

Social capital and rural institutions in Kenya—Is Machakos unique?*

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Abstract: In Eastern Africa, the experience of Machakos has been heavily debated between Malthusians and the more optimistic Boserupians. Machakos was the epitome of overpopulation and resource degradation in the 1950s, but has since thrived. The Boserupians view Machakos as an illustration of how population growth can solve rather than exacerbate the vicious cycle of poverty and resource degradation. The question arises whether Machakos is unique. This study investigates the role of social capital in Machakos. Using principal component analysis, the authors estimate various dimensions of social capital and find significant differences between Machakos and two other Kenyan regions particularly when it comes to the formation of associations.

Key words: Kenya; regional differences; soil conservation; social capital; principal components

1. Introduction

Capital is vital for economic development, but the first growth accounting studies, such as Solow (1956), focused on physical capital and found that it can only partially explain the process of economic growth. Later attention has been focused on other forms of capital, including human capital in the form of skill, training, and education (Becker, 1964), and organizational capital (Prescott & Visscher, 1980). Another important aspect of economic growth is the way in which economic actors interact and organize themselves to generate growth and development.

Features of social structure and organization, such as trust, norms that facilitate coordination, and cooperation, are increasingly called “social capital” (Coleman, 1988; Coleman, 1990; Putnam, 1993). Intuitively, the basic idea is that social capital constitutes an important asset, one that can be called upon in times of crisis, enjoyed for its own sake, used for material gain (Woolcock & Narayan, 2000) or employed to resolve disputes (Schafft & Brown, 2000). In development policy, social capital is viewed as a productive asset which can be strategically mobilized by individuals and groups for particular ends (Wong, 2003; World Bank, 2001). Social capital is a valuable asset, but like all kinds of capital it can be misused. The ways in which social capital affects economic growth in broader terms can be summarized as building trust in institutions and people, which facilitates cooperative decision making and collective action.

Pessimism currently pervades much of the debate on the ability of Africa to feed its population (World Bank, 2001). The vicious cycle of land degradation and increasing poverty has been described as a downhill spiral into a poverty trap (Cleaver & Schreiber, 1994). Land degradation is recognized as a key factor in the low and declining

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levels of agricultural productivity. Population pressure leads to cultivation of new lands that are frequently inferior due, for instance, to steep slopes and high soil erosivity. Soil erosion leads to poverty, short-sightedness and insecurity—and possibly further to large families, population explosion, and land fragmentation.

This bleak Malthusian picture has, however, been strongly criticized by a high profile series of optimistic studies of the Kenyan Machakos district (Tiffen, et al., 1994; Zaal & Oosterndorp, 2002). In the 1950s, this region already had all the characteristics mentioned above: It was eroded, poor, and considered to be overpopulated. The prospects were that it would deteriorate further as the population grew, holdings became smaller, erosion increased and income declined. Instead, there has been remarkably successful land management and impressive success in food production not only for sub-national and national markets but also for export (Boserup, 1965; Tiffen, et al., 1994; Tiffen, 1995). Meanwhile, environmental conditions actually improved due to reforestation and the creation of broad, labor-intensive bench terraces, both of which saved water and reduced erosion. Many explanations for this upturn have been offered in the literature. According to Boserup (1965) and Tiffen, et al (1994), Machakos was not overpopulated and overgrazed, but was underpopulated. The solution was more population, better technology and management. This so-called “Boserupian hypothesis” is of considerable importance for the development literature and in particular for the prospects of sustainable development. In the literature, there are many variants of the “Boserup hypothesis”. The insight given by these studies is that an increasing population motivates even poor farmers to invest in soil conservation. From this perspective, declining land productivity is endogenously self-correcting, which does not imply that population pressure will always lead to more intensification and thus should be counted as something positive. The issue at stake is whether we are correct in worrying about overgrazing, erosion, forest degradation, and other phenomena related to a growing population density, or whether the problems are mainly transitional: Perhaps an increasing population density is in fact that a step towards solving, rather than causing or aggravating, resource and poverty issues.

Case studies were designed to test the “Boserupian hypothesis” yield contradictory results. Ovuka (2000), like Tiffen, et al (1994), studied Murang’a (which borders Kiambu) between 1960 and 1996 and found an increased population, declining conserved land and deteriorating soil fertility. Consequently, she concluded that more people led to more erosion. Besides population pressure, Zaal and Oosterndorp (2002) found that market access factors (distance to markets, prices, etc.), external influence, and enabling government policies were significant in determining agricultural intensification. Similarly, it has been suggested that Machakos’ success is due to its proximity to the capital Nairobi, which provides a ready market for agricultural produce.

Naturally there are other studies that do not support the “Boserupian hypothesis” and there are many cases that provide evidence of escalating population density and resource degradation (Pender, et al., 2004). Resolving these divergent outcomes is crucial for policy makers given the vital role that agriculture plays in any poverty reduction and rural development initiatives. Interestingly, Mazzucato and Niemeijer’s study (2002) shows that it is not just the population density per se that determine whether resources will be developed or degraded. Instead, they argue that how people adjust to the rise in numbers is decisive, and focus on the role of local informal institutions, such as land tenure systems, as well as customs, norms, and networks, which are among the prime determinants of what we refer to as social capital.

Our interest is directed to those features of culture or institutions that are commonly referred to as social capital and that are particularly relevant for collective action when it comes to the improvement of natural resources and agriculture. Agriculture in these regions faces a number of barriers in addition to soil erosion: The difficulty in acquiring adequate inputs, distance to markets, lack of insurance, credit and market information, as

well as high transaction costs in general. A number of these difficulties can at least partly be overcome by collective action.

A peculiarity of social capital is that it cannot be directly measured, and at best, we are faced with indicators reflecting specific features of social structure. Because of the difficulties inherent in identifying and valuing social capital, it may have been neglected not only in national accounts but also in policy discourse. Debate about precisely what elements should be included in social capital is ongoing. Empirical handling of many such measures is difficult. We try, therefore, in this paper to use Principal Component Analysis (PCA) to find some relevant and intuitively appealing variables that will conveniently summarize relevant aspects of social capital that may help explain differences in economic development between regions. We believe it should be of considerable policy interest to identify and promote factors facilitating cooperative capacity for addressing rural development.

The paper is organized as follows. In the second section, we discuss the theoretical links motivating the development of social capital constructs in the context of soil conservation. A description of the study areas and the descriptive data are set out in section 3. An operational method for assessing and measuring social capital is discussed in section 4. Section 5 presents an interpretation of the principal component results. The district's differences and what role they may be playing in making Machakos unique are discussed in section 6, and section 7 concludes comments and policy implications.

2. Social capital, collective action, and rural development

Social capital is an elusive concept. On one hand, the central ideas were formulated a long time ago. One example is the paper by de Tocqueville (1840) where even the title is still a pertinent formulation of current research issue with its focus on “the use which citizens make of public associations.” This paper highlights the importance of associations primarily for purposes of overcoming the restrictions in the credit and labor markets that would otherwise make large undertakings difficult. By highlighting this, de Tocqueville ties social capital to democracy and market economics. He follows up by citing examples where associations build trust, confidence, and moral values and have value in providing information. He ties the importance of associations to the freedom of press, cooperative or collaborative efforts and democracy. Although having been written in the United States almost two centuries ago, many of his concerns are important issues in Kenya today.

One prominent book with quantitative measures of social capital is Putnam (1993) on the differences in social capital between north and south Italy. He argues that different levels of social capital could best explain the differences in democracy and economic development between these regions. The study distinguishes two now widely used types of social capital: Bonding capital located in groups and bridging capital found in the connections between people across groups. Hence associational life, or voluntary group membership, is an important variable in many social capital studies, including ours. Fukuyama (1995) also emphasizes association membership, but then argues that it is shared norms and values that underpin behavior and motivation.

Collier (2002) carefully attempts to define social capital by arguing that the social component requires measures of social capital that are borne out of social interactions and are capable of producing external effects, such as increasing the stock of knowledge, reducing the scope for opportunistic behavior or preventing the free rider problem of collective action. The capital element requires that measures have longevity that is independent of the social interactions that generated it.

There is, however, an important critique of the concept of social capital, stemming from its limited

theoretical underpinnings and lack of empirical scrutiny. While acknowledging in general terms the beneficial effects of social capital, Dasgupta (2003, 2005) is fairly negative to the term itself. He argues that some elements of social capital are private and, hence, already included in human capital (Glaeser, Laibson & Sacredote, 2002; Sobel, 2002). Dasgupta recognizes that there are many important institutions, networks, and other aspects that are “social” and not individual, such as all the phenomena that comprise the market institutions, public good resources, and resource allocation mechanisms of society. Dasgupta argues that it is not possible to carve out a particular subset that can meaningfully be called social capital.

There is no doubt much to be said about this position. One of the key questions in economic theory is what determines why some regions are better off than others. When trying to answer this question, it is common to look for answers in growth theory. We make comparisons between similar regions with respect to values on saving rates, capital stock and labor, technical progress and so on, but still find it difficult to explain differences in growth rates (Romer, 1996). Among several suggestions of how to explain differences in welfare, institutional characteristics, such as culture, property rights structure, level of development, social structure is often argued to be of crucial importance.

In this paper, we are interested in analyzing certain socio-cultural and organizational traits of society, such as the tendency to form associations and to invest in trust in order to facilitate cooperative efforts, communal action, and overcome barriers (i.e., transaction costs and lack of information or insurance). These traits are commonly referred to as “social capital” and we retain the term for convenience as a label for a number of interesting variables, without necessarily taking any position as to whether this term rightly should be given a similar dignity as, for instance, the term “human” capital.

Inextricably linked to the definition of social capital is its empirical measurement. For those who view social capital as the property of the group rather than the individual, the most common measures examine membership of voluntary organizations, churches, or political parties. An important element addressed here is not mere membership but also the intensity of engagement. Social trust has been used in many studies as a means of approximating levels of social capital. One contentious issue with this measure, however, is how to define trust. There is a danger in using single questions about trust and linking them to broad measures of a nation’s economic performance (Baron, et al., 2000).

In a pioneering study of social capital in developing countries, Narayan and Pritchett (1999) examined the links between social capital and village level economic outcomes in Tanzania. This study is of particular relevance here because of Tanzania’s many ecological and cultural similarities with neighboring Kenya. The authors asked questions about household membership in groups, the characteristics of the groups, and individual values and attitudes. A novel feature in this study is the use of the oft-quoted social capital operational features—trust and membership in associations. The study confirms the importance of heterogeneity in group membership for economic outcomes. Narayan and Pritchett concluded that performance was influenced by the communities’ past experiences in how to organize cooperatively.

In an analysis of household welfare in Indonesia, Grootaert (1999) treats social capital as a production factor like physical or financial capital. He investigated the link between social capital, household welfare and poverty using a multivariate analysis. The study identified six dimensions: density of associations, internal heterogeneity, frequency of meeting attendance, decision making, payment of dues and communal orientation of the associations from which a social capital index was constructed. This turned out to be positively related to household welfare, which is interesting (despite a questionable additive index with equal weights that was used). Similar positive

relationships between income and group membership are reported in La Ferrara (2002) for women in the slums of Nairobi and in Haddad and Maluccio (2003) who focused on rural South Africa.

In a study of watershed management in 60 villages in India, Krishna (2001) investigated the link between social capital and development performance. This study defined social capital dimensions corresponding with an agrarian society in circumstances relevant to Kenya. The key finding was that high stocks of social capital were a necessary but not sufficient condition for community development. He concluded that social capital needed to be complemented with information and connections with markets and the state in order to be effective. Broadly speaking, the operational features describing social capital are “membership in voluntary organizations”, “trust”, and “community affiliation”.

A number of other studies in developing countries show that a defining feature of being poor is exclusion from social networks and institutions. Without access to networks, credit, information, insurance, etc., it is hard to work one's way out of poverty (Fafchamps & Minten, 2001; Fafchamps & Lund, 2003; Fafchamps, 2004). These analysis contribute to understanding how social networks play a role in economic outcomes through risk pooling. The current study seeks to provide a richer understanding of how soil conservation decisions are embedded in a social context.

There are several direct or indirect channels through which social capital may affect soil conservation. Firstly, a farmer may learn about a technology via other farmers. A positive or negative attitude of the farmer's group towards the technology may influence the farmer's behavior. Thus, a social group can affect demand for SWC (soil and water conservation) adoption directly. Secondly, social capital may also affect SWC adoption via features of social structure that eases economic constraints (for instance, pooling labor and sharing farm implements for terrace construction). Finally, communities with high degrees of social capital may find it easier to solve collective action problems than societies less well-endowed with social capital. For example, there is a need for coordination in the construction of SWC structures between neighboring farms. It is, therefore, of particular interest to ascertain whether there are measurable differences in these mechanisms between the successful Machakos and the other communities of Kiambu and Meru.

3. Study sites description, data, and sample comparisons

Both Meru Central¹ and Machakos are in Eastern province, while Kiambu is found in Central province. Kiambu District covers a total area of 1,323.9 square kilometers, bordered by Nairobi (the capital) and Kajiado to the south. Administratively the district comprises 7 divisions and 37 locations. The Agikuyu people largely inhabit the district (Kiambu District Development Plan, 2002).

Meru district is an important smallholder agriculture district in Kenya's eastern province, covering 2,982 square kilometers. Administratively, within the district there are 10 divisions, 27 administrative locations. The Ameru people largely occupy the district. Meru Central is bordered by Mount Kenya on the west and the drier lowlands to the north and east. It ranges in altitude from 300 to 5200 meters at the peak of Mt. Kenya. The southeastern slopes of Mt. Kenya, where many of the farms lie, receive an average of 1300mm of rainfall per year. Over 45 percent of the population is classified as poor (Meru Central District Development Plan, 2002).

Machakos district covers an area of 6,281.4 square kilometers, of which only 1,574 square kilometers is under rain-fed agriculture. The district borders Nairobi and the Muranga district to the Northwest. The district

¹ For brevity, we will refer to this district simply as Meru.

covers 12 administrative locations and 62 sub-locations and is largely inhabited by the Akamba people (Machakos District Development Plan, 2002).

The three districts are, at least superficially, very similar when it comes to household and agro-ecological characteristics (see Table 1).

Table 1 Agro-ecological, climate, and socio-economic characteristics

	Kiambu		Machakos		Meru	
Mean annual rainfall (mm) ^a	1250		1190		1300	
Agro-ecological zone ^b	UM3-4		UM3-4		UM2-3	
Number of households	189,706		186,297		120,265	
Contribution to poverty	1.48%		1.32%		1.48%	
	1989	1999	1989	1999	1989	1999
Population density (persons/km ²) ^c	588	660	462	539	579	769
Number of women's groups	1147	4036	2073	5936	954	5026
Earnings per hectare	--	1179	--	1242	--	870

Data source: Relevant district development plans.

Notes: ^a Recorded in the nearest Met (meteorological) station; ^b Agro-climatic zoning developed by Jaetzold and Schmidt (1983); ^c referring to study area population density. Due to administrative boundary changes in the 1990s, previous population density values are not comparable.

Machakos has been through its resource crisis and is thriving (at least in relative terms). The number of poor people is also the lowest as shown by the district's contribution to the country's overall poverty. This proportion takes into account the adult illiteracy rate and a composite index of deprivation in economic provisioning.² In terms of agricultural earnings per hectare in Kenya Shillings (KS), Kiambu is closer to Machakos than Meru.

Our interest in this study is directed to those features of culture or institutions that are commonly referred to as social capital and that are particularly relevant for collective action when it comes to the improvement of natural resources and agriculture. These districts were largely chosen as study areas because they are densely populated and well endowed with agricultural productivity. Questions of sustainability are consequently of great concern.

3.1 Data

The study draws on survey data collected from 356 rural households in Kenya during the period of January-April 2003. The survey randomly took samples from each district. From the sub-locations, we selected 10 villages randomly and 20 households from each of the chosen 10 villages.³ A household-level questionnaire collected information about relationships; membership in voluntary groups and associations; monetary and in-kind contributions; and sources of agricultural, private and public information.

The social networks literature suggests that resources are found in personal relationships that households maintain. In this study, we first examined membership in various community groups: self-help groups, religious groups, savings and loan groups, labor sharing groups and so on. This information serves as a basis for refining and verifying the social capital indicators. Table 2 presents descriptive statistics on the number of, and the most important, associations the households belonged to. There are striking differences among the districts when it

² This is indicated by the percent of population without access to safe water and to health services, and underweight children under age five.

³ A multi-stage sampling procedure was used to select the sample with the random population of households to yield 12 households per village.

comes to association membership and key associations.

It is quite common for households in Kiambu district to belong to only one association (56 percent) and the smallest proportion belongs to three associations (4 percent). In contrast, the households of Machakos had the largest participation, with 33 percent of them belonging to three associations, and the smallest proportion that did not belong to any single association (3 percent). In line with conventional wisdom, the average number of association meetings is the highest in Machakos. The higher density and diversity of networks in Machakos may imply more network resources than other two districts. This finding is similar to Burt (1992), who found that the more the relations of this nature, the better for individual goal attainment.

Just looking at the volume of associations is of limited value because it does not say much about the resources that are accessed by the individual, since some of the associations offer similar resources. There is no value addition from accessing basically similar resources from different associations. Hence, an interesting aspect is the diversity of groups, which does seem to be slightly higher in Machakos. In Kiambu and Meru, almost half of the memberships are in “merry-go-round” or rotational savings and credit associations (ROSCAS), which are mutual savings and credit associations.

Table 2 Membership in associations (percentage)

Number of associations	Kiambu	Machakos	Meru
No associations	9	3	10
One association	56	24	46
Two associations	31	40	31
Three associations	4	33	13
Most important association			
Merry-go-round (rotational savings and credit associations)	48	27	47
Agricultural group	13	19	12
Religious group	23	32	20
Other general welfare groups (burial, village, football, political, women, etc.)	16	22	20

Machakos has higher membership in both professional (agricultural), religious and other associations. Church organizations provide not only spiritual guidance but material benefits as well, such as opportunities for interaction and support. They also instill a sense of shared values and norms among their adherents, teach worldly virtues, such as love, patience, concern for others and self-sacrifice, and bring individuals together in a cohesive and cooperative community. There is also the likelihood that the links and trust forged in religious congregations are stronger than in other associations. Different associations are also for obvious reasons rather distinct in this respect. Respondents were asked about their reasons for membership in the three most important associations they had mentioned. These reasons are shown in Table 3.

Overall, family welfare and a safety net against unforeseen risks were the most important reasons cited for being in groups. Many other reasons were too diverse to be readily classified. Focus group discussions revealed that these reasons were mainly to improve the households’ alternative income-generating potential and purchase of durable assets. Assistance during hardship and access to credit were important uses of the groups that we have summarized as the credit and insurance motive. This appeared to be a particularly prominent motive in Machakos (30 percent). The presence of rotational savings and credit associations help close the liquidity gap because

commercial banks generally reject smallholders due to the risky nature of their activities and their lack of collateral to secure loans. Focus group discussions reported that maintaining close ties with groups was an important way to manage crises such as illness, death, school fees and price uncertainty. Such problems can be devastating for farmers dependent on agriculture, prompting them to establish groups where assistance is based on reciprocal arrangements in case of an emergency. While there are no fees, all members are supposed to pay and provide labor in the event of another member's death.

Table 3 Reasons for being in groups (percentage)

	Kiambu	Machakos	Meru	All
None	18	21	12	17
Family welfare	45	40	63	49
Credit and insurance	19	30	12	20
Others	17	9	14	13

A puzzling observation in Machakos, with the largest degree of association membership, was a large share (21 per cent) of respondents who could not give any reasons for belonging to an association. This result is odd, but might be due to "association fatigue" beginning to set in within the Machakos district. Naturally these are very dynamic processes and it is possible that Machakos started early with a high degree of association membership and that the population, although having reaped benefits, is also beginning to grow tired of spending too much time at meetings. However, our present data do not allow us to test this possibility.

Table 4 provides information on the proportions of households that reported individual benefits from group membership. The most common benefits were sharing labor and information, while sharing cash was less common in all three districts. A notable proportion indicated that they receive no benefits. Interestingly, Machakos was the community where the largest number of members felt they did not receive any benefits (58 percent), despite having the largest proportion of households in associations.

Table 4 Benefits from groups (percentage)

	Kiambu	Machakos	Meru
None	49	58	48
Cash	7	9	8
Information	20	15	22
Labor	24	18	23

Focus group discussions revealed that this could be due to temporary conflicts in the cooperative movement that were experienced during the period of study. There had been leadership wrangles among the societies and delayed payments for crop and milk deliveries. The results seen might be partly temporary, but there are at least two other possibilities. First, it could be a selection effect: Since Machakos has higher association participation; there are a larger number of passive members who have a hard time explaining their memberships. Second, it could also be that we are witnessing a backlash. If many people joined associations in Machakos in the past (possibly because of social pressure), then the success might eventually generate some fatigue and resistance. Another plausible explanation is the insight provided by Collier (2002) that social interactions may fade while the "capital" aspect lingers on. All of these issues touch on the broader issues of whether social capital is stable over time and whether, indeed, it is endogenously given by development or exogenously given by historical conditions. Unfortunately these fundamental questions are very hard to answer and it seems they would require, at the very

least, data on social capital (and other variables) over time which we do not have.

3.2 Social capital indicators description

Our questions on social capital were based on World Bank studies of social capital, poverty, and development. The questions were first refined and adapted to country-specific conditions, based on information from key informants among village leaders.⁴ In particular, we found that it was important to clarify the questions concerning trust to make the issues clear to farmers in these closely-knit societies. A series of focus group discussion questions were also developed to complement the survey instrument. We identified a range of social indicators at the individual household, community, and other higher levels.

Despite some ambiguity, social capital is generally understood as a property of the group rather than the individual. Hence, the most common measures put emphasis on membership in associations. Accordingly, our first set of questions (*C1-C5*) relates to participation in groups and voluntary organizations as formal sources of social interaction (Putnam, 1993; Paxton, 1999; LI, et al., 2002). The second group of questions (*T1-T5*) intends to capture household contacts and intimate interactions with personal friends, but not (necessarily) in formal associations. The third group focuses on neighborhood interactions and the fourth on information flows. Summary statistics of the data are provided in Table 5.

Table 5 Descriptive statistics of social capital indicators

Variable	Ref ^a	Kiambu	Machakos	Meru
Membership in any association ^b	C1	0.91	0.96	0.90
Number of associations to which individual belongs (0 to 3)	C2	1.30	2.00	1.47
Number of meetings per month (0 to 34)	C3	2.83	6.02	3.05
Monetary contributions per annum (KS '000) (0 to 96)	C4	3.8	3.6	5.1
Value of monetary benefits per annum (KS '000) (0 to 68)	C5	3	2.9	4
Number of close friends to discuss personal matters (0 to 45)	T1	3.9	4.5	3.8
Number of persons who can lend you money during crisis ^c (1 to 4)	T2	2.7	2.6	2.7
Number of persons who can give you food during crop loss ^c (1 to 5)	T3	2.4	2.5	2.4
Number of people who sought household's assistance (0 to 24)	T4	2.6	3.1	2.5
Value of assistance given out last year (KS '000) (0 to 30)	T5	2.1	1.2	1.3
Lent out significant number of tools ^b	N1	0.85	0.83	0.95
Received significant number of tools ^b	N2	0.84	0.77	0.94
Will contribute time to project without direct benefits ^b	N3	0.03	0.07	0.03
Will contribute money to project without direct benefits ^b	N4	0.00	0.08	0.02
Participated in any community project last year ^b	N5	0.48	0.63	0.75
Media is important source of market information ^{b, d}	I1	0.47	0.20	0.23
Relatives important source of market information ^{b, d}	I2	0.63	0.35	0.31
Neighbors most important source of market information ^{b, d}	I3	0.56	0.52	0.53
Relative most important source of government information ^{b, d}	I4	0.35	0.39	0.33
Media most important source of government information ^{b, d}	I5	0.47	0.38	0.43
Public agents most important source of government information ^{b, d}	I6	0.52	0.49	0.52

Notes: ^a This column provides a key to the variables for convenience. The full survey is available on request; ^b Yes=1, No=0;

^c excludes family members; ^d Variables I 1-6 measure whether or not the relevant source is mentioned among the three most important (out of 12 possible) sources.

⁴ See www.worldbank.org/poverty/scapital/index.htm. The questionnaire is available on request.

The extent of association involvement starts with a simple yes/no question, followed by the number of groups people belong to (*C2*), number of group meetings (*C3*), and finally material contributions to voluntary associations and benefits received from them (*C4-5*). Note that these features are closely linked to membership in groups and active participation in them (Fukuyama, 1995; Warde, et al., 2003). The obtained level of civic participation should be a reasonable measure of the household's social capital resulting from formal involvement in voluntary groups.

The first three questions more related to how much people put into associations, and Machakos has higher values. The two questions *C4-5* are somewhat different: The amount of money people contribute or receive partly reflects the strength of the associations, but it also is a reflection of the financial needs of group members during the year. Machakos does not come out higher on these variables—maybe because its people did not need to borrow much money during the year. This could in principle be a sign that Machakos is wealthier and, thus, that the interpretation of questions *C4-5* is somewhat more complex.

Naturally, the family itself is an important asset (for general welfare as well as for production), but this is (at least, partially) captured in variables describing family structure. The second group of questions attempts to measure the dimension of social capital assessing whether the individual has friends to rely on for emotional and practical support. We aim here at capturing friendships that are “strong ties”, or bonding links, as distinct from “weak ties” (Granovetter, 1973). The third group of questions is intended to capture these weaker ties, also commonly known as “bridging” or community engagement social capital. These indicators are not necessarily mutually exclusive. They measure community engagement and volunteering effort, in other words, how closely people associate with their neighborhood and their willingness to participate in projects from which they derive no immediate personal gains. Community engagement reveals a shared sense of capacity to affect change at the community level, while volunteering is understood as commitment of unpaid time or money outside the household for the benefit of others. This distinction is important in isolating situational networks that arise when people form networks around settings over which they have no control, for instance, amongst neighbors.

Another important dimension of social capital concerns the exchange of information among stakeholders. Information is vital for production and other management decisions on farms and has considerable market value. Some network members have the ability to obtain information both from their own sources and from contacts with others through informal chats on issues of common interest. Some members have access to expensive commercial or official media channels, such as television, radio and daily newspapers that relay important information often beyond the reach of many poor neighbors or friends. The returns to an individual who provides information to others may be power, reputation and satisfaction (Lin, 2001).

4. Estimating an index of social capital

Aggregating, comparing, and interpreting this wealth of information is complicated. Casual inspection of Table 2 shows that Machakos does score somewhat higher on many of the questions, but far from all. People spend more time with associations, but receive less assistance from them. They have more friends, which is not necessarily reflected in the number of friends they would turn to for economic assistance. The information is multidimensional and many of the answers are interlinked.

In the literature, aggregation methods vary from ad hoc weighting and addition of indicators scores to the calculation of weights for each indicator. For example, an expert panel of policy makers or rural farmers could

determine the weights. These relatively simple methods are plagued by conceptual and methodological problems. Primarily, they are based on the assumption that all selected indicators measure the same underlying concept. Additionally, it is assumed that the selected indicators are perfect measures, ignoring possible measurement errors.

We use Principal Components Analysis (PCA) to overcome these problems and concerns. PCA is a popular and standard technique used in the literature for inequality dimensions (Maasoumi, 1986), poverty and welfare (Sahn & Stifel, 2000), and in social capital analysis (Grootaert, 1999; Narayan & Pritchett, 1999). It is used in this paper for three closely related purposes: Firstly, PCA isolates and measures the social capital embedded in the various indicators and creates a household-specific social capital score or index. Comparisons can then be made between the regions under consideration. Secondly it is to identify latent, non-observable structures, using associations between indicators. The underlying assumption here is that there are a number of unobserved (latent) variables of interest, in our case, various aspects of social capital such as trust and social cohesion. We assume that the measures created by answers to our questions at least partially reflect these underlying variables. The third goal is to reduce the dimensionality of the original data set. A smaller set of uncorrelated variables is easier to understand and use in further analyses than a larger set of correlated variables. The main idea is to find appropriate and practical ways to utilize the available data in lieu of the data that would have been theoretically desirable.

Essentially, PCA segments the information contained in a set of indicators into several components. The technique seeks a few uncorrelated linear combinations of the original variables that capture most of their information. Each component is constructed as a unique index based on the values of all the indicators. For example, a set of T “time indicators”, such as number of monthly meetings, duration of church meetings, time spent at a café with friends, etc., can be characterized as a vector (t_1, t_2, \dots, t_p) and linearly transformed by $F = a_1 t_1 + a_2 t_2 + \dots + a_p t_p$ into a one-dimensional “friends” index F . The weights are mathematically determined to maximize the variation of the linear composite with the original variables. The linear composites⁵ are ordered with respect to their variation so that the first few principal components together account for most of the variation present in the original variables.

Algebraically, the first principal component F is a linear combination of t_1, t_2, \dots, t_p , $F = \sum_{i=1}^p a_{1i} t_i$, such that the variance of F_1 is maximized, given the constraint that the sum of the squared weights is equal to one, i.e., $\sum_{i=1}^p a_{1i}^2 = 1$. The random variables, t_i , can be either deviation from mean or standardized scores. Principal components analysis finds the optimal weight vector $(a_{11}, a_{12}, \dots, a_{1p})$ and the associated variance of F_1 that is denoted λ . The second principal component F_2 is similarly defined, but the optimization is subject to the constraint that the vector be orthogonal to or independent of F so that $\sum_{i=1}^p a_{1i} a_{2i} = 0$ and $\sum_{i=1}^p a_{2i}^2 = 1$. The procedure continues with more components, and as successive components are extracted, the variance of the principal components gets smaller. The first few components have the highest possible sum of squared correlation with the original variables. This process is continued until as many components as variables have been computed. However, the first few principal components usually account for most of the variation in the variables, and

⁵ The composite can be based on either a covariance or a correlation matrix. The latter is a covariance matrix of standardized variables and is used in this analysis because it avoids problems caused by different scales for the variables (See Duteman (1994) and Johnson and Wichern (2002) for elaboration.).

consequently our interest is focused on these. The main statistics from a principal components analysis are the loadings or weight vectors $a=(a_1, a_2, \dots, a_p)$ associated with each principal component and its associated eigenvalue or variance λ . The pattern of eigenvectors for a principal component is used to interpret the principal component, and the magnitude of the eigenvalues provides an indication of how well they account for the variability in the data. The relative sizes of the eigenvalues indicate the relative contribution of the variable to the variance of the principal component. Such a specification permits the reproduction of a maximum amount of information contained in the original data (Maasoumi, 1986).

5. Results from the application of PCA

Table 6 shows the eigenvalues for the first four principal components of all observations. The question of how many principal components to retain is not readily resolved. The issues to consider include total sample population explained the relative size of the eigenvalues, and the subject matter of interpretation of the components. A commonly used guide is the Kaiser criterion in which we retain only values with eigenvalues greater than 1. This means that, unless a factor extracts at least as much as the equivalent of one original variable, it is dropped.

Table 6 Results from the principal component analysis

	1st PC	2nd PC	3rd PC	4th PC
Eigenvalues	2.39	2.05	1.67	1.41
Variance	0.12	0.10	0.08	0.07
Cumulative	0.12	0.22	0.31	0.38
Sphericity test	Chi square=1120.4 degrees of freedom 190			

Using Cattell's scree,⁶ plot criterion shows a steep slope from the first to the fourth component. However, the fifth from the last can be fitted fairly well by a straight line of negligible slope. Furthermore, the fifth and sixth components were very hard to interpret. The first four had, as we see in Table 7, clear loadings that could be interpreted as groups of variables with a common interpretation. From the fifth eigenvector on, the loadings were smaller and the variables are harder to group intuitively. Consequently, we base our discussion on the first four components. This means that we have narrowed down our data set from 19 original variables to 4 new ones that still explain 38 percent of all the variation in the original variables.

The PCA is sensitive to the magnitude of correlations. Hence, robust comparisons of the indicators must be done to ensure quality of the eigenvalues and scores. A measure of such appropriateness of the overall model is given by Bartlett's sphericity test, which tests whether the correlation matrix is an identity matrix. This is, then, a test of how the whole approach works in this particular case, since it tests the hypothesis that the eigenvalues and consequently the principal components are equal (null) versus the alternative of different eigenvalues. The hypothesis of equal eigenvalues is rejected at the 1-percent level of significance as evidenced by the large chi-squared value of 1,120 against 190 degrees of freedom.

Table 7 presents the results for the four eigenvectors retained. There is a high degree of correspondence between the variables that actually compose the various principal components and the groups into which the

⁶ This is a plot of the obtained eigenvalues versus components and retaining factors, which are above the inflection point of the slope.

variables had originally been placed in the questionnaire.

We now turn to a discussion of the first principal component, which is not only the one that picks up the highest proportion of variation. The first principal component has high positive loadings for three out of the five variables *C1-C3*, with which we intended to cover the role of associations (member, associations, meetings) and one additional variable that comes from our third block of variables, *N5*, (participation in community projects). We call this factor simply “associations”. It principally covers the tendency of people to join associations and spend resources, time and money on them. Note that also the variables *C4-5*, as well as *T3* and *T2*, have fairly strong correlations with this latent variable. Although we have set the cut-off for inclusion to 0.3, these additional correlations do not contradict but reinforce this interpretation of the first latent variable as a measure of associations. The second principal component, which we have called “trust”, consists of the variables *T1-3* (number of friends in general and who you would turn to for help in crisis or in the event of a bad harvest). We thus find three of the five elected variables we selected to represent friendship. These three are clearly interlinked in realistic everyday situations covering reciprocity and trust in Kenya.⁷

Table 7 Loadings on the first four principal components

Variable	Ref	Factor 1	Factor 2	Factor 3	Factor 4
Membership (yes/no)	C1	0.363	-0.119	0.195	-0.061
Number of associations	C2	0.508	-0.163	0.161	-0.034
Number of meetings	C3	0.421	-0.159	0.053	-0.062
Monetary contribution to associations	C4	0.236	-0.037	0.081	0.169
Benefits received	C5	0.272	-0.159	-0.038	0.176
Number of close friends	T1	0.155	0.345	-0.196	0.115
Number of persons to help in economic crisis	T2	0.221	0.513	-0.206	-0.079
Number of persons to help with crop loss	T3	0.274	0.431	-0.245	-0.099
Value of assistance given last year	T5	0.015	0.088	0.001	-0.143
Lent tools to neighbors	N1	0.049	0.347	0.565	-0.058
Borrowed tools from neighbors	N2	0.076	0.302	0.588	-0.074
Prepared to contribute time	N3	0.085	0.038	-0.251	0.103
Prepared to contribute money	N4	0.029	-0.099	0.028	0.062
Participated in community project	N5	0.339	0.019	0.069	-0.029
Main source of market information: media	I1	0.016	0.121	-0.107	0.124
Main source information: relatives	I2	0.101	-0.069	0.046	0.505
Main source of information: commune	I3	0.034	-0.211	-0.010	-0.475
Main source of government information: relatives	I4	0.104	0.082	-0.104	0.035
Main source of government information: media	I5	-0.019	-0.087	0.155	0.447
Main source of government information: public	I6	0.033	-0.172	-0.043	0.399

The third component focuses on the lending and borrowing of agricultural tools mainly between neighboring farms, and consequently we call this latent variable “neighborhood cohesion”. The negative loadings on some of the friendship variables really indicate that there is a distinct, professional neighborhood collaboration that is to

⁷ Although there is precedence in the literature (Zak & Knack, 2001) for using “trust” as a proxy for social capital, it is important to acknowledge that the definition of this variable can be problematic. (Glaeser, et al., 2000)

some extent separate from the more personal friendship ties captured in PC2.⁸

Finally, it is fascinating to see how separate the fourth group of variables is. It concerns where and how an individual member of the community finds information concerning both markets and more official matters, and receives low loadings in the first three principal components and in the fourth component. Practically, all other variables on trust, friendship and associations also have low loadings. The strongest loadings for the fourth PC are found on variables I2-3 and I5-6. It is worth noticing that I3 is negative and is presumably a strong substitute for one of other sources of information (maybe I2). It makes sense to call this fourth component “information”.

6. Interpretation and discussion of the district differences

We now turn to the differences among the three regions. In the introduction, we mentioned that Machakos differs substantially from other regions in terms of farm technology adopted and socio-economic welfare. Since we want to compare the social capital stocks among the regions, the principal component weights estimated in Table 4 above are applied to estimate the index for each individual. Table 8 presents district averages for each of the social capital variables identified. Machakos has a clearly higher mean score for “association”, while the differences among the other variables are less pronounced.

Table 8 Descriptive statistics of social capital indices

Variable	Kiambu		Machakos		Meru	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Association	2.34	1.57	0.11	2.44	0.60	1.60
Trust	4.26	1.37	40.49	1.90	40.31	1.58
Neighbor	0.96	0.37	0.92	0.41	10.08	0.24
Information	3.34	3.47	0.97	2.61	0.01	2.69

One may recall that there were marked differences in individual “associational indicators”, which are also confirmed in the analysis. We need to test whether these differences are statistically significant. A widely cited study of social capital and health of individuals used aggregate survey data responses in this similar manner (Kawachi, et al., 1997). The results from the tests of Kruskal-Wallis and Mann-Whitney are summarized in Table 9.

Table 9 District differences in social capital

	Kruskal-Wallis (p-value)	Mann-Whitney (p-value)	
		Kiambu	Meru
Associations	0.000*	0.000*	0.000*
Trust	0.500	0.313	0.303
Neighbor	0.000*	0.268	0.000*
Information	0.436	0.419	0.176

Note: * indicates significance at 1 per cent.

The Kruskal-Wallis test indicates that the difference in the means for “association” and “neighbor” between Machakos and the other two districts is statistically significant ($\chi^2=56$ (2) *df*, $p<0.0001$). There is however no significant difference for “trust” and “information”. To compare Machakos to each of the two other districts

⁸ Note, however, that PC2 also has fairly strong loadings for N1-2, but since these two variables form the only two components of the third PC (with higher factor loadings), they were excluded.

individually, we use pair-wise Mann-Whitney tests. The results are similar except that when it comes to “neighbor”, the difference is only significant with respect to Meru and not to Kiambu. For this variable, it is worth noticing that Machakos has the lowest value but not the highest, which was found in Meru.

The wide variations in levels and forms of social capital among regions require an explanation. In our post interview group discussions, we gathered information on participant history of associational ties. Machakos is striking for two major reasons that are of particular importance to this study. First of all, the population is very homogeneous and comes mainly from the Akamba culture. They are known to have strong cohesion and have a long tradition of working together (referred to as *mwethya*). Regular contacts through various groups and cooperative movements enhanced the principle of collective action. In general, the ability to sustain such collective action is important because better prices can be negotiated on the basis of volume. Fluctuating market prices can offer tempting opportunities for individuals to obtain better prices by violating their commitments to the group and selling elsewhere. Lack of commitment on the part of farmers was frequently mentioned to be increasing, suggesting that maintaining collective action was not easy. In the past, the collective action problem was handled in a variety of ways in Machakos. Churches and political leaders constantly reminded members of the importance of solidarity and mutual benefits of collective action. Several cooperatives built commitment by running other social development programs. Although this is a non-economic activity, it was seen to be community-wide in terms of inculcating values and tolerance. These techniques appeared to have worked better in Machakos than other areas, suggesting that strong leadership could be partly responsible.

Additionally, farmers in Machakos initiated modern agricultural techniques quite early, already in the 1950s, soil erosion was severe and caught the attention of many researchers as witnessed by the debate (Tiffen, et al., 1994). The farmers were also hit by a series of unusual and unfortunate weather events, which provoked famine that also gained attention because it was close to the capital Nairobi. Information on these events was passed on to younger generations through the women’s groups. Such historical ecological experiences are important in shaping farming decisions. These women’s groups act as a “library of information” on how to cope with dynamic change in complex systems both temporally and spatially. In that way, “associations” help connect the present and the past. Such ecological information is crucial to understand qualitative changes in complex systems as a means for improving the community’s chances of survival. This view is consistent with adaptive management studies documented by ecologists (Holling, 1978). Lastly, participants mentioned the role of religious institutions in reinforcing community cohesion. It was noted that values, such as respect for each other, honesty, sharing, reciprocity and humility, are enhanced. These were viewed as key ingredients for the success of local institutions.

Patterns of labor market participation may also impact social capital. The apparent decline of social capital in Machakos can be explained by young people now turning away from agriculture and into new businesses or employment. There are new employment opportunities offered by expansion of Export Processing Zones (EPZ), occasioned by the African Growth Opportunity Act (AGOA).⁹

Both Kiambu and Meru have different social structures that do not favor collective action from associations. For instance, in Meru horticultural producers collectively bought seed from a private horticulture company, but sold their produce individually to the company. They complained of problems with unfair competition among

⁹ The African Growth and Opportunity Act (AGOA) is a United States Trade Act that significantly enhances access for 39 (to date) sub-Saharan African countries to U.S. markets. The Act was signed into law by U.S. President George Bush as Title 1 of the Trade and Development Act of 2000 and was amended in 2004 to extend it to 2015. Retrieved from <http://www.agoa.gov/> and <http://www.agoa.info/>.

each other to the advantages of the company. In contrast, in Machakos the cooperative or association maintained seed exchange networks among themselves and were always assured of a supply of quality seed, and then sold their produces collectively.

7. Conclusions

The importance of financial, human, and natural capital for economic development is well known. In this study, we explore the somewhat vague set of characteristics called “social capital”. We recognize the need to have specific dimensions of social capital based on firm economic theories. Social capital may enter the production and utility functions at the individual and collective level by facilitating joint production, as well as the exchange of labor, credit and information. The use of principal components analysis do not support the creation of a single measure of social capital, but four readily distinguishable and interpretable measures, namely, the tendency to form “associations”, the existence of “trust”, cooperation with “neighbors”, and a fourth factor related to the flows of “information”. The authors’ findings concur with those of Haddad and Maluccio (2003), who found similar factors (except information) as determinants of economic outcomes in rural South Africa.

There is evidence confirming that Machakos is different, particularly with respect to higher association membership and diversity. This result is similar to Isham (2002), who found regional differences in similar social capital measures and their impact on fertilizer use in Tanzanian villages. Our findings agree with other studies (such as Narayan & Pritchett, 1998), showing that heterogeneity of group membership is an important factor behind differences in economic outcomes. These results support the idea advocated by others (Putnam, 1993; Narayan & Pritchett, 1998; Isham, 2002; Haddad & Maluccio, 2003) on various dimensions of social capital. It is possible that Machakos originally had more churches and ethnic homogeneity, and that this eventually paved the way for more active associations and a culture of trust, which turned out to be the most important form of social capital. Alternatively, it could be that Machakos had special cultural predispositions and more formal associations that are actually better for economic development.

A policy conclusion of this paper is that there are efficiency and equity arguments for intervention geared at promoting the accumulation of social capital. One policy response would increase the tendency to associate by building or strengthening local community networks, such as churches and farmers’ clubs. Another would encourage church attendance by providing tax exemptions for those who tithe. Yet another would teach “service learning” in schools and take measures to facilitate mutual trust promoting community self-help through mutual volunteering.

However, some caution is necessary. Policy recommendations are difficult for several reasons. The first is the apparent importance of long-standing historical and cultural factors in driving social capital, which suggests it may not be easily susceptible to policy intervention. Secondly, there is a need for improved measurement of social capital and for more research on its responsiveness to policy intervention. To conclude, we know that social cohesion is readily destroyed and hard to build, which implies that social controversy can be very disruptive. As for the grand debate between the Boserupian and Malthusian views, we must be humble and say that many more studies are needed. This one does show that Machakos was special, but on the other hand, it was not different enough to preclude dramatic improvements also seen in other similar regions. This will, however, require determined policy-making efforts that need to be founded on more research.

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