximity also appears to impact the *land tenure security* and *communal lands management* categories. This may be due to the greater access to markets and services found in larger towns.

Certain agroecological variables are important predictors of capabilities across categories. For instance, the presence of cracking clay soil is negatively associated with *land tenure security* and *communal lands management*. As noted, this may have several explanations. A communities' lack of access to the technology needed to cultivate this kind of soil may make cracking clay a hindrance in land management. Outsiders, especially those with access to capital and technology, may be more likely to encroach on land with cracking soils because of their high potential productivity, thereby challenging a community's tenure. Rainfall class is also an important predictor, notably of *money management* and *communal lands management* capabilities. Finally, access to aquifer type is a significant determinant as access to poor quality aquifers negatively affects *mobilization*, and has slightly positive effects on both *common vision of problems* and *communal lands management*. This finding points to the complexity and significance of both water quality and abundance as developmental factors in Kordofan.

Economic, institutional, and environmental factors all appear to be important, though in different ways and measures, as predictors of various dimensions of community capabilities for autonomous governance of natural resources. Interestingly, certain variables affect the scores of only a few categories rather than the CCIs overall one. For example, price shocks affect *money management* (negatively) and *communal lands management* (positively), but not the overall CCI. Conversely, proximity to nearest town, rainfall, and access to aquifer type influence multiple categories of community capability, as well as the total CCI score. One general conclusion that can be made from these findings is that there are significant and measurable linkages between capabilities (and thus also empowerment or disempowerment processes) on the hand, and certain salient economic development, institutional, and

agro-ecological factors on the other. While some of these linkages can be understood with relative ease, others require further analysis and theorization before their interpretation becomes possible and recommendations for development interventions to strengthen capabilities can be generated.<sup>11</sup>

#### **4.4. Determinants of Achievements**

As mentioned earlier, a reciprocal feedback relationship between community capabilities and achievements is hypothesized here, although this does not mean that strong capabilities necessarily and by themselves translate into strong achievements to meet agents' goals. In this section, the paper explores whether the CCI can be a predictor of achievements, with other, external factors controlled for. Although we believe a two-way effect between capabilities and achievements occurs, examining the effect of achievements on capabilities is not possible with the available data. Time-series data is required to measure the effect of achievements in one period on capabilities in the subsequent period since we expect the effect to occur over time. For the purpose of our analysis of the influence of capabilities on achievements, we assume that capabilities can affect achievements almost simultaneously, though this can also occur over time.

To determine the effect of capabilities on achievements, we construct an index of achievements related to natural resource governance using factor analysis. The index consists of 14 indicators, including increased agricultural yields and sales over the past three years, improvements in health and nutrition, improved access to potable water, improvements in quality of life over the past three years, success of community initiatives and increase in incomes from community initiatives, percentages of boys and girls attending school, wealth, and living standard levels (see Table E.1 for the complete breakdown). Because capabilities and achievements may be endogenously determined, a simple regression would produce biased coefficient estimates. Therefore, using the instrumental variables approach, we include the predicted value of the CCI in the regression rather than the CCI score itself. Furthermore, since, according

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<sup>11</sup> A qualitative analysis of 14 extreme cases gives additional insights into the factors shaping community capabilities. Information on nine communities with very low capabilities (CCI < 40) reveals commonalities that may be inhibiting their ability to manage natural resources effectively and to develop capabilities. These communities are mostly very remote from town centers, have a high illiteracy rate, and have a poor natural resource base. Some are small villages recently split off from larger ones. Many constitute former nomadic pastoralists that have recently taken up settled agriculture, while others continue to move seasonally due to the instability of resources, such as water. The high rate of seasonal migration in these communities also leads to instability in leadership and management. By contrast, analysis of five high capability communities (CCI > 70) shows that these generally enjoy good access to schools, have relatively high literacy rates, good access to sources of finance, and are close to town centers or have village markets of their own. Natural resources, particularly water, are abundant, allowing in some cases for horticultural or cash crop activities. Finally, two of these communities have participated in IFAD projects. These findings support the results of the broader quantitative analysis here, confirming the role of proximity to towns, access to village markets and primary schools, participation in an IFAD project, access to high quality water sources, and participation in the cash economy in determining community capabilities. Furthermore, they highlight the potential significance of some issues the Community Capabilities Survey did not investigate in depth, such as seasonal migration, recent transition from nomadic pastoralism to settled agriculture, and water abundance. These variables may be taken into account in the design of future surveys on community capability. See report on Extreme Cases by Babo Fadlalla for individual community profiles.



to the approach, at least one exogenous variable from the CCI regression must be excluded from the achievements equation for the model to be identified, we use village size and Pharonic circumcision as exclusion restrictions, with the assumption that they affect capabilities but not achievements directly.

Factor analysis shows three significant factors among the achievement indicators, though we regard a fourth factor as also important (see results in Table E.1). The first factor can be interpreted as improvements in quality of life. Variables loading onto this factor include improvements in health, nutrition, potable water access, agricultural yields and sales, and quality of life in general. The second factor is school attendance, which the variable school attendance of boys and of girls represents. The third we interpreted as living standard, since standard of living and wealth load onto it. The fourth factor includes success of community initiatives and increased income from them, and was thus called success of community initiatives. These four factors are weighted equally to create a composite achievements index.

Regression results are mixed with respect to the effects of the CCI score on achievements (see Tables E.2 -E.6). The CCI appears to be a positive and significant predictor only of the success of community initiatives (Table E.6), a factor that the individual CCI indicators of participation in an IFAD-funded project, ABS credit access, and price shocks also explain (though further analysis is required to understand the effect of price shocks, as the correlation between price shocks and *communal lands management* scores, which was discussed earlier, needs further investigation). Access to groundwater from the poorer quality A3 and C2 aquifers negatively affects school attendance, though the low adjusted R-squared of 0.06 indicates a poor fit. The living standard weakly increases with access to village markets. None of the individual explanatory variables is statistically significant in predicting improvements in quality of life or the overall achievements index score.

Capabilities appear to have a strong effect only on the success of community initiatives. A significant relationship between the CCI score and improvements in quality of life, school attendance of boys or girls, living standard, or the composite achievements index score is not detected. One possible interpretation of these results is that the variables determining school attendance and standard of living are largely at the individual or household level rather than being the direct result of community capabilities and action, in contrast to the case of community initiatives. It is also likely that capabilities relevant in a specific domain (in this case autonomous community governance of natural resources) may not be significant predictors of developmental achievements only indirectly related to this domain. It is also important to note that there may be a variety of factors impacting such achievement indicators, as well as factors over which communities may have virtually no control, which have not been considered in this analysis. Finally, in light of these possibilities and of our findings, it should be mentioned that many communities generally value capabilities and empowerment for their own sake, so that establishing

definitive relationships between community capabilities and various developmental achievements may not be necessary in order to justify development programs aiming to bolster capabilities. At the same time, these findings point to the need for further research on the link between different kinds of economic, social, and human achievements, community and individual capabilities, and governance of natural resources. A step in this direction is documented in other research reports from the IFAD-IFPRI project. Further research may build on the tools developed for this project as well as draw upon the debate on the link between poverty reduction and empowerment, including the literature cited earlier.

#### **4.5. CART Analysis: CCI, Environment, and Poverty Interactions**

As a complement to the regression analyses conducted, we use an alternative approach, nonparametric Classification and Regression Tree (CART) analysis, to identify the economic and agroecological predictors of community capabilities, achievements, and poverty. As potential predictors of the CCI score, we employ in this model the same set of variables used in the regressions in section 3.1-3.3. However, additional variables suspected of being endogenous with the CCI, such as public primary school access and clinic/hospital access are also included. We recognize that reverse causality from the CCI score to these variables might drive their relationships. However, examining the predictive power of these variables for the CCI may be useful to identify those communities most able to take charge of local natural resource management.

Regression trees for the CCI offer insights into how development interventions should be designed and targeted for maximum effectiveness. For instance, primary school access appeared as the most important predictor of capabilities: communities with primary schools have on average a CCI 14 points higher than those without them. Access to primary school may thus be a simple, low-cost indicator to identify communities with high capabilities for future development interventions. Another key predictor is access to credit from an agricultural development bank. In communities with primary schools, the distinction is striking—communities with agricultural development bank access have higher CCI scores by an average of 26 points. Geographical region or agroecological zone also help to predict the score, with lower capabilities found in the relatively arid north and the low-rainfall savannah transition zone. Distance from the nearest town is an important factor in predicting the level of capabilities, with more remote communities being at a disadvantage. However, for these remote communities participation in an IFAD-funded project increases the CCI score by around 15 points on average. This participation also has a strong effect in northern communities, increasing their scores by 18 points. CART analysis for the individual alternative CCI categories, *mobilization*, *money management*, *land tenure security*, *common vision of problems*, and *communal lands management* showed similar results.

The various branches of the CCI regression tree suggest different development strategies for communities depending on the circumstances they face. For instance, communities that already have high capabilities, as indicated by the presence of a primary school, may benefit tremendously from access to credit through an agricultural development bank. Rural road networks may also be important for these communities. Projects cofinanced by IFAD or other development organizations may have the greatest impact for communities far from commercial centers or in arid or semi-arid zones. Conversely, for communities that already have a primary school and ABS credit access a basic development project may not be an appropriate or cost-effective kind of intervention to enhance capabilities. It may be a better use of resources to target other communities with such projects or to design for communities with strong capabilities projects that cater to their strengths. The results here confirm that the heterogeneity in capabilities found across communities calls for a range of context-specific intervention packages, which may be useful for project designers looking to tailor their interventions to local situations.

Contrary to the results from the instrumental variables regression analysis presented in section 3.4, the CART analysis indicates that CCI score is an important and positive predictor of achievements. However, CART analysis does not allow us to control for potential endogeneity between these two variables, making it impossible to draw conclusions about the direction(s) of causality: the positive relationship between capabilities and achievements may be bidirectional, or achievements may promote capabilities. Access to village markets, location in the north, and horticulture as the main source of livelihood are also associated with higher achievements. While it is difficult to determine the nature of the relationship between wealth levels and community capabilities due to the high likelihood of reverse causality, it is useful to investigate the predictive power of the CCI score for wealth. In the analysis, wealth (as perceived by local IFAD project managers and coded on a scale from 1 to 5) was taken as the dependent variable, and the CCI along with other economic and environmental variables were taken as possible predictors. The variable importance rankings and the regression tree show CCI score to be an important predictor of wealth, since increases in the CCI score are associated with greater wealth. Also associated with wealth are lower rainfall, village market access, and price shocks. However, further data on shifts in exogenous factors of wealth in the study area is needed in order to delve further into the relationship between capabilities and wealth.

## 5. CONCLUSION

The research on which this paper is based draws from a broader project on empowerment conducted in Kordofan, Sudan. According to the empowerment model developed under the project and adopted here, community capabilities result from the interplay of states and characteristics of agents on the one hand, and on the other hand a complex set of factors, including institutions, policies, the natural environment, economic context, shocks, and others. The goal in this paper has been first to present the CCI, a tool designed to measure community capabilities in the domain of autonomous natural resource management, with empirical reference to communities surveyed in North and South Kordofan, Sudan, and then the steps taken to test and refine the tool. Second, the paper presents some preliminary findings obtained through analyses on the predictors of community capabilities in this domain, along with broader conclusions relating to them.

The main result of the various phases of factor analysis described above is that the 24 indicators of capabilities constituting the original, expert panel-designed index can be taken as a basis for measuring five distinct aspects, or CCI categories, of community capability for autonomous governance of natural resources. These aspects are level of autonomy and the abilities to take initiative, manage funds, organize, and manage communal lands. The analysis here shows that the CCI constructed with these categories and their related indicators is robust to different weights and specifications, and that correlation among the indicators is sufficiently high to infer that they represent common underlying aspects of community capabilities. However, the indicators can be categorized in different ways. In testing the original index, five alternative categories or factors were identified (namely *mobilization*, *money management*, *land tenure security*, *common vision of problems*, and *communal lands management*), which are an appealing substitute for the five original categories. There is a degree of subjectivity in choosing the most appropriate specifications for categories and related indicators in the two possible indices, but results do not change dramatically with different specifications. With respect to capabilities, the results suggest that rural communities in Kordofan are on average relatively strong in their autonomy and in their ability to take initiative, while their abilities to manage funds and organize (along with their levels of achievements) fall well short of the maximum possible score.

One important goal behind developing tools to measure community capabilities is to identify predictors of these capabilities so that interventions to strengthen them can be formulated. Another is to clarify the relationship between the expansion of these capabilities, in other words, empowerment, and other developmental goals. In this regard, our correlation analysis on the original CCI reveals the significance of village size, participation in an IFAD project, access to a village market and credit, proximity to the nearest town, rainfall, cracking clay soils, access to groundwater, and war shocks as

predictors of capabilities. At the same time, the analysis indicates that some variables only influence specific aspects of capabilities, while others have a broad effect and affect a number of capabilities. This suggests that the type of intervention to be implemented depends on the local context and on the capabilities that are either of particular relevance for development or of concern to the local population.

Though methodologically distinct from the regression analyses conducted, the CART analysis of the CCI led to complementary results, as it suggested that various development strategies may be needed to strengthen capabilities, given the different circumstances that communities face. For instance, communities that already have high capabilities or that benefit from the presence of services and infrastructure (for example, a primary school) may benefit tremendously from access to credit through an agricultural development bank. Rural road networks may also be particularly important for these communities. The findings also indicate that for communities that have strong capabilities because they have primary school and credit access, a basic community development project may not be an appropriate intervention, and that development resources should be used either to target communities with weaker capabilities or to design interventions that complement the strengths of high-capability communities. The paper, however, notes that the relationship, including the directions of influence, between wealth and community capabilities is not entirely clear. As a result, the authors suggest that further analysis to determine the most appropriate development interventions for each community is needed. This could be achieved through further investigation into the relationship between social, economic, and environmental indicators of development and indicators of capabilities, employing the CCI as a potentially powerful tool to measure capabilities and map their predictors.

## APPENDIXES

### Appendix A: Factor Analysis of Original Capability Categories

**Table A.1. Factor analysis on autonomy/agency**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
<b>1</b>	<b>1.03742</b>	0.56254	0.9832	0.9832
2	0.47488	0.38534	0.4501	1.4333
3	0.08955	0.14818	0.0849	1.5182
4	-0.05863	0.14173	-0.0556	1.4626
5	-0.20036	0.08739	-0.1899	1.2727
6	-0.28776	.	-0.2727	1.0000

#### Factor Loadings

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Community is able to autonomously determine rules of access	0.13609	0.98148
Legal recognition of Village Development Committee	0.11665	0.98639
Community control over water yard revenues	<b>0.41905</b>	0.82440
Communal land is recognized by government	<b>-0.52527</b>	0.72410
Communal land is recognized by neighboring communities	-0.33437	0.88820
Communal land is challenged/used by others	<b>0.66482</b>	0.55801

Correlation coefficient (p-value) between category index and factor: 0.1049 (0.3393)

**Table A.2. Factor analysis on ability to take initiatives**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
<b>1</b>	<b>1.94538</b>	0.95326	0.7048	0.7048
2	0.99212	0.98252	0.3594	1.0642
3	0.00960	0.19648	0.0035	1.0677
4	-0.18689	.	-0.0677	1.0000

#### Factor Loadings

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Community is able to diagnose its problems	<b>0.55843</b>	0.68815
Community is able to prioritize its needs	<b>0.56882</b>	0.67644
Community is able to mobilize resources	<b>0.78426</b>	0.38494
Community is able to find solutions to its problems	0.30509	<b>0.83361</b>

Correlation coefficient: **0.9969 (0.0000)**

**Table A.3. Factor analysis on ability to manage funds**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
<b>1</b>	<b>1.82103</b>	1.80716	1.0542	1.0542
2	0.01388	0.12143	0.0080	1.0623
3	-0.10755	.	-0.0623	1.0000

**Factor Loadings**

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Community is able to mobilize savings	<b>0.37036</b>	0.86283
Community is able to lend	<b>0.90972</b>	0.17240
Community is able to fully recover loans	<b>0.92535</b>	0.14373

Correlation coefficient: **0.8867 (0.0000)****Table A.4. Factor analysis on organizational ability**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
<b>1</b>	<b>1.14585</b>	1.36292	1.2337	1.2337
2	-0.21707	.	-0.2337	1.0000

**Factor Loadings**

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Total number of groups/associations	<b>0.75692</b>	0.42708
Past organizational experience	<b>0.75692</b>	0.42708

Correlation coefficient: **0.9870 (0.0000)**

**Table A.5. Factor analysis on ability to manage communal lands**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
<b>1</b>	<b>1.58540</b>	0.73803	0.6912	0.6912
2	0.84737	0.33764	0.3695	1.0607
3	0.50973	0.29408	0.2222	1.2829
4	0.21565	0.19324	0.0940	1.3770
5	0.02242	0.16424	0.0098	1.3867
6	-0.14182	0.06912	-0.0618	1.3249
7	-0.21095	0.02294	-0.0920	1.2329
8	-0.23389	0.06644	-0.1020	1.1309
9	-0.30033	.	-0.1309	1.0000

**Factor Loadings**

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Community is able to exclude outsiders from communal land/water through fees	<b>0.70614</b>	0.50136
Community is able to exclude outsiders through communal guards	<b>0.51390</b>	0.73591
Community is able to exclude outsiders through other means	<b>-.56014</b>	0.68624
Community enforces time restrictions on its members for access/use of communal land	<b>0.49006</b>	0.75984
Community enforces time limitation of number of users/grazing animals for access/use of communal land	-0.09726	0.99054
Community enforces other restrictions on its members in access/use of communal land	-0.05236	0.99726
Community uses sanctions as enforcement mechanisms	<b>0.45458</b>	0.79336
Community uses mediation as enforcement mechanism	0.17188	0.97046
Effectiveness of compliance with land use rules set by community	0.14269	0.97964

Correlation coefficient: **0.6610 (0.0000)**



## Appendix B: Deriving New Categories of Capability

Table B.1. Factor analysis for 18 indicators of CC

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	<b>3.56223</b>	<b>1.55340</b>	0.3692	0.3692
2	<b>2.00883</b>	<b>0.49916</b>	0.2082	0.5774
3	<b>1.50967</b>	<b>0.30923</b>	0.1565	0.7338
4	<b>1.20044</b>	<b>0.13488</b>	0.1244	0.8582
5	<b>1.06557</b>	<b>0.35488</b>	0.1104	0.9687
6	0.71069	0.43997	0.0737	1.0423
7	0.27072	0.07512	0.0281	1.0704
8	0.19560	0.05323	0.0203	1.0907
9	0.14237	0.07121	0.0148	1.1054
10	0.07117	0.04375	0.0074	1.1128
11	0.02741	0.08132	0.0028	1.1156
12	-0.05391	0.05128	-0.0056	1.1100
13	-0.10518	0.02143	-0.0109	1.0991
14	-0.12661	0.01376	-0.0131	1.0860
15	-0.14037	0.05270	-0.0145	1.0715
16	-0.19308	0.03825	-0.0200	1.0515
17	-0.23132	0.03393	-0.0240	1.0275
18	-0.26525	.	-0.0275	1.0000

**Table B.1. Continued**

<b>Rotated Factor Loadings (promax rotation)</b>						
<b>Variable</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>Uniqueness</b>
Community is able to mobilize resources	<b>0.85909</b>	-0.20638	0.05684	-0.01693	0.02271	0.31731
Community is able to find solutions to its problems	<b>0.88054</b>	-0.18009	0.03837	0.06692	0.03185	0.23191
Total number of groups/associations	<b>0.61600</b>	0.25713	-0.02931	-0.05123	0.08282	0.44677
Past organizational experience	<b>0.61952</b>	0.26900	-0.06427	0.00712	-0.16968	0.47318
Community has organized to address an issue in past 3 yrs	<b>0.46118</b>	-0.15056	0.08553	0.20750	0.08549	0.68576
Community is able to mobilize savings	0.34153	<b>0.39291</b>	0.19635	-0.05189	0.04467	0.66592
Community is able to lend	-0.08258	<b>0.91839</b>	0.02552	0.03871	-0.05769	0.19241
Community is able to fully recover loans	-0.16714	<b>0.93374</b>	-0.00467	0.04039	0.03975	0.17048
Communal land is recognized by government	-0.11097	0.03213	<b>0.37859</b>	-0.08803	<b>0.44469</b>	0.67916
Communal land is recognized by neighboring communities	0.11670	0.05897	<b>0.44527</b>	0.00400	-0.18867	0.77599
Communal land is challenged/used by others	-0.06551	-0.05070	<b>-0.81094</b>	0.03222	-0.08486	0.36584
Presence of conflict over land requiring arbitration in past 5 yrs	0.02126	0.07280	<b>-0.52646</b>	0.04247	0.07417	0.68976
Community is able to diagnose its problems	0.01972	0.03425	-0.01235	<b>0.82652</b>	0.05315	0.28716
Community is able to prioritize its needs	0.03852	0.06508	-0.06040	<b>0.79613</b>	-0.01982	0.35013
Community is able to exclude outsiders from communal land/water through fees	0.29779	-0.09224	-0.14797	-0.07781	<b>0.58342</b>	0.46635
Community is able to exclude outsiders through communal guards	0.18441	0.15970	-0.36592	-0.09472	<b>0.36477</b>	0.56799
Community enforces time restrictions on its members for access/use of communal land	0.08462	-0.01402	0.10591	0.05919	<b>0.52573</b>	0.67748
Community uses sanctions as enforcement mechanisms	-0.19955	0.03891	0.11746	0.17314	<b>0.58133</b>	0.60966

**Table B.2. Deriving new within-category weights—Factor 1 (Mobilization)**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
1	2.40541	1.81025	0.8964	0.8964
2	0.59517	0.59301	0.2218	1.1182
3	0.00216	0.12342	0.0008	1.1190
4	-0.12126	0.07673	-0.0452	1.0738
5	-0.19799	.	-0.0738	1.0000

**Factor Loadings**

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Community is able to mobilize resources	0.80427	0.35315
Community is able to find solutions to its problems	0.85727	0.26509
Total number of groups/associations	0.64730	0.58101
Past organizational experience	0.61385	0.62319
Community has organized to address an issue in past 3 yrs	0.47734	0.77214

**Scoring Coefficients**

<b>Variable</b>	<b>1</b>
Community is able to mobilize resources	0.27617
Community is able to find solutions to its problems	0.42601
Total number of groups/associations	0.19814
Past organizational experience	0.20311
Community has organized to address an issue in past 3 yrs	0.06887

**Rescaled scoring coefficients (such that coefficients add up to 1)**

0.24  
0.36  
0.17  
0.17  
0.06

**Table B.3. Deriving new within-category weights—Factor 2 (Money management)**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
1	1.82103	1.80716	1.0542	1.0542
2	0.01388	0.12143	0.0080	1.0623
3	-0.10755	.	-0.0623	1.0000

**Factor Loadings**

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Community is able to mobilize savings	0.37036	0.86283
Community is able to lend	0.90972	0.17240
Community is able to fully recover loans	0.92535	0.14373

**Scoring Coefficients**

<b>Variable</b>	<b>1</b>
Community is able to mobilize savings	0.04217
Community is able to lend	0.41889
Community is able to fully recover loans	0.53746

**Rescaled scoring coefficients**

0.04  
0.42  
0.54

**Table B.4. Deriving new within-category weights—Factor 3 (Land tenure security)**

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	1.13058	0.92473	1.1829	1.1829
2	0.20585	0.29493	0.2154	1.3982
3	-0.08908	0.20246	-0.0932	1.3050
4	-0.29154	.	-0.3050	1.0000

**Factor Loadings**

Variable	1	Uniqueness
Communal land is recognized by government	-0.41581	0.82710
Communal land is recognized by neighboring communities	-0.41581	0.82710
Communal land is challenged/used by others	0.72727	0.47108
Presence of conflict over land requiring arbitration in past 5 yrs	0.50582	0.74414

**Scoring Coefficients**

Variable	1
Communal land is recognized by government	-0.17472
Communal land is recognized by neighboring communities	-0.17472
Communal land is challenged/used by others	0.49463
Presence of conflict over land requiring arbitration in past 5 yrs	0.22488

**Rescaled scoring coefficients (and reversed signs)**

0.16  
0.16  
-0.46  
-0.21

**Table B.5. Deriving new within-category weights—Factor 4 (Common vision of problems)**

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	1.19693	1.40577	1.2114	1.2114
2	-0.20884	.	-0.2114	1.0000

**Factor Loadings**

Variable	1	Uniqueness
Community is able to diagnose its problems	0.77361	0.40153
Community is able to prioritize its needs	0.77361	0.40153

**Scoring Coefficients**

Variable	1
Community is able to diagnose its problems	0.45429
Community is able to prioritize its needs	0.45429

**Rescaled scoring coefficients**

0.5  
0.5

**Table B.6. Deriving new within-category weights—Factor 5 (Communal land management)**

<b>Factor</b>	<b>Eigenvalue</b>	<b>Difference</b>	<b>Proportion</b>	<b>Cumulative</b>
1	1.10128	0.99153	1.3085	1.3085
2	0.10975	0.20160	0.1304	1.4389
3	-0.09185	0.18567	-0.1091	1.3297
4	-0.27752	.	-0.3297	1.0000

**Factor Loadings**

<b>Variable</b>	<b>1</b>	<b>Uniqueness</b>
Community is able to exclude outsiders from communal land/water through fees	0.67138	0.54925
Community is able to exclude outsiders through communal guards	0.45391	0.79396
Community enforces time restrictions on its members for access/use of communal land	0.49840	0.75160
Community uses sanctions as enforcement mechanisms	0.44282	0.80391

**Scoring Coefficients**

<b>Variable</b>	<b>1</b>
Community is able to exclude outsiders from communal land/water through fees	0.42140
Community is able to exclude outsiders through communal guards	0.21395
Community enforces time restrictions on its members for access/use of communal land	0.24566
Community uses sanctions as enforcement mechanisms	0.20579

**Rescaled scoring coefficients**

0.39  
0.2  
0.23  
0.19

## Appendix C: Treatment Effects Model for Participation in IFAD-Funded Project

**Table C.1. Regression of CCI with treatment effects model to control for IFAD project participation**

Treatment effects model -- MLE

Number of observations = 85 Wald chi2(16)=233.68 Log likelihood = -310.15428 Prob > chi2=0.0000

<b>Variable</b>	<b>Coefficient</b>	<b>Std. Err.</b>	<b>z</b>
Alternative CCI			
Village size	<b>1.92792</b>	.8532	2.26
Community practices pharonic circumcision	-1.548393	2.536126	-.61
Presence of village market	<b>8.78185</b>	2.369133	3.71
Pastoralism is main source of income	3.801768	3.195385	1.19
Distance from town in Km	<b>-.2668532</b>	.0603	-.43
Squared distance from town in Km	<b>.0007629</b>	.0003146	2.43
Access to ADB credit	<b>18.50125</b>	3.058055	6.05
Rainfall level	<b>7.329638</b>	2.579729	2.84
Presence of non-cracking clay soil	<b>-5.654937</b>	2.936483	-.93
Presence of cracking clay soil	<b>-13.07853</b>	3.773018	-.47
Community has access to aquifer a2	<b>-9.768538</b>	3.105578	-.15
Community has access to aquifer a3	-.5451026	5.764204	-.09
Community has access to aquifer c2	-4.298885	2.857637	-.50
Community has experienced major price or market shock in past 5 yrs	-3.38957	2.106768	-.61
Community has experienced major conflict in past 5 yrs	<b>-8.298427</b>	2.55468	-.25
Participation in IFAD project	<b>11.12514</b>	4.057553	2.74
Constant	<b>44.16001</b>	7.187823	6.14
<b>PARTICIPATION IN IFAD PROJECT</b>			
Village size	<b>2.945079</b>	1.57411	1.87
Village size squared	<b>-.4224286</b>	.2148765	-.97
Pastoralism is main source of income	<b>1.786658</b>	.6456743	2.77
Distance from town in Km	<b>.0291819</b>	.0162032	1.80
Squared distance from town in Km	-.0001624	.0001019	-1.59
Primary seasonal migration is to a rural area in Kordofan	<b>1.521627</b>	.5266594	2.89
Constant	<b>-7.514156</b>	2.832904	-.65
Rho	<b>-.1935379</b>	.3486683	

Likelihood Ratio test of indep. eqns. (rho = 0): chi2(1) = 0.30 Prob > chi2 = 0.5820

## Appendix D: Determinants of CCI by Category

**Table D.1. Mobilization**

Number of observations = 85 Adj R-squared = 0.6237

<b>Source</b>	<b>SS</b>	<b>df</b>	<b>MS</b>
Model	395.226959	16	24.7016849
Residual	173.167158	68	2.54657586
Total	568.394118	84	6.76659664

<b>Mobilization</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
Village size	<b>.8085104</b>	.2012429	4.02
Community practices pharonic circumcision	-1628059	.5983267	-.27
Participation in IFAD project	<b>1.647644</b>	.5483703	3.00
Presence of village market	<b>1.975077</b>	.5577608	3.54
Pastoralism is main source of income	.7409591	.6764504	1.10
Distance from town in Km	<b>-0283067</b>	.0134808	-1.10
Squared distance from town in Km	.0000159	.0000707	0.22
Access to ADB credit	.8625049	.7218105	1.19
Rainfall level	.5553788	.6013484	0.92
Presence of non-cracking clay soil	-.8250686	.690867	-.19
Presence of cracking clay soil	-1.264751	.8856495	-.43
Community has access to aquifer a2	<b>-2.755342</b>	.7267437	-.79
Community has access to aquifer a3	<b>-2.815607</b>	1.366463	-.06
Community has access to aquifer c2	<b>-2.470807</b>	.6741994	-.66
Community has experienced major price or market shock in past 5 yrs	.142456	.4988217	0.29
Community has experienced major conflict in past 5 yrs	<b>-1.342091</b>	.6050304	-.22
Constant	<b>5.193048</b>	1.656546	3.13



**Table D.2. Money management**

Number of observations= 85      Adj R-squared = 0.3724

<b>Source</b>	<b>SS</b>	<b>Df</b>	<b>MS</b>
Model	183.957605	16	11.4973503
Residual	189.995337	68	2.79404907
Total	373.952941	84	4.45182073

<b>Money Management</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
Village size	-.2508023	.2107945	-1.19
Community practices pharonic circumcision	.3002393	.6267251	0.48
Participation in IFAD project	.7970144	.5743976	1.39
Presence of village market	.9651119	.5842338	1.65
Pastoralism is main source of income	.3059504	.7085568	0.43
Distance from town in Km	-.0216247	.0141207	-1.53
Squared distance from town in Km	.0000984	.0000741	1.33
Access to ADB credit	<b>4.701601</b>	.7560698	6.22
Rainfall level	<b>1.086368</b>	.6298902	1.72
Presence of non-cracking clay soil	-1.128329	.7236577	-1.56
Presence of cracking clay soil	-.9444921	.9276851	-1.02
Community has access to aquifer a2	-.6051244	.7612372	-0.79
Community has access to aquifer a3	.39191	1.43132	0.27
Community has access to aquifer c2	-.302071	.7061989	-0.43
Community has experienced major price or market shock in past 5 yrs	<b>-1.804852</b>	.5224972	-3.45
Community has experienced major conflict in past 5 yrs	-.5817936	.633747	-0.92
Constant	-.1901172	1.735171	-0.11

**Table D.3. Security of land tenure**

Number of observations = 85 Adj R-squared = 0.3127

<b>Source</b>	<b>SS</b>	<b>Df</b>	<b>MS</b>
Model	113.484638	16	7.09278985
Residual	142.327127	68	2.09304599
Total	255.811765	84	3.04537815

<b>Security of tenure</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
Village size	.0386728	.1824449	0.21
Community practices pharonic circumcision	-.0602852	.5424372	-0.11
Participation in IFAD project	.6688669	.4971472	1.35
Presence of village market	.2159451	.5056605	0.43
Pastoralism is main source of income	-.3724833	.6132634	-0.61
Distance from town in Km	<b>-.0266732</b>	.0122216	-2.18
Squared distance from town in Km	<b>.0001085</b>	.0000641	1.69
Access to ADB credit	-.0677734	.6543864	-0.10
Rainfall level	.0430456	.5451766	0.08
Presence of non-cracking clay soil	.0760202	.6263334	0.12
Presence of cracking clay soil	<b>-1.898021</b>	.8029213	-2.36
Community has access to aquifer a2	.1374771	.6588588	0.21
Community has access to aquifer a3	1.023848	1.238822	0.83
Community has access to aquifer c2	<b>1.122662</b>	.6112226	1.84
Community has experienced major price or market shock in past 5 yrs	-.7303009	.4522269	-1.61
Community has experienced major conflict in past 5 yrs	<b>-2.104972</b>	.5485147	-3.84
Constant	<b>10.33584</b>	1.501809	6.88

**Table D.4. Common vision of problems**

Number of observations = 85 Adj R-squared = -0.0586

<b>Source</b>	<b>SS</b>	<b>Df</b>	<b>MS</b>
Model	17.5054164	16	1.09408852
Residual	104.847525	68	1.54187537
Total	122.352941	84	1.45658263

<b>Vision</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
Village size	.0392126	.1565911	0.25
Community practices pharonic circumcision	-.0860656	.4655697	-0.18
Participation in IFAD project	.1051947	.4266977	0.25
Presence of village market	.047706	.4340045	0.11
Pastoralism is main source of income	<b>1.052869</b>	.5263593	2.00
Distance from town in Km	.0024573	.0104897	0.23
Squared distance from town in Km	-.0000193	.000055	-0.35
Access to ADB credit	-.0159213	.5616549	-0.03
Rainfall level	.3883756	.467921	0.83
Presence of non-cracking clay soil	-.18152	.5375771	-0.34
Presence of cracking clay soil	-.6346461	.6891412	-0.92
Community has access to aquifer a2	.6378228	.5654935	1.13
Community has access to aquifer a3	.9029598	1.063272	0.85
Community has access to aquifer c2	<b>.9503474</b>	.5246077	1.81
Community has experienced major price or market shock in past 5 yrs	-.0651181	.3881429	-0.17
Community has experienced major conflict in past 5 yrs	.0865776	.470786	0.18
Constant	<b>7.950863</b>	1.288991	6.17

**Table D.5. Communal land management**

Number of observations = 85 Adj R-squared = 0.6588

Source	SS	Df	MS
Model	604.436757	16	37.7772973
Residual	230.669126	68	3.39219303
Total	835.105882	84	9.94173669

Land Management	Coef.	Std. Err.	t
Village size	.1139763	.2322644	0.49
Community practices pharonic circumcision	<b>-1.255848</b>	.6905583	-1.82
Participation in IFAD project	.5636889	.6329012	0.89
Presence of village market	-.3590993	.6437392	-0.56
Pastoralism is main source of income	.6344044	.7807248	0.81
Distance from town in Km	<b>-.0457977</b>	.0155589	-2.94
Squared distance from town in Km	<b>.0001493</b>	.0000816	1.83
Access to ADB credit	1.191716	.8330771	1.43
Rainfall level	<b>1.481758</b>	.6940458	2.13
Presence of non-cracking clay soil	.0682766	.7973637	0.09
Presence of cracking clay soil	<b>-2.165395</b>	1.022172	-2.12
Community has access to aquifer a2	-.1779688	.8387707	-0.21
Community has access to aquifer a3	<b>2.902698</b>	1.577103	1.84
Community has access to aquifer c2	1.018441	.7781267	1.31
Community has experienced major price or market shock in past 5 yrs	<b>1.857789</b>	.5757146	3.23
Community has experienced major conflict in past 5 yrs	.3714034	.6982954	0.53
Constant	<b>3.18573</b>	1.911902	1.67

## Appendix E: CCI Impact on Achievements

Table E.1. Factor analysis on 14 achievement indicators

Factor	Eigenvalue	Difference	Proportion	Cumulative
1	3.91985	1.74710	0.4951	0.4951
2	2.17275	1.12068	0.2744	0.7695
3	1.05207	0.07118	0.1329	0.9024
4	0.98090	0.62436	0.1239	1.0263
5	0.35653	0.15361	0.0450	1.0714
6	0.20292	0.11180	0.0256	1.0970
7	0.09112	0.06046	0.0115	1.1085
8	0.03066	0.11373	0.0039	1.1124
9	-0.08307	0.02166	-0.0105	1.1019
10	-0.10473	0.02381	-0.0132	1.0887
11	-0.12854	0.04125	-0.0162	1.0724
12	-0.16979	0.01257	-0.0214	1.0510
13	-0.18235	0.03883	-0.0230	1.0279
14	-0.22119	.	-0.0279	1.0000

### Rotated Factor Loadings (promax rotation)

Variable	1	2	3	4	Uniqueness
Quality of life has improved	<b>0.49733</b>	0.00498	-0.24990	-0.18952	0.31468
Community health standard has improved	<b>0.93663</b>	-0.01138	0.11717	0.14788	0.25528
Community nutrition standard has improved	<b>0.93336</b>	-0.03426	-0.00596	0.16118	0.19728
Sales have increased	<b>0.37811</b>	-0.04205	-0.05878	-0.16086	0.72336
Yields have increased	<b>0.58144</b>	0.02041	-0.04968	-0.26828	0.34911
Access to potable water has improved	<b>0.31480</b>	0.10937	-0.01805	-0.17527	0.68305
Initiative I was successful	0.11254	0.04616	-0.02074	<b>0.71628</b>	0.47143
Community initiatives I have increased income	0.02781	-0.03596	-0.01055	<b>0.80515</b>	0.32196
Community initiatives II have increased income	0.14080	0.02576	-0.02301	<b>0.78862</b>	0.42019
Community initiatives III have increased income	-0.03986	0.02169	-0.05459	<b>0.55674</b>	0.59226
School attendance by boys has improved	0.02697	<b>0.84313</b>	0.06353	0.02240	0.27472
School attendance by girls has improved	-0.07147	<b>0.83963</b>	-0.05927	-0.00124	0.28208
Community living standards have improved	0.04609	0.11608	<b>0.94903</b>	-0.02833	0.16057
Wealth has increased	-0.00651	0.12207	<b>0.90664</b>	0.04019	0.14722

**Table E.2. Regression of achievements index on CCI and other explanatory variables**

Number of observations = 85

Adj R-squared = 0.2437

<b>Source</b>	<b>SS</b>	<b>Df</b>	<b>MS</b>
Model	130.757836	15	8.71718905
Residual	214.45884	69	3.10809913
Total	345.216676	84	4.10972233

<b>Total Achievements</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
CCI score	.0624146	.1042685	0.60
Participation in IFAD project	-.7081102	1.116912	-0.63
Presence of village market	1.510487	1.304336	1.16
Pastoralism is main source of income	-.0409022	.8981211	-0.05
Access to ADB credit	.0402438	2.032002	0.02
Distance from town in Km	.0017656	.0331494	0.05
Squared distance from town in Km	-.0000585	.0001215	-0.48
Rainfall level	-.762155	1.272428	-0.60
Presence of cracking clay soil	.1961428	1.880629	0.10
Presence of non-cracking clay soil	.800178	1.015393	0.79
Community has access to aquifer a2	.152138	1.269345	0.12
Community has access to aquifer a3	-2.383809	1.505061	-1.58
Community has access to aquifer c2	-.5191339	.8883266	-0.58
Community has experienced major price or market shock in past 5 yrs	-.1572542	.6913862	-0.23
Community has experienced major conflict in past 5 yrs	-.0425552	1.163699	-0.04
Constant	-.7397281	4.582317	-0.16

**Table E.3. Regression of standard of living improvements on CCI and other explanatory variables**

Number of observations = 85      Adj R-squared = 0.3219

<b>Source</b>	<b>SS</b>	<b>df</b>	<b>MS</b>
Model	33.1851221	15	2.21234147
Residual	41.7223489	69	.604671723
Total	74.9074709	84	.891755606

<b>Achievements in Standard of Living Improvements</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
CCI score	.0121778	.0459902	0.26
Participation in IFAD project	.3104317	.4926417	0.63
Presence of village market	.2225312	.57531	0.39
Pastoralism is main source of income	-.2318297	.3961387	-0.59
Access to ADB credit	.3014187	.8962651	0.34
Distance from town in Km	-.0008108	.0146214	-0.06
Squared distance from town in Km	-.0000201	.0000536	-0.38
Rainfall level	-.7198019	.5612359	-1.28
Presence of cracking clay soil	.3710605	.8294984	0.45
Presence of non-cracking clay soil	.3535325	.4478645	0.79
Community has access to aquifer a2	.0320013	.5598764	0.06
Community has access to aquifer a3	-.6406889	.6638446	-0.97
Community has access to aquifer c2	-.146381	.3918186	-0.37
Community has experienced major price or market shock in past 5 yrs	-.4851358	.3049532	-1.59
Community has experienced major conflict in past 5 yrs	.6080408	.5132785	1.18
Constant	1.406392	2.021145	0.70

**Table E.4. Regression of school attendance on CCI and other explanatory variables**

Number of observations = 85      F( 15, 69) = 1.40    Root MSE = .87086      Prob > F = 0.1729  
R-squared = 0.2332      Adj R-squared = 0.0665

Source	SS	df	MS
Model	15.9135051	15	1.06090034
Residual	52.3292527	69	.758394966
Total	68.2427578	84	.812413783

Achievements/School Attendance	Coef.	Std. Err.	t
CCI score	-.028186	.0515055	-0.55
Participation in IFAD project	.0285328	.5517204	0.05
Presence of village market	.8684381	.6443025	1.35
Pastoralism is main source of income	.2374632	.4436446	0.54
Access to ADB credit	.9215693	1.003747	0.92
Distance from town in Km	-.0086929	.0163748	-0.53
Squared distance from town in Km	-7.42*10-6	.00006	-0.12
Rainfall level	.3303105	.6285406	0.53
Presence of cracking clay soil	-.6019389	.9289738	-0.65
Presence of non-cracking clay soil	.3974911	.5015734	0.79
Community has access to aquifer a2	-.813039	.627018	-1.30
Community has access to aquifer a3	<b>-1.47302</b>	.7434544	-1.98
Community has access to aquifer c2	<b>-.7589285</b>	.4388064	-1.73
Community has experienced major price or market shock in past 5 yrs	-.196903	.3415238	-0.58
Community has experienced major conflict in past 5 yrs	-.575411	.574832	-1.00
Constant	1.881353	2.263526	0.83



**Table E.5. Regression of level of living on CCI and other explanatory variables**

Number of observations = 85

Adj R-squared = 0.2196

<b>Source</b>	<b>SS</b>	<b>df</b>	<b>MS</b>
Model	27.1299098	15	1.80866065
Residual	48.4486326	69	.702154096
Total	75.5785424	84	.899744552

<b>Achievements/welfare level</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
CCI score	-.0091405	.0495589	-0.18
Participation in IFAD project	.0874592	.5308692	0.16
Presence of village market	<b>1.029606</b>	.6199524	1.66
Pastoralism is main source of income	.1090996	.4268779	0.26
Distance from town in Km	-.0069272	.015756	-0.44
Distance from town in Km2	.0000268	.0000577	0.46
Access to ADB credit	.3168952	.9658126	0.33
Rainfall level	-.2437438	.6047862	-0.40
Presence of non-cracking clay soil	-.4850412	.4826174	-1.01
Presence of cracking clay soil	-.1760253	.8938651	-0.20
Community has access to aquifer a2	.2554763	.6033211	0.42
Community has access to aquifer a3	-.1266155	.715357	-0.18
Community has access to aquifer c2	.2028823	.4222226	0.48
Community has experienced major price or market shock in past 5 yrs	-.2415375	.3286166	-0.74
Community has experienced major conflict in past 5 yrs	-.5053826	.5531073	-0.91
Constant	1.217441	2.17798	0.56

**Table E.6. Regression of success of community initiatives on CCI and other explanatory variables**

Number of observations = 85

Adj R-squared = 0.5034

<b>Source</b>	<b>SS</b>	<b>df</b>	<b>MS</b>
Model	41.4153847	15	2.76102565
Residual	28.5309394	69	.413491875
Total	69.9463242	84	.832694335

<b>Achievements/success of community initiatives</b>	<b>Coef.</b>	<b>Std. Err.</b>	<b>t</b>
CCI score	<b>.0875634</b>	.0380311	2.30
Participation in IFAD project	<b>-1.134534</b>	.4073848	-2.78
Presence of village market	-.6100881	.4757465	-1.28
Pastoralism is main source of income	-.1556353	.3275827	-0.48
Access to ADB credit	<b>-1.499639</b>	.7411568	-2.02
Distance from town in Km	.0181965	.012091	1.50
Squared distance from town in Km	-.0000578	.0000443	-1.31
Rainfall level	-.1289197	.4641081	-0.28
Presence of cracking clay soil	.6030465	.6859449	0.88
Presence of non-cracking clay soil	.5341955	.3703568	1.44
Community has access to aquifer a2	.6776994	.4629838	1.46
Community has access to aquifer a3	-.1434849	.5489592	-0.26
Community has access to aquifer c2	.1832933	.3240102	0.57
Community has experienced major price or market shock in past 5 yrs	<b>.766322</b>	.2521778	3.04
Community has experienced major conflict in past 5 yrs	.4301976	.4244502	1.01
Constant	<b>-5.244914</b>	1.671364	-3.14

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