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Social determinants of soil and water conservation in rural Kenya

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Abstract Soil erosion is a major environmental problem and threat to rural development in Kenya. Numerous attempts to address the problem have apparently had little success. There are however some districts that have been very successful, notably Machakos. In this study we search for the factors that determine successful development in soil conservation such as social capital, human capital and market integration. One of our main results is that social capital measures are significant determinants of investment in soil conservation. A better understanding of the relevant mechanisms is essential for developing policies targeting improvement in natural resource management.

Keywords Kenya · Social and economic factors · Soil conservation · Random effects probit

JEL Classification Z13 · Q10 · Q16 · O13

1 Introduction

Over the last few decades, global land and water management has either not improved or worsened; and environmental degradation in many places has been significant (see UN conference on Environment and Development (UNCED) in 1992 and World Summit on Sustainable Development (WSSD) in 2002.

Many parts of Kenya experience severe soil erosion which has been estimated at 72 tons per hectare per annum (de Graff, 1993). Soil erosion contributes to low and declining farm productivity that can profoundly affect poor farm households with

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minimal economic margins. There are also downstream effects such as water pollution, sedimentation and siltation of water bodies, disruption of aquatic ecology and destruction of road infrastructure. Finding ways to reverse these trends is an urgent need in Kenya and neighbouring countries.

Alarmed over these threats and in particular the impacts on land productivity, policy makers have sought to encourage investment in soil and water conservation (SWC) technologies. A wide variety of SWC approaches have been initiated in Kenya (Hudson, 1995; Pretty, 1995). In the 1930s policy measures included forced culling of livestock, compulsory labour to construct terraces and prohibition of farming on steep slopes. Frustration with farmer indifference led the government and donors to stimulate adoption of SWC technologies by offering various inducements aimed at soil conservation. Typically, cross-slope technologies such as terraces, infiltration ditches and bunds were promoted. The goals of these projects were to raise farm production and incomes, while reducing degradation. The incentives included input subsidies and technical assistance for the construction of SWC structures. Persuading farmers through economic incentives is believed to be a solution to minimize land degradation. Success as measured by adoption has however been very limited because the altered practices are either abandoned or neglected once the subsidies and other support are terminated (Lutz, Pagiola, & Reiche, 1994; Kerr, Sanghi, & Sriramappa, 1996). Many reasons have been cited for this fact, including the coercive methods that may have contributed to soil conservation resentment. Furthermore, the vast investment in soil conservation may have failed because of the exclusively technical definition of activities without regard to local farming conditions.[1]

Despite the long history and inclusion of economic incentives, the overall performance of soil conservation programs is mixed. A long-standing question in economics is why some regions are successfully adopting soil conservation while others do not. For instance, in the 1950s the Machakos region was a disaster characterised by soil erosion, poverty and low crop productivity (Tiffen, Mortimore, & Gichuki, 1994). It became famous as an early example of the poverty-resource link that we now witness in many places. A combination of factors is taken to be causing this land degradation, including increased population pressure on natural resources, deforestation caused by firewood demands, and overgrazing resulting from overstocking. This is generally viewed as evidence of the vicious cycle through large families, high discount rates and myopic planning. This integrated process of poverty and increased resource degradation has been described as 'the downhill spiral' that leads to a poverty trap (Cleaver & Schreiber, 1994). Machakos is often presented as key evidence that this situation can be transitory. The 'Machakos miracle' involved massive local initiative and effort in building physical structures such as terraces. More importantly, these structures were built with self-organized local labour groups without sanction.

Today it presents an interesting case study of successful rural development. Soil erosion has been drastically reduced and the region is one of the best terraced in Kenya (Tiffen et al., 1994; Zaal & Oostendorp, 2002). It appears, among other things, that reductions in soil erosion were influenced by the presence of technical assistance promoting SWC and market access to Nairobi, which favoured high value

[1] For instance, the width of terraces must be sufficient to allow for easy turning at each end since farmers use oxen for cultivation.

cash crops and thus increased the value of soil conservation investment. There is much speculation behind the transformation. Some argue that population pressure may have fuelled the innovation process coupled with improvements in land quality (Templeton & Scherr, 1999). Other factors such as market conditions, weather and government activities have been touted as possible drivers (Brown & Shresta, 2000). The debate remains unresolved and is still highly controversial (Barbier, 2000).

Given the lack of consensus and relatively few successful examples, the purpose of this paper is to compare Machakos to Kiambu and Meru[2] to identify factors that explain the success of Machakos. These study areas, shown on the map in the appendix are in Eastern and Central provinces of Kenya. Both Machakos and Meru are in Eastern province while Kiambu is found in Central province. Both Kiambu and Meru districts are high potential regions with fertile land but susceptible to land degradation. We thereby shed light on whether Machakos is different and how this success can be emulated. We explore the underlying determinants including human capital (education, age), biophysical characteristics (slope, erosion status), tenure characteristics (affecting ability to finance investments and incentives to invest), and infrastructure and access to markets (affecting prices of inputs and outputs). As a more novel ingredient, this paper also places emphasis on one additional mechanism that may contribute to the understanding of SWC adoption. This mechanism is 'social capital' which embraces the qualities of people and organizations that influence the responses of people to economic opportunity (Abramovitz & David, 1996). An understanding of these factors will ratchet up the pace of development, because if one knows what determines success and what causes failure, and if one can influence these factors, then significant improvements can be made in soil and water conservation.

We show that some of our indices of social capital and economic variables influence investment in soil conservation. The finding suggests that contemporary research in soil conservation seeking to explain the differences in adoption should think about some of the issues that originate in social arrangements. Such an assessment can serve as a useful guide for the design of appropriate and sustainable SWC programmes and support services. Policy makers may use information obtained from this study to enhance adoption of SWC measures. Many believe that adoption of SWC measures will reduce soil erosion and increase land productivity and the incomes of farmers in Kenya. To our knowledge this is the first paper to test how social structures that vary from region to region may affect soil conservation in Kenya.

The remainder of the paper proceeds as follows. We explain in detail the reasons as to why social interactions matter for soil conservation in the next section. Section 3 describes the data and the derivation of social capital variables. Section 4 presents the estimation strategy. In Sect. 5 we present results that incorporate the effect of biophysical variables, human capital, infrastructure and social capital. Section 6 concludes and draws a few key policy implications of the findings that may help guide the design of appropriate and sustainable SWC programmes and support services.

[2] These areas in Central and Eastern Kenya respectively show increasing environmental degradation.

2 Why might social capital matter for soil conservation?

Recent theoretical work has emphasized the interaction among social arrangements, incentive structure and growth (Fershtman, Murphy, & Weiss, 1996). Similarly, Pretty (2003) documented the growth of social capital as evidenced by group activity in a wide range of natural resource management sectors, including watershed management, integrated pest management and farmer experimentation. It is not immediately obvious that investment in soil and water conservation requires social capital. However, the 'Machakos miracle' suggests that collective action is needed to: implement soil conservation on individual farms (e.g. through labour exchange, marking out contours, credit provision, risk sharing); raise awareness of soil erosion and conservation; and provide farmer led, group based training in soil conservation, maintenance of links with government agencies etc. Let us now turn to these activities in more detail.

First, social networks can foster cooperative behaviour and ease coordination problems (Krishna, 2001; Bowles & Gintis, 2002). The construction of soil conservation structures is complex and demanding in terms of labour intensity and technical skills. Local farmers are poorly equipped to deal with these problems since they have little formal training and little access to good agricultural extension services. These constraints make soil conservation unattractive particularly for less endowed households. Farmers rely on labour pooling to overcome labour shortages particularly during peak seasons, especially those farmers who are pressed to hire labour. Decision-making by farmers is complex because there are many related considerations such as appropriate soil conservation structures coupled with related concerns of crop choice, farming skills and technical knowledge. In these circumstances farmers tend to observe, seek information, borrow and learn from the farming methods of their friends.

Second, formal credit markets do not function well in agricultural societies due to high information, monitoring and transaction costs, lack of collateral and moral hazard problems (Stiglitz & Weiss, 1981). One would expect land to be collateral, but due to non-tradability in developing countries this is not the case. The lack of credit discourages investment in productive activities like soil conservation. Under these conditions, strong social capital can facilitate the pooling of finances, which can then be invested in soil conservation.

Third, benefits from soil conservation investments are uncertain, and materialize with a lag. Faced with no possibility to save or borrow, as is typical in rural low wealth societies, investment is made at the expense of current consumption (see for example Hoff, Braverman, & Stiglitz, 1993). Under these circumstances, social ties through support networks and reciprocity norms fill the gap in consumption smoothing. Given that these and similar sharing arrangements have been practiced over the years, they can be viewed as implicit insurances. An example of this sharing mechanism is alleviation of food insecurity through social networks. One's level of assets and food security determines the degree to which one discounts future gains. Those who possess more endowments will place a higher value on the long-term from conservation investment because their capacity to survive in times of food insecurity is greater than those in dire poverty (Shivley, 1997). Similarly, since farmers operate under imperfect and asymmetric information, one practical aspect of social capital is the ability to provide information channels that may be relevant for SWC investment decisions.

Finally, while SWC technologies are employed on individual farms, the techniques operate at the landscape level, thereby making collective action particularly relevant. For instance farm technologies like terracing (or pesticide application) require widespread and coordinated adoption in order to be effective. A technology that requires 10 hectares could be internalised and adopted within a single farm in some areas, but requires coordination of hundreds of farmers in our study areas. Technologies that operate on a watershed scale are more feasible where traditions of cooperation are strong. Again, the success of SWC investment requires cooperative behaviour among farmers. For example, run-off causing soil erosion does not respect boundaries. This means that even if a farmer adopts SWC measures, the farmer may still face damage coming from neighbouring farms where no control measures are taken. Another context of cooperative behaviour involves farmers sharing implements, exchange information on construction and on the proper layout of SWC structures among farms. In addition, construction of SWC structures demands a lot of labour. Farming households collaborate in labour exchange in order to overcome these labour constraints. These examples suggest a complex mixture of public, club and private goods and hence it is easy for one to benefit without payment, in effect to free ride. Social institutions based on trust, reciprocity and rules for behaviour can mediate this kind of unfettered private action. The broad agreement is that social interactions affect economic outcomes like SWC investment. A key objective is to better understand these mechanisms.

2.1 Understanding the mechanisms for collective action

Many questions about the determinants of adoption remain unclear. Early studies focus on individual and plot characteristics (see Feder, Just, & Zilberman, 1985 for a detailed survey). Economic research on farm technology adoption has partially addressed the issue of how social factors can affect adoption (Foster & Rosenzweig, 1995). These studies are based on the idea that neighbouring households are members of a social structure in which they exchange information on agricultural practices. However, none of them tests how social structures that vary between economic and agro-ecological contexts may affect farm technology adoption. If all regions receive the same level of assistance, why then should results vary so much from one locality to another? It is claimed that more cooperative groups caring for each other will achieve better outcomes, while those with lower levels of cooperation will achieve less. Non-economic research suggests that the characteristics of social structures are critical determinants of adoption (Rogers, 1995). However, social capital has not been measured in any satisfactory way yet, but has rather been addressed in an ad hoc manner (Paldam & Svendsen, 2004).

Structures of social relations may or may not enable people to trust one another. Trust, in turn, allows people to coordinate their actions for mutual benefit. Thus trust is a mechanism that overcomes market failures which arise because of uncertainty (Ostrom, 1990). This capacity to resolve collective action problems may bring about many advantages, such as soil conservation and economic progress. Economic incentives play a critical role in encouraging changes in behaviour, though they do not guarantee a positive effect on personal attitudes. Education can change attitudes and beliefs, though many barriers, both within individuals and their social and economic environments, can prevent pro-environmental attitudes from being expressed in action (Gardner & Stern, 2002). Collective management of resources depends on certain characteristics of the community. For instance, when community management is employed, local people should be involved in making the rules. A social group with shared norms and values within networks of social interaction makes rules easier to enforce because of social pressure (Gardner & Stern, 2002).

The literature on social capital has come to the fore with the much-publicised work of Putnam (1993). There is a small but well-established literature on this subject from developing countries that describes survey methods. Most of them stress indicators of trust and social participation on a range of outcomes: economic growth on cross-country studies (Knack & Keefer, 1997), household incomes in Tanzania (Narayan & Pritchett, 1999) and greater use of modern agricultural inputs in Tanzania (Isham, 2002). In another context social capital serves to mitigate effects of individual-specific economic shocks faced by poor households (Carter & Maluccio, 2003; Fafchamps & Lund, 2003). A system of social exchange is an integral ingredient of a rural household's risk reduction and coping strategies. Similarly, social capital is needed for mutually beneficial collective action and coordination (Krishna, 2001; Krishna & Uphoff, 1999). Narayan and Pritchett (1999) found higher group membership associated with higher household income in Tanzania. In the study of 60 villages in India, Krishna found high stocks of social capital, yet this alone did not translate to community development.

In any economic model, the decisions of one agent will be influenced by the behaviours of others. Inclusion of community social interactions is not straightforward. Positive effects of group behaviour on individual behaviour can be interpreted as social effects, while they are due to characteristics common to all villagers. For the individual farmer, social capital in the form of good relationships with others is a private asset he can draw on as capital. In addition to this, there are social or public good effects of social capital. Not only am I better off if I have a good deal of social capital, but I also benefit indirectly by living in a society where everyone has ample social capital, since it will lead to a trusting and entrepreneurial atmosphere conducive for investments and growth. These features, however, may pose some problems. First, there is an identification problem in the analysis of contemporaneous behaviour also known as the reflection problem, Manski (2000). The reflection problem arises because the behaviour of the farmers in a village affects the behaviour of an individual farmer in that village but the behaviour of that farmer affects village behaviour, thus creating simultaneity bias (Durlauf, 2002). Following Manski (2000) and Durlauf and Fafchamps (2004) we tackle the problem of identification by including a lag in the transmission of social effects. We exclude the observation of individual i from his average village group.

3 Data

The data used in this study were collected in the Machakos, Kiambu and Meru districts from January through 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. The study employed questionnaires that were administered to household heads regarding demographics, human capital and land under cultivation, assets, access to markets and infrastructure, community variables and plot level[3] agricultural practices (crops and acreage, output, prices, SWC types etc.) for the 2001/2002 production season. The questionnaire also collected information about relationships, membership in voluntary groups and associations, monetary and in-kind contributions, sources of agricultural and sources of private and public information. The survey information was complemented by key informants among the village leaders.

The questions were based on World Bank studies of social capital, poverty and development (see www.worldbank.org/poverty/scapital/index.htm). The questions were first refined based on information from key informants among village leaders. 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. The refined questions used in the study are in Appendix II.

3.1 Descriptive statistics

The descriptive statistics on household and plot characteristics for the study regions are presented in Table 1. A number of previous studies on soil conservation have employed dichotomous variables (Feder et al., 1985; Place & Hazell, 1993; Shiferaw & Holden, 1998) to represent the decision status. Individual plot-level adoption models assess adoption in terms of the likelihood that a farmer, with given social and economic characteristics, will adopt a given technology. In our case the dependent variable is '*Conserve*', a dichotomous variable taking a value of one if there were a physical soil conservation structure on the plot and zero if there were none during the last 5 years. The structures included bench terraces, fanya juu and infiltration ditches. Overall, the proportion of plots with SWC was highest in Machakos and lowest in Kiambu. Previous studies have indicated that prior adoption was highest in Machakos (Tiffen et al., 1994) which is observed in our data as well.

The choice of covariates in the model is based on a literature review of the determinants of adoption, which have found some of these variables to be significant (Ervin & Ervin, 1982; Feder et al., 1985; Besley & Case, 1993; Shiferaw & Holden, 1998; Lapar & Pandey, 1999; Gebremedhin & Swinton, 2003). Topographic and farm characteristics may influence land investment decisions. The proportion of highly eroded plots does not vary between Kiambu and Meru. Equally there is little variation in the proportion of lowly eroded between plots Meru and Machakos. These are the farm characteristics that may influence adoption of SWC measures. The proportion of plots located in the upper slope is roughly comparable across the regions. However, there is a remarkable difference in the proportion of plots located in the mid slope. It is highest in Meru and lowest in Machakos. The position of a plot on the slope profile also known as catena is an important indicator of the erosion potential as well as soil conditions (Lapar & Pandey, 1999). On a typical slope the steepest region is found mid slope. Thus, one would expect that the marginal productivity loss due to erosion from a plot in the middle catena with fertile topsoil to be highest in the short term. Hence, plots on the mid slope/catena would be expected to have more conservation investments because of the higher slope compared to those on the lower catena.

[3] A plot as used in this study is a contingent piece of land that has been cultivated with a specific crop or crop combination for which the farmer can measure the inputs and outputs.

Table 1 Descriptive statistics of variables

Variable	Definition	Kiambu		Machakos		Meru		All	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Dependent variable									
CONSERVE	Presence of SWC structure on plot	0.53	0.64	0.67	0.44	0.64	0.43	0.57	0.49
Farm characteristics									
HIGHLY EROSION	Proportion of highly eroded plots	0.23	0.42	0.06	0.24	0.19	0.36	0.19	0.39
MODERATE EROSION	Proportion of mildly eroded plots	0.04	0.09	0.25	0.42	0.13	0.09	0.12	0.11
LOW EROSION	Proportion of lowly eroded plots	0.74	0.44	0.65	0.48	0.67	0.41	0.69	0.34
UPPER SLOPE	Plot located in upper slope = 1, Else = 0	0.39	0.48	0.37	0.47	0.35	0.48	0.37	0.48
MID SLOPE	Plot is located in mid slope = 1, Else = 0	0.31	0.46	0.29	0.46	0.48	0.50	0.35	0.47
LOW SLOPE	Plot is located in lower slope = 1, Else = 0	0.29	0.45	0.33	0.49	0.16	0.37	0.27	0.41
Tenure security									
HIGH	Complete rights = 1, Else = 0	0.71	0.45	0.12	0.33	0.66	0.47	0.51	0.68
MEDIUM	Preferential use rights = 1, Else = 0	0.16	0.37	0.62	0.48	0.15	0.35	0.21	0.41
LOW	Limited use rights = 1, Else = 0	0.13	0.34	0.25	0.44	0.19	0.39	0.15	0.36
Behavioural/household characteristics									
EDUCATION	Years of schooling for all above 16	7.6	2.56	6.14	2.28	6.77	2.27	7.16	2.48
AGEHH	Age of the household head in years.	52.8	14.3	55.13	10.61	47.91	12.51	51.9	13.5
DEPENDENCY RATIO	Ratio adults to <6 and >65 in family	0.32	0.20	0.31	0.22	0.28	0.20	0.31	0.21
HIRED LABOUR	Share hired farm workers	0.31	0.57	0.08	1.29	0.06	1.43	3.2	1.5
REMITTANCES	Receipt of remittances = 1, Else = 0	0.69	0.46	0.90	0.30	0.61	0.95	0.77	0.42
PER CAPITA LAND	Share of land area to family size	0.30	0.32	0.29	0.27	0.26	0.18	0.28	0.27
PERENNIAL CROP	Perennial crop on plot = 1; Else = 0	0.28	0.45	0.31	0.46	0.41	0.49	0.32	0.47
PRIOR ADOPTION	Proportion of previous adoption (%)	0.31	0.18	0.69	0.25	0.51	0.36	0.51	0.23
Distance to									
PRODUCE MARKET	Mean walk time to nearest market (min)	33.00	16.00	60.00	55.00	31.00	18.00	35.0	24.0
ADMINISTRATIVE HQ	Bus fare home to divisional centre (Kshs)	56.00	9.00	47.00	8.00	42.00	27.00	47.0	21.0
Sample size (number of plots)									
ADOPTERS		183		44		93		320	
NONADOPTERS		162		22		52		236	

Household characteristics include years of education, age (linear and quadratic term) and gender. These variables reflect human capital of the household. On average the youngest household head is found in Meru. The mean number of years of formal education is lowest in Machakos for household members age 16 and over. The largest proportion of male-headed households is found in Meru, while it is roughly comparable in the other districts. Household demographic characteristics will also affect conservation investment decisions and outcomes by imposing some costs. The major costs are labour costs for initial construction of the structures and maintenance, and an opportunity cost of the land lost to construction structures. To capture the effects of household age composition, we include a dependency ratio which is equal to the number of persons who cannot work (under age 6 and above 65) divided by the total number of household members.

Consistent with areas of high population densities, land holding per capita is almost uniform across the study regions. The proportion of households receiving remittances is highest in Machakos and lowest in Meru. Indicators for access to markets differ. Farmers in Machakos travel the farthest distance to sell their produce, while the distances in Meru and Kiambu are comparable. In terms of bus fares to markets for farm inputs (typically the divisional centres), the mean fare is highest in Kiambu and lowest in Meru. Compared to Kiambu and Meru, Machakos cannot readily be described either by high tenure security or by shorter distance to markets. Although poor land tenure has been blamed for the relatively low investment in SWC, we find the situation in Machakos confounding. One would expect uncertainty in tenure to weaken farmer investment incentive especially for long-term structures. Also, poorly defined land rights may reduce production since farmers are unable to access credit without collateral. However, it may also be the case that investment in SWC is a way to secure the rights to the land. As we see from Table 1, it is not immediately obvious which differences in the descriptive statistics might explain the observed differences in adoption. Given the polarisation of views on SWC adoption in Kenya, it is particularly interesting to search for alternative plausible influences. This is basically why we turn to a regression model.

3.2 Social capital measures

Though social capital is recognized as being an important element of resource management, it remains a difficult issue to address empirically. The studies by Krishna (2001) and Narayan and Pritchett (1999) mentioned earlier are relevant to our study because they are based on a rural agrarian setting and the manner in which they construct their social capital variables. These studies ask questions[4] about the household's social relations, memberships in groups, participation in community activities, attitudes and values in settings similar to ours. Responses from these questions are combined to form quantitative indicators of social capital using factor analysis. The technique is a method of data reduction, which attempts to describe the indicators as linear combinations of a small set of underlying variables (Dunteman, 1994; Johnson & Wichern, 2002).

We have no a priori theoretical basis for choosing measures of social capital. A feature of this paper is the use of Principal Component Analysis (PCA). This is a statistical method that can assist in statistically (not subjectively) identifying and

[4] See World Bank: Social capital initiative. http://www.worldbank.org/poverty/scapital/index.htm.

weighting the indicators in order to calculate an aggregate index of relative social capital for a specific household. We sought social capital indicators designed to measure: (1) interactions with one another by borrowing small farm implements, risk coping strategies, discussing various local issues and learning from each other about SWC techniques; (2) working with neighbours and local participation in collective action activities; and (3) sources of agricultural market and public information. Most of the social capital literature specifically mentions trust as an important constitutive element. Unfortunately, we could not ask respondents the extent to which they trusted their neighbours due to its inappropriateness, evidenced during the design phase. Presumably however trust is both reflected by and built through activities such as borrowing money or food from non-relatives. Such activities would thus be more common in environments in which people trust one another and we are therefore using this as a proxy for trust.

As a first step, the Pearson correlation coefficient of the approximately 35 variables is computed. This enables the analyst to drop highly insignificant and weakly correlated social capital indicator variables from the subsequent steps of analysis. One well-known application of PC analysis is as an aggregation method (Temple & Johnson, 1998). Specifically, PC analysis isolates and measures the social capital component embedded in the various variables or indicators and creates a household specific social capital score. The method basically slices information contained in a set of indicators into several components. Each component is constructed as a unique index based on the values of all indicators. Table 2 presents for the factor loadings.

It turned out that many of the variables were highly collinear and significant. The analysis also uncovered patterns and associations by looking at loadings on variables across components of the variation. The loadings were used as weights yielding an overall component measure of social capital derived as a sum of the product of

Table 2 Loadings on the first four principal components

Variable		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 Ass	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
Nr of persons to help in econ crisis	T2	0.221	0.513	–0.206	–0.079
Nr 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 neighbours	N1	–0.049	0.347	0.565	–0.058
Borrowed tools from neighbours	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 info: Media	I1	0.016	0.121	–0.107	0.124
Main source info: Relatives	I2	0.101	–0.069	0.046	0.505
Main source of info: Commune	I3	0.034	–0.211	–0.010	–0.475
Main source of Gov info: Relatives	I4	0.104	0.082	–0.104	0.035
Main source of Gov info: Media	I5	–0.019	–0.087	0.155	0.447
Main source of Gov info: Public	I6	0.033	–0.172	–0.043	0.399

component scores.[5] In the PC analysis a component was retained as long as its eigen-value was greater than one and four components were retained.

To interpret the loadings or weights we set the criterion to 0.3 or more. Since the data were collected at the household level, we compute indices at that level and then average the values to obtain a regional average index. Correspondingly, four distinct aspects of social capital were derived to create quantitative measures (constructs) of social capital, namely association, trust, community and information. The indices will be used to assess individual and combined influence of various social capital variables at the regional level. The first component, which accounted for the largest amount of variation in the data set, regroups a number of variables relating to a measure of membership and degree of participation in local associations as well as participation in community projects. No membership at all was coded zero. These variables are all indicators of an individual's strong connections with neighbours. This factor was named 'Association' since that term captures the main essence of the variables captured. The second component interpreted as a 'trust' index, is based on three variables reflecting solidarity in reduction of adverse shock, lending of money, food and reciprocity. Interestingly, these first two indices approximate Putnam's (1993) now famous components of trust and civic engagement. Broadly speaking, the dominant features describing social capital are 'membership of voluntary organizations' and 'trust' (Glaeser, Laibson, & Sacerdot, 2002).

In addition, the third component relates to results from the loadings on participation in the sharing of farm tools and assisting neighbours. It captures resident volunteerism and presence in the community. It goes beyond the first component capturing public participation among neighbours for a shared sense of community. Paxton (1999) reports similar findings on neighbours borrowing implements and participating in community matters. Lastly, there is a component reflecting how farmers collect information. It was created from sub-indices formed from counting and ranking households' most important sources of information on crop prices, agricultural news and government news. This ranking was then reversed such that a household with all three sources of information was ranked first, and a household with only one was ranked last. Using such an ordinal measure may result in loss of valuable information if some source is better than others. The PC analysis showed a negative loading on community sources that resulted in some households having negative aggregates. Due to the low loadings of the variables in other components it was fairly easy to name this group 'Information' and a high value on this variable thus reflects the fact that the individual is well connected through a strong network of social contacts and has many different sources of information.

These four indices of social capital were used to evaluate the differences in levels of social capital among Machakos, Meru and Kiambu. Table 3 presents the descriptive statistics for our social capital indices, which will also be used in the empirical analysis.

The sum of 'association' ranges from 0 (no membership) to 16. There are big differences between Machakos and the other regions. The mean of 'association' in Machakos was 43% and 37% higher than in Kiambu and Meru respectively. Our second indicator of social capital 'trust' it appears to be almost equally shared. There

[5] If X_1, X_2,...,X_n are the original set of n variables, then a variable Y formed from a linear combination of these takes the form $Y = a_1X_1 + a_0X_2 + \cdots + a_nX_n$ where the a_i's (i = 1, 2,..., n) are the principal component loadings or weights. The weights or loadings add up to one.

Table 3 Descriptive statistics of social capital indices

Variable	Kiambu			Machakos			Meru			All		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Association	2.34	0	12.6	4.11	0	16	2.60	0	8	3.02	0	16
Trust	4.26	2	9	4.49	1	18	4.31	1.6	11	4.36	2	18
Community	0.96	0	1.1	0.92	0	1.4	1.08	0	1.2	0.99	0	1.4
Information	3.34	–4	13.5	2.96	–2.3	10.3	3.01	–3	10.2	3.11	–4	13.6

are, however, considerable differences in the range of the index. The maximum value of 'trust' is twice as high in Machakos as in Kiambu. Interestingly, Machakos ranks lowest with regard to 'community' and 'information'[6] indices. We use these constructs in a multivariate analysis to understand how social aspects of individual and community behaviour contribute to or detract from sustainable agriculture.

4 Modelling and estimation issues

There are many classes of models explaining soil management. Many emphasize the role of soil as capital and are consequently dynamic models. These models link and investigate the effects of economic and biophysical factors such as market imperfections, price incentives, soil depth and so forth on soil capital (see McConnell, 1983; LaFrance, 1992; Goetz, 1997; Yesuf, 2004). While these studies show that economic and biophysical factors explain most of the variation, the role of social and economic factors in explaining soil conservation outcomes remains an important area of research. However, many empirical studies including this one only have a cross-section of data from one point in time. In this sense the analysis is, therefore, a static one, but some aspects of dynamic optimisation can still be gleaned by comparing investments on individual plots.

Arguments have been presented above as to why social capital may affect SWC adoption decisions. However, despite these theoretical claims social capital remains a problematic notion on the empirical level. Farmer investment decisions are based on consideration of benefits and costs. Empirical models describing adoption of farm technology are based on the assumption that households choose to adopt when the present value of future net returns from adoption rise above the present value of future net returns from non-adoption. The effects of market distortions are reflected in higher input prices, which affect the profitability of agricultural production. Conceptually, social capital mediates costs through its influence on constraints and preferences (Zak & Knack, 2001). Individuals and regions endowed with social capital help to lower costs that go along with an increasing need for collective action and coordination among farms. In this context it shapes opportunities and constraints for farmers.

To highlight these points formally, let h denote the household and p the number of plots within the household. The household makes a decision to invest in SWC on a plot as a function of observable and unobservable household characteristics as shown in Eq. 1:

[6] The information index has a negative minimum due to the negative weight attached to communal sources of information, presumably seen as substitutes for other sources of information.

$$Y_{hp} = \beta' X_{hp} + \varepsilon_{hp} \qquad Y_{hp} = 1 \quad (\text{if } Y_{hp} > 0) \tag{1}$$

where Y_{hp} is an observed binary (latent) variable indicating the household's decision whether or not to invest in SWC on a plot. The vector X_{hp} includes explanatory variables for observable household characteristics which influence the decision to invest in soil conservation. Lastly, β is a vector of coefficients to be estimated, and ε_{hp} is the error term assumed to be random.

The data set consists of multiple plots managed by a household, thus there is potential for correlation among plot observations to deflate standard errors and bias the estimated coefficients. An alternative method of estimation which accounts for such multiple plot level data is the random effects probit (Wooldridge, 2002). The random effects probit model assumes that the correlation between successive disturbances for individual plots can be reduced to a constant ρ (Butler & Moffit, 1982). The relationship in Eq. 1 is modified to account for multiple plots as

$$\begin{aligned} y^*_{hp} &= \beta' X_{hp} + v_h + \mu_{hp}, \\ \varepsilon_{hp} &= \upsilon_h + \mu_{hp} \quad \text{and} \quad \text{var}[\upsilon_h + \mu_{hp}] = \text{var}[\varepsilon_{hp}] = \sigma^2_\upsilon + \sigma^2_\mu \end{aligned} \tag{2}$$

The correlation between two successive error terms for plots belonging to the same household is a constant estimated as in Eq. 3:

$$\text{corr}[\varepsilon_{hp}, \varepsilon_{hp-1}] = \rho = \sigma^2_\mu \big/ (\sigma^2_\mu + \sigma^2_v) \tag{3}$$

The estimated correlation across plots is evaluated using a simple *t*-test (Greene, 1995). If the data is not consistent with the random effects model (no evidence of random effects in the model), the estimate of ρ will turn out to be negligible. The set of unobservable characteristics v_h are household-specific attributes that also influence farm investment decisions. The presence of household-specific but plot invariant characteristics lays the basis for using a *random-effects* estimator (Wooldridge, 2002). In particular there may be substantial variation in plot characteristics, within a household. This may create potential for correlation among the plots which may deflate the standard errors and bias the estimated coefficients. We also experiment with the alternative probit model.

An issue that may complicate the estimation process is linking previous conservation investment decisions to current economic and social capital variables, which may lead to biased estimates due to changing farmer characteristics. Our data cover soil conservation at various dates in the past whereas social and economic variables are current. The correct approach when using cross-sectional data is to establish relationships between current conservation indicators and social and economic determinants. Studies linking previous conservation investments to current economic characteristics found in the literature are flawed. Besley and Case (1993) and Besley (1995) are perhaps the best examples of accounting for the problem. Therefore, following Besley (1995) we use investments undertaken during the last 5 years. Although explanatory variables can change over time, it is highly unlikely that they would have changed dramatically during those 5 years. Moreover, in this study, identification is facilitated by the fact that our data is at the plot level. Since the adoption process has not yet reached equilibrium, our data allow us to solve the problem by including prior adoption (earlier SWC investments) for each plot.

5 Results and discussion

Table 4 reports the results for the decision to adopt SWC based on Eq. 2. For comparison, we also present the alternative probit estimation results in which we use clustering to correct the standard errors due to the non-independence of plots from the same household. The marginal effects of the explanatory variables were calculated at their sample means. The probit model is significant with a χ^2 value of 216.32 and with 25 degrees of freedom. At a glance the results from both models are comparable and consistent with our expectations. We conducted statistical tests to determine the appropriateness of the random effects probit model. First, a test of the null hypothesis that the ρ coefficient is 0 using a likelihood ratio test yielded a sample χ^2 value of 63.5 at the 1% level of 21.7. The result suggests that the plot variance component is not negligible and consequently, the use of the random effects model is justified. In addition random effects probit models can be used to analyse data sets that include a single plot observation (Greene, 2000). Second, a likelihood ratio test corroborated the superiority of the random effects probit over the probit estimation.

The estimates suggest that some of our measures of social capital enhanced the likelihood of investing in soil conservation. Estimated coefficients for 'Associations', 'Trust' and 'Community' are positively and significantly correlated with a higher likelihood of SWC adoption. The magnitude of impact upon SWC adoption is largest for Trust and Associations followed by Community among social capital variables components. The result suggests that having more ties increases the likelihood of adopting soil conservation. A willingness to cooperate enhances collective action to provide public goods such as soil conservation. Associations describe group membership in voluntary organizations. These results may have either of the two following interpretations. First, they may indicate membership in cooperative societies, which are economically oriented and thus provide technical assistance and credit. Cooperatives pool resources to enhance joint commercialisation of agricultural produce, thus improving farmers' margins. Membership in associations plays a number of different roles, including guarantors of informal loans through rotating informal credit schemes, the exchange of farm implements and information and the primary means through which extension services operate. They also provide a ready source of pooled labour under reciprocal arrangements. Members of a group may take turns in constructing terraces for each other. Informal credit is important especially in rural areas where formal credit markets are not well developed. Investment in soil capital or any other asset requires access to credit. Other studies have also found membership in local networks to be positively correlated with adoption of soil conservation (Gabunada & Barker, 1995; Swinton & Quiroz, 2003).

With respect to *Trust* the results suggest that people rely on each other to share resources and to pool risk, which are both critical for soil conservation investment. This can occur through two possible channels: First, in the context of land enhancing investment decisions, there is an assurance of consumption smoothing in the event of production shortfalls. This can be attributed to the safety net provided by friends in periods of economic need. The importance of this insurance is apparent for SWC investment since farmers undertake investments in which they have no experience or since it involves a shortfall in production that they are not familiar with. This transfer of resources and self-insurance mechanisms plays an important role in farm investment decisions by alleviating liquidity constraints. Finally, there are fewer

Table 4 Estimated Coefficients of Probit and Random-Effects Probit Models of Probability that a Plot has SWC Investment

Variable	Probit		Random-effects Probit	
	Estimated coefficient	Marginal effects	Estimated coefficient	Marginal effects
Social capital characteristics				
Individual level social capital				
ASSOCIATIONS	0.174	0.022	0.219**	0.024
TRUST	0.193*	0.023	0.187*	0.036
COMMUNITY	0.236**	0.034	0.228	0.021
INFORMATION	–0.341	–0.021	–0.377	0.035
Physical and farm characteristics				
Soil erosion status (ref. LOW EROSION)				
HIGH EROSION	1.187	0.428	0.587	0.222
MODERATE EROSION	1.509	0.319	1.942	0.527
Location on toposequence (ref. LOWER)				
UPPER SLOPE[a]	0.078	0.065	0.044*	0.071
MID SLOPE[a]	0.210	0.046	0.237	0.056
Perceived tenure security (ref.HIGH)				
MEDIUM	0.031	0.066	–1.019	–0.078
LOW[a]	–1.193	0.125	–1.124**	–0.118
Socio-economic characteristics				
Human capital				
EDUCATION	–0.175**	–0.031	–0.154**	–0.099
AGE H/HEAD	0.134*	0.015	0.179*	0.022
AGE SQUARED	–0.012	–0.002	–0.013	–0.002
DEPENDENCY RATIO	0.354	0.172	0.734*	0.136
HIRED LABOUR	0.262	0.069	0.322	0.002
REMITTANCES	–0.523*	–0.108	–0.984**	0.130
PER CAPITA LAND	–1.618**	–0.274	–1.669**	–0.163
PERENNIAL TREE CROPS[a]	–1.145*	–0.212	–1.276**	–0.132
DISTANCE TO MARKET	–0.013**	–0.002	–0.017**	–0.028
BUS FARE TO DIVISION	–0.002	–0.005	–0.041	–0.014
PRIOR ADOPTION	–0.423	–0.198	–0.481*	–0.215
District dummies[b]				
MACHAKOS (1 = YES, 0 = NO)	0.973*		0.988	
MERU (1 = YES, 0 = NO	0.765		1.121	
Constant	–1.485*		–1.345*	
Regression diagnostics	–	–	0.927	
Rho				
Log-likelihood	–238.97		–237.31	
Wald chi-square (25)	216.32		95.34	
Number of observations	556		556	

Legend: Partial derivatives are in probability units

** and * significant at the 1% and 5% level

[a] For dummy variables marginal effect is a discrete change from 0 to 1

[b] Default district is KIAMBU

coordination problems and related costs in SWC organization across farms, which reduce spatial externalities. Availability of *Information* may be a determinant of soil conservation investment even if it is not statistically significant at standard levels. Well-informed farmers are more likely to act rationally and have longer planning horizons.

We included two district dummies, Machakos and Meru, to control for regional differences. These coefficients are positive and significant which suggests that the explanatory variables in our model do not entirely explain why adoption of SWC is lowest in Kiambu. This result is not surprising and confirms a stylised fact in African adoption studies. Many studies have reported location specific dummy variables explaining the largest proportion of variation in adoption patterns. Arguably, our understanding of farmer adoption behaviour remains insufficient. Shifting focus to include social factors is one way to help getting around finding the ultimate underlying factors. Several studies suggest the inclusion of factors such as social interactions at higher aggregation levels (Place, Swallow, Wangila, & Barrett, 2002).

Land tenure security captured as '*Low*' is significant and negatively correlated with conservation investment decisions. Tenure security gives the assurance of retaining the long-term gains from investment in land enhancing investments. This result is consistent with other studies on the impact of tenure security and soil conservation improvements (Besley, 1995; Shiferaw & Holden, 1998; Gebremedhin & Swinton, 2003).

The location of a plot on the toposequence is a significant determinant of SWC adoption. Estimated coefficient for '*Upper Slope*' is positive and suggests an increase the likelihood of adoption. This pattern is what one would expect given the need for SWC is greater at steeper slopes and lower in the lowlands. Steeper slopes are more vulnerable to erosion on average but also to land slides. The amount of soil that would be lost is determined by the rate of erosion, which is itself a function of the physical characteristics of the plot including location on a slope and the amount of soil present.[7] The coefficients of '*Soil Erosion*' status are positive but not significant.

'*Education*' has a negative and significant impact on adoption behaviour. This result does not support the expectation that more education should improve access to information and increase the understanding on benefits of conservation investments. In addition, as shown in the literature education can change attitudes and beliefs (Gardner & Stern, 2002). The finding is consistent with Rahm and Huffman (1984) and Pender and Kerr (1998). A plausible explanation is related to time available for farm work. When more children go to school, increasing the average level of family education, they also decrease the amount of time available for soil conservation. This could also be due to a high opportunity cost of labour, since educated people can earn more in tasks other than farming. For such households, investment in land quality is in competition with the portfolio of other investments made or pending. This may partly explain why the impact of education on conservation can be negative, particularly if the positive effects from knowledge of conservation benefits are not known. More plausible, as shown by Weir and Knight (2000), is that household level education may only be important to the timing of adoption but less crucial to the question of whether a household ever adopts a farm technology. Early innovators tend to be educated and are copied by those who adopt later, thus obscuring the relationship between education and adoption. The result may also be attributed to our measure of education captured by the average number of years of schooling by all household members aged over 16, yet it is clear that education can take many other forms. More research is needed to establish the relationship between education and environmental behaviour.

[7] Inclusion of a soil depth variable to control for land quality did not noticeably alter the coefficients or their standard errors.

There is a concave relationship between age and investment in SWC. A possible reason could be that younger and also stronger farmers have longer planning horizons and hence lower discount rates. Consequently, they are prepared to invest in soil conservation in spite of the lag before benefits are realized. This result is consistent with others in the literature (Lapar & Pandey, 1999; Shiferaw & Holden, 1998).

Households with *Remittances* are less likely to adopt soil conservation measures as indicated by the negative and significant coefficient. A possible explanation is that the extra earning opportunities reduce the time for farm work or relax liquidity constraints (World Bank, 1994). Additionally, they may have little concern about land quality due to their orientation towards off-farm activities.

Farmers with larger land holdings are less likely to invest in soil conservation result, and those with smaller farms per family size are more likely. Three plausible reasons can explain the finding. First, the critical issue of maintaining per capita food production demands induces intensification. Greater food demand by larger households suggests greater land scarcity, which may encourage careful land management. Alternatively, larger households have more labour to undertake construction of physical anti-erosion structures. This result is consistent with the Boserupian population driven argument for intensification (Tiffen et al., 1994; Templeton & Scherr, 1999). However, this result runs contrary to the neo-Malthusian hypothesis that a larger population will increase land degradation. In the Philippines it was found that small farm size was a barrier to undertaking land conservation investment (Shivley, 1999).

The presence of '*Tree crops*' discourages soil conservation investment adoption as expected. Tree crops provide soil cover, substituting soil conservation structures and controlling erosion at least as effectively as the run-off barrier (Young, 1997). The result suggests that agroforestry techniques are the preferred means of controlling erosion. Perhaps there could be synergistic benefits, only known to the farmer, of having a combination of tree crops and soil conservation structures. A similar finding of farmers not willing to make any other investments in agriculture has been reported in Kenya (Soule & Shepherd, 2000).

Distance to markets as an indicator of market related transaction costs and proxy for the quality of other public services was found to be negative and significant. Increased market access costs act as an economic disincentive via reduced farm profitability and thus inhibits soil conservation investment. As a rational response, farmers faced with high plot to market costs commit less attention to agriculture. Improvements of market access and transport cost reduction investment enhance the adoption of land management practices in rural areas (Binswanger & McIntire, 1987; Pender, Jagger, Nkonya, & Sseunkuuma, 2004).

The estimated coefficient of '*Prior adoption*' is negative and significant. This result is consistent with the hypothesis that farmers learn from others or that neighbouring farmers share some other unobserved determinants of adoption such as placement of SWC structures, economies of scale in input supply or output marketing. Similar results are reported for Tanzania in the case of crossbred-cow technology (Abdulai & Huffman, 2005).

6 Conclusion

Machakos is still a rather unique success story in agricultural intensification. In spite of population pressure and land degradation, farmers undertook investment in soil conservation. Other factors such as market access factors, external influence and enabling government policies also play a role in explaining the transformation in Machakos. Our analysis shows that we can identify most of the factors explaining high SWC investment, and there are some variables that should be amenable to policy intervention. Our study shows that social capital is very important both at the individual and village levels. The natural response to the finding that social capital is important is to ask, 'How do we build social capital in regions where it is lacking?' Unfortunately, nobody has a handbook on how to go about it. This paper has argued that social capital can be added to a list of strong determinants, along with other economic variables. The role of social capital is to create avenues to finding solutions to collective dilemmas, improve access to technology and increase the benefits of investment.

Other results show that adoption of SWC varied with farm and behavioural characteristics. Tenure security is important as found in most studies. With better security of tenure, there is incentive to build terraces because farmers are able to recoup benefits that flow over a long period of time. In the case of insecure tenure, farmers face lower returns from soil conservation because of the likelihood of eviction before realization of full benefits. While increasing household education is important in Kenya, it does not necessarily solve problems of soil erosion. Like all potential investments, the expected benefits of all activities need to be compared. Education reduces small farmers' soil conservation efforts by increasing household opportunities to earn off-farm income. Those with higher education allocate their resources to better earning opportunities. However, such tradeoffs should not imply that education investment should not be pursued. Inclusion of elements of sustainable agriculture in the education curricula could help change attitudes towards sustainable land management (Gardner & Stern, 2002). We found little evidence of an impact of access to administrative centres, but rather that access to markets is extremely critical for the adoption of SWC.

The implications for policy making are as follows: Many policies and programmes for rural development are supported by governments and development partners in natural resource management, agriculture, marketing etc., cooperating at the local level. In order to avoid the failures of past projects, it is important to subject these policies to rigorous tests of social arrangements. Planners for SWC should therefore identify local social structures and economic factors to guide their potential investments. Furthermore, government interventions promoting farm technology should deliberately target younger farmers.

Recent work has presented evidence that household economic performance and collective action are increasing with social capital (Narayan & Pritchett, 1999; Krishna & Uphoff, 1999; Krishna, 2001; Carter & Maluccio, 2003). Linking this discussion to our findings indicates that social relations are very important attributes that farmers can employ to alter constraints. We found that several dimensions of social capital were very important both at the level of the individual farmer and at the community level. Also, we incorporate social factors and important economic policy variables into the analysis. We demonstrate that relative improvements can be made in soil conservation even among poor people. Of particular importance are good infrastructure which reduces transportation costs and facilitates market access, tenure security and several dimensions of social capital that appear to correlate with the ability to work together in associations, to trust each other and to spread information.

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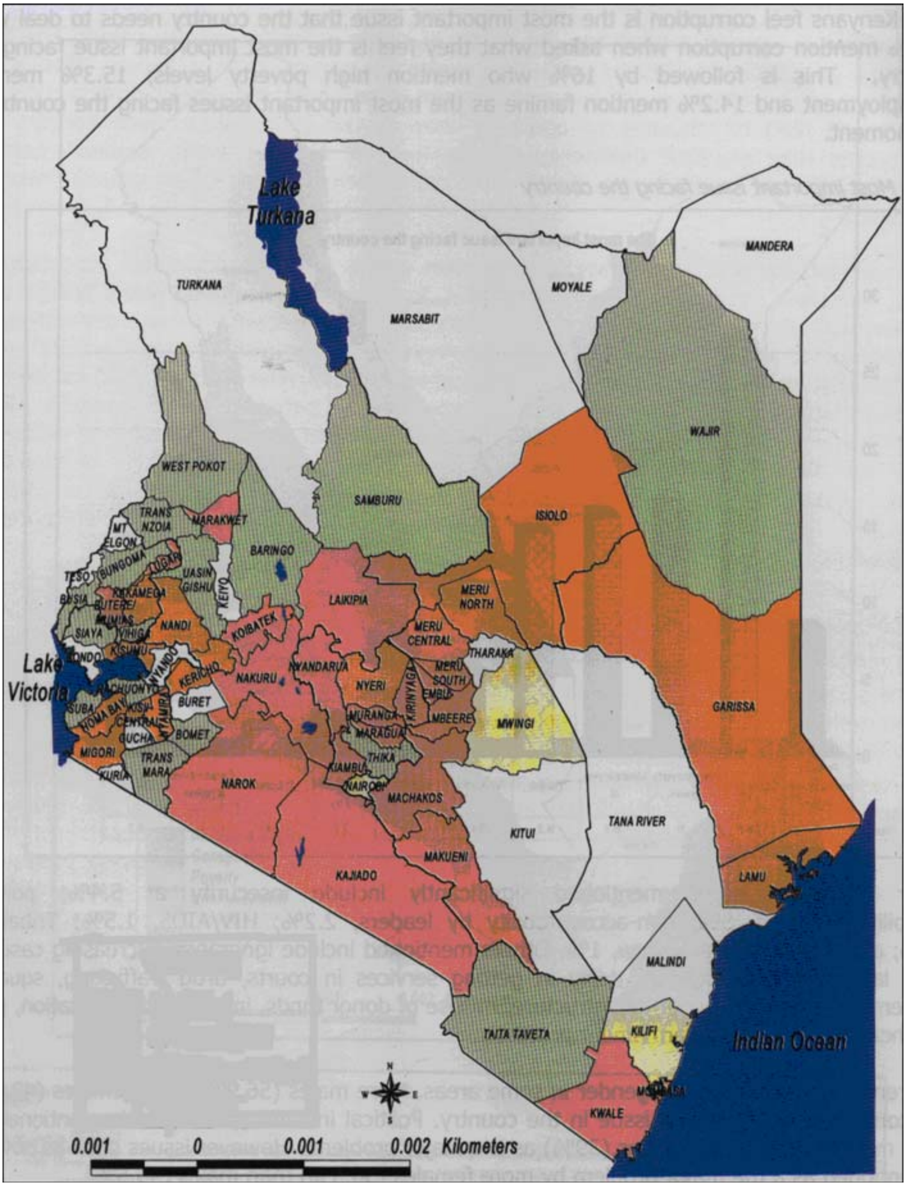
Appendix I



Appendix II Survey questions used to extract social capital information.

Social Capital

Associations

In this section, I would like to ask you about the groups or organizations, networks or associations to which you or any members of your household belong. These could be formally organized groups or just informal groups of people who meet regularly to talk or do an activity.

C1Do you or any member of the household belong to any organisation or association? 1.YES………….. 2.NO……………..[Read out the possible types from the list] (Farmers group, Traders and Business Association, Church, Soccer Club, Agricultural club, Credit/Finance group, Merry-Go-Round, Village committee, Burial committee, Political group, Cultural group, Water group, NGO, Civic group, and so on).

C2.Of all the groups to which members of your household belong to, which are the three (3) most important to you and/or your household?

a) b) c)

C3.How many times in an average month did anyone in the household participate in each of these groups' activities, e.g. by attending meetings and group work?

C4. How much money, time or goods did your household contribute to the group last year?

4a **Money** (amount Kshs) 4b **Time** (hours) 4c **Goods** (value Kshs)

Group1: a) b) c)

Group2: a) b) c)

Group3: a) b) c)

C5. What are the two main benefits from joining the groups?

For example improved household access to livelihood and access to services, important in times of emergency, beneficial to the community, enjoyment/leisure, social status/self esteem, others (please specify).

Group1: a) b)

Group2: a) b)

Group3: a) b)

C6. Does the group help your household with any of the following services? 1 YES 2 NO

	Group1	Amount	Group2	Amount	Group3	Amount
Agricultural inputs (seed, pesticide, technical advice etc)						
Artificial insemination services						
Credit/ savings services						
Soil conservation advice/ information						
Information on crop prices/market opportunities						

Personal Friends and contacts

T1. About how many close friends do you have these days? (These are people you feel at ease with, can talk to about private matters, or call for help)…………

T2. If you suddenly needed a small amount of money [Enough to pay for expenses for your household for one week], how many people beyond your immediate family could you turn to?

a) No one b) One to two c) Three to four d) Five or more people (Please tick one).

T3. Suppose you suffered a serious economic setback, such as crop loss. How many people could you turn to for help in this situation beyond your immediate family?

a) No one b) One to two c) Three to four d) Five or more people (Please tick one).

T4.In the past one-year, how many people with a personal problem have turned to you for assistance? ……………

T5.If so, please state the value/ amount ……………Kshs.

Neighbourhood Relations

N1. Have you during the past year assisted anyone with significant amount of tools? (Jembe, Fork, Hoes, Wheelbarrows, Spades etc) 1. YES… 2. NO…

N2. Have you or household received such help? 1. YES ……… 2. NO………..

N3/4.If a community project does not directly benefit you, but has benefits for many others in the neighbourhood, would you contribute time or money to it?

TIME	MONEY
a) Will not contribute time [1]	a) Will not contribute money [1]
b) Will contribute time [2]	b) Will contribute money [2]

N5. In the past year, have you worked with others in the community /village to do something for the benefit of the community? 1. YES 2. NO

If Yes, please state the activity…………………….

<u>Sources of Market Information</u>

I1-3.What are the <u>three</u> most important sources of market information (jobs, price of good or crops etc)?

a) Community centres, b) relatives, friends, neighbours, c) Radio, d) Television e) Community leaders, f) NGOs g) Business associates, h) Groups/Associations, i) Government agents, j) Internet, k) National newspapers l) Others.

I4-6.What are the most important sources of information about what the government services (such as agricultural extension, tree planting week, family planning etc)?

a) Community centres, b) relatives, friends, neighbours, c) Radio, d) Television e) Community leaders, f) NGOs g) Business associates, h) Groups/Associations, i) Government agents, j) Internet, k) National newspapers l) Others.

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