The influence of social capital on natural resource management in marginal areas of Kenya

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Abstract

This paper analyzes the influence of social capital on the farmers' perception of the soil erosion problem and the level of investments in soil conservation in marginal areas of Kenya. It uses data from a survey of 321 households in Machakos and Taita-Taveta Districts. A Heckman's two-step model is applied to assess the influence of social capital on investments in soil conservation by farmers. Results show that the education level of the household head, slope of farmers' fields, proportion of off-farm income, and the status of soil erosion are significant determinants of the likelihood of farmers recognizing soil erosion as an important problem. Household size, slope, land tenure security, membership diversity, age of household head, farm size per capita and membership in groups influence investments in soil control measures such as terraces. The effects, however, are location-specific. The policy challenge is to establish and strengthen social capital elements that have a strong influence on communities undertaking soil conservation measures to promote sustainable agriculture, and improve land tenure security.

Key words: Social capital; Resource management, Soil erosion, Perceptions; Two-step estimation; marginal areas, policy, Kenya.

JEL: C24, D23, Q15, Z13

Introduction

Land degradation and declining agricultural productivity are common features in many developing countries, especially in Sub-Saharan Africa (SSA). These phenomena have been attributed to the inappropriate traditional land tenure systems of managing agricultural land. Among the indicators of land degradation is soil erosion[1]. Farmers singularly depend on land

[1] Other forms of soil degradation are damages to physical and chemical properties of soil, reduction in moisture capacity, and soil mining.

for their livelihoods. It is uncommon for them not to be aware of serious soil degradation unless they are either recent immigrants to a new agro-ecological zone or the process of degradation has not yet significantly affected yields (Scherr, 1999).

In Kenya, most rural resource poor households are concentrated on low potential lands where inadequate or unreliable rainfall, adverse soil conditions and topography limit agricultural production and increase the risk of land degradation. Attempts of such households to improve their livelihoods often lead to over-exploitation of land and water resources. Consequently, resource management by poor households is crucial in addressing poverty and other development challenges in Kenya.

Land degradation in Kenya manifests itself in depletion of natural capital such as forests and soil resources. This situation is worse in the marginal lands, which constitute about 80 percent of the total agricultural land, largely due to increasing human and animal population. People in these regions are faced with frequent food shortages. Soil erosion and soil mining are prominent characteristics of land use in these ecologically fragile areas. While efforts have been made to motivate land users to efficiently use the land resource, soil conservation has been given limited attention in agricultural policy.

While several studies have looked at factors influencing soil conservation investments (e.g. Tiffen et al., 1994; Shiferaw and Holden, 1998), limited attention has been given to the role of social capital. Yet social interactions (i.e. social capital) matter as they create social networks, foster trust and values, sustain norms and culture, and influence economic and social outcomes (Quibria, 2003).

Social capital has been variously defined. For example, as an aggregate of actual and potential resources linked to membership in a group (Bourdiew, 1986) or as a stock of trust and emotional attachment to a group (Coleman, 1988). It has also been referred to as tacit knowledge, a collection of networks, an aggregation of reputations, and organizational capital (Stiglitz, 1999) or as features of social organization such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit (Putman, 1995), which this study embraces. It is argued that if soil erosion presents a potential threat to livelihoods, the society will get concerned and mobilize resources to mitigate potential negative consequences.

There has been a great debate about the role of social capital in economic growth (Collier and Gunning, 1999); in missing capital and insurance markets (van Bastelaer, 2000); in collective action and provision of local public goods (Otsuka and Tachibana, 2001) or about its measurement (Quibria, 2003). Notwithstanding, there are merits of considering social capital (Cramb, 1993).

Agricultural production is often influenced by the level of conventional inputs such as physical capital and labour. However, social capital can complement the process. There is glaring paucity of information regarding the contribution of social capital in soil conservation in a marginally agricultural setting in Kenya. For example, Frank et al., (2002) analyzed the effect of group structural variables on performance in an activity like tree nurseries in high potential zones and less favourable zones, while de Haan et al., (1996) examined the performance of dairy groups in high potential zones in Kenya. In the Philippines, Cramb (2004) examines the effect of social capital on terracing. This paper aims to fill this gap in empirical literature.

Methodology

Study sites

The study was conducted in a transition zone between semi-arid and semi-humid areas of Kenya, depending on altitude. In these areas, the crop season is short and averages between 115 and 145 growing days and experience between 15 and 24^0C mean diurnal temperatures. Maize intercrop with beans or pigeon peas predominate in these largely mixed crop-livestock agricultural systems (Mwakubo et al., 2004). Rainfall is erratic with frequent flush floods that expose soils to rapid erosion. Households in these areas frequently experience crop failures and food shortages.

Survey data was gathered from 321 rural households in agriculturally marginal lower midlands of Machakos District and in relatively productive coastal lowlands of Taita-Taveta District in 2003. Four administrative units were chosen in each study area on the basis of contrasting terracing density and physical infrastructural endowments such as road network. Two administrative units with higher terracing density but one with higher and the other lower physical infrastructural endowments were selected in each district. Likewise, two administrative units with lower terracing density but one with higher and the other lower physical infrastructural endowments were also selected. A village was then selected randomly from each of the administrative units. The survey instrument was administered to 40 randomly selected households in each village, which is about 15% of the village sample and therefore representative.

The model

Conceptually, investments in soil erosion conservation depends on the farmer's perception of the severity of the soil erosion problem. Depending on the perception, farmers opt to mitigate the consequences of the erosion problem or ignore. The outcome of the farmers' decision will be observed in soil conservation measures such as terraces. The perception model permits selection of households that have invested in terracing. Acknowledgement of a soil erosion problem precedes an investment decision. The outcome (i.e. observed terraces) is as a result of a two-step process. Following Greene (2000) the model consists of two equations. The first equation is the "selection equation," captured by the perception of soil erosion function, which is expressed as:

$$z_i^* = w_i'\gamma + u_i, \quad i = 1,\ldots\ldots, N \tag{1}$$

where z_i^* is a latent variable, γ is a Kx1 vector of parameters, w_i' is a 1xK row vector of observations on K exogenous variables and u_i is a random disturbance. The latent variable is unobservable, but the dichotomous variable is observable.

$$z_i = \begin{cases} 1 & z_i^* > 0 \\ 0 & otherwise \end{cases} \tag{2}$$

The second equation is a linear model that captures the soil erosion control efforts, which is indicated by the terracing intensity . It is given as:

$$y_i = x_i'\beta + e_i, \quad i = 1,\ldots\ldots, n, \qquad N > n \tag{3}$$

where y_i is an observable random variable, β is an Mx1 vector of parameters, x_i' is a 1xM vector of exogenous variables and e_i is a random disturbance.

To avoid a "selectivity problem" which arises when y_i is observed when $z_i = 1$, and if $\rho \neq 0$; a two-step estimation procedure is employed (Heckman, 1979). The basis for this estimation procedure is the conditional regression function expressed as:

$$E(y_i \mid z_i > 0) = E(y_i \mid u_i > -w_i'\gamma) = x_i'\beta + E(e_i \mid u_i > -w_i'\gamma) = x_i'\beta + (\rho\sigma_e)\lambda_i \tag{4}$$

where λ_i is the "inverse Mill's ratio," $\phi(x)$ is the standard normal probability density evaluated at the argument, and $\Phi(x)$ is the cumulative distribution function for the standard normal variable evaluated at the argument. The Mill's ration (λ_i) depends only on unknown parameters of (1) which can be estimated by a Probit procedure.

Consequently, the perception of soil erosion problem selection Probit and primary terracing intensity least square regression models are specified as:

$$\begin{aligned} perception = f(&age, education, slope, tenure, membershipdiversity, groups, participation, sex, \\ &extension, erosion, fractionofoffar\min come) \end{aligned} \quad (5)$$

and

$$\begin{aligned} terrace = f(&age, education, familysize, farmsizepercapita, transport\cos ts, slope, tenure, income, \\ &fractionofoffar\min come, membershipdiversity, groups, participation, sex, extension) \end{aligned} \quad (6)$$

The elements of social capital in the study include: groups, membership diversity, and household participation in decision making within a group. The *groups* variable is the number of groups to which members of a household belong to. Membership diversity was measured by rating according to five criteria: religion, gender, age, political affiliation, and education. A diversity index was calculated for each organization, ranging from one to two (1=same, 2=different) and then summed up per household. With participation, two questions were asked to respondents to (i) evaluate the relative roles of their leaders and members in decision-making and, (ii) evaluate the effectiveness of their leaders. The responses were combined in a "democratic functioning score" to determine the participation score in decision-making. These scores were evaluated for each household. Details are discussed in Mwakubo et al., (2004).

Survey Results

Household characteristics

The descriptive statistics for selected variables are presented in Table 1. The average age of the household head is higher in areas that are distant from major markets (e.g. Taita-Taveta district) compared with more urbanized areas (e.g. Machakos district), reflecting differences in the extent of rural-urban migration. The same applies to the mean values of perception of the soil erosion problem and the gender of the household head. Individual perception of the soil erosion problem, and the subsequent negative effects, would spur action that would mitigate the effects that would arise from non-intervention. Soil erosion or generally soil degradation is a process that takes a long time for the consequences to be appreciated and only then if those affected are able to directly associate them to that process.

The mean terrace length per hectare in areas that are close to major urban centres is higher and those that are distant. This shows that even in marginal areas, there are significant differences in soil conservation investments. This may be due to soil conservation campaigns and higher values that are placed on land in order to supply farm produce to nearby high-income urban dwellers. The mean values of farm slope index, education level of household head and the land tenure system also vary although the values are not significantly different.

Perception of soil erosion and determinants of terracing intensity

The sigma values from the Heckman's two-step process are greater than zero, which shows that the two equations are independent (Table 2). The Wald χ^2 statistics are significant indicating the rejection of the null hypotheses, which posit that the estimated coefficients are equal to zero. The Mills' lambda is significant with respect to one of the study sites, which means that selection is important.

The age of household head coefficient is positive for distant marginal areas (Taita-Taveta). Older household heads are more likely to acknowledge soil erosion as an important problem and will seek to construct terraces to reduce soil erosion than younger farmers. Areas that are close to urban areas have more opportunities for off-farm activities, especially for young people. Consequently, the mean age of households is lower compared to relatively more distant areas. The location variable is negative and significant implying that soil conservation investments in marginal areas are location-specific. This has to do with learning and coping mechanisms that differ in these areas.

Per capita farm size has negative and significant effect on terracing intensity in areas with lower population density. Higher average land size implies less pressure on land for various uses by households and subsequently there is less motivation for intensified terracing of farms. Nonetheless, the effects of erosion will be more be discernible on larger than smaller fields. The slope of the farm is positive and significant on terracing intensity in areas that are closer to urban markets. The pooled results are also similar. There is generally easier flow of information including that about soil conservation measures through the agricultural extension services besides the need to raise agricultural production to supply the high-value urban markets.

Security of land tenure has a positive and significant effect on the likelihood of observing intensified terracing for soil conservation in marginal areas. This suggests that farm households with insecure land tenure rights are less likely to make any significant investments in soil conservation measures. This finding is consistent with other empirical evidence from elsewhere (e.g. Shiferaw and Holden, 1998). The education variable does not significantly influence terracing intensity. This is a surprising result since education is expected to have a significant bearing on resource management on the farm including terracing. Possibly, the more educated people are, the more likely they will secure off-farm jobs and their managerial inputs on farm level activities may be significantly less.

Density of membership in groups and membership diversity significantly shape terracing intensity in marginal areas. Where density of memberships is higher, terracing intensity is also higher. Groups positively affect soil conservation investments through labour exchange and the inherent social or peer pressure besides the non-costly acquisition of information. However, membership diversity negatively influences terracing intensity. This is an interesting result since it implies that a heterogeneous group presents greater opportunities for soil conservation information sharing would be wrong. Possibly, this is likely to create conflicts. As Balland and Platteau (1996) argue, collective action is usually more successful with homogenous groups. Participation in decision-making however, does not influence terrace investments.

Policy implications

The study has established that social capital have a significant role to play in soil conservation in marginal areas. It is also of various forms and don't act in the same direction. The attributes of social capital are membership into groups, membership diversity and participation. Generally these components of social capital do not influence the likelihood of acknowledging awareness of the soil erosion problem. This finding is surprising since extensive interaction in social groups would be expected to influence perception of soil erosion as an important problem especially in food insecure environments, such as in marginal areas of Kenya. It seems to suggest therefore that policy makers need not worry about the participation in decision-making by members of groups. Membership diversity influences terrace intensity but negatively implying that efforts should be geared towards its reduction. The more of the number of groups that household members belong to, the higher the likelihood of a household intensifying investments in terraces in an effort to control the soil erosion problem. Other variables that are important are land tenure security, farm size per capita and age of household head.

The policy challenge therefore is to devise innovative and cost-effective measures to encourage household membership into groups. Since collective action is more successful with smaller groups, it is worthy to increase the number of groups. Improving land tenure security would also significantly contribute to increased terracing, and thus contribute to higher farm production, increased incomes and sustainable agriculture in marginal areas.

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Table 1: Descriptive statistics of selected variables

Variable/ measurement	Machakos			Taita-Taveta			*t*-value[a]
	N	Mean	Std. Deviation	N	Mean	Std. Deviation	
Age (yrs)	146	47.82	14.85	144	51.49	15.02	-2.097**
education (yrs)	151	6.82	3.91	105	7.24	3.84	-0.85
terraces (metres)	152	951.07	1293.83	144	613.66	2098.68	1.675*
family size (persons)	152	6.03	2.61	144	6.47	2.75	-0.408
Farm size percapita (ha/person)	149	0.35	0.58	144	0.46	0.65	-0.421
Transport costs (ksh)	152	107.17	19.13	144	90.42	36.58	4.974***
Slope (increasing scale)	149	2.33	0.87	140	2.19	0.85	1.307
tenure(increasing scale)	148	5.90	1.24	144	5.85	0.99	0.368
income (Ksh)	152	63162.63	181637.56	140	43537.48	88332.86	1.158
Income per capita (Ksh/person)	152	1153.65	27930.00	140	8447.67	22297.19	0.91
Farm size (ha)	149	1.98	3.47	144	2.54	3.31	-1.425
fraction of off-farm income	152	0.33	0.36	140	0.28	0.36	1.155**
perception (0,1)	152	0.59	0.49	144	0.74	0.44	-2.757***
membership diversity (index)	125	14.48	7.24	67	14.03	8.33	0.389
groups (index)	152	1.24	0.91	144	0.72	0.98	4.744***
participation (index)	125	7.53	4.56	67	7.07	3.96	0.686
Erosion (0,1)	151	0.89	0.32	143	0.79	0.41	2.286**
Sex (0,1)	152	0.93	0.26	144	0.80	0.40	3.293***
Extension (0,1)	149	0.21	0.41	143	0.34	0.48	-2.599***

Note: Std. means standard; N is the number of respondents

[a] Mean difference test with equal variances assumed

* $P< 0.10$, ** $P<0.05$ and *** $P<0.01$.

Table 2: Heckman's two-step regression results

Variable	Machakos (N=113)		Taita-Taveta (N=45)		Pooled (N=158)	
	Coefficient	Std. Err.	Coefficient	Std. Err.	Coefficient	Std. Err
Step one: Perception equation: a Probit specification						
age	-0.004	0.003	-0.007*	0.004	0.0016	0.0046
education	-0.046***	0.013	-0.009	0.014	-0.0233	0.0166
slope	0.090*	0.051	-0.033	0.060	0.1234*	0.0712
tenure	-0.098**	0.040	0.064	0.062	-0.0642	0.0557
Fraction of offarm income	-0.517***	0.113	0.081	0.123	-0.5350***	0.1643
Membership						
diversity	0.018	0.040	-0.037	0.034	-0.0634	0.0508
groups	-0.396	0.411	0.363	0.344	0.4667	0.4938
participation	0.031	0.030	0.021	0.022	0.0120	0.0294
erosion	0.524***	0.141	0.806***	0.110	0.6745***	0.1689
sex	0.007	0.184	0.091	0.111	-0.2327	0.1918
extension	-0.228**	0.107	-0.165	0.112	-0.1825	0.1364
constant	1.354***	0.391	0.165	0.431	0.6116	0.5040
Step two: terraces selection equation						
district					-1.3113***	0.3891
age	-0.021	0.030	0.115*	0.069	0.0259*	0.0138
education	-0.112	0.110	-0.228	0.221	0.0402	0.0468
family size	0.691**	0.285	-0.859*	0.456	0.0839	0.0712
farm size percapita	1.250	1.189	-4.988*	2.683	-0.1901	0.2089
transport costs	-0.019	0.018	-0.026	0.017	-0.0032	0.0056
slope	1.111**	0.520	1.194	0.738	0.3756*	0.2024
tenure	0.765**	0.331	-1.599*	0.894	0.1741	0.1355
income	0.000	0.000	0.000	0.000	0.0000	0.0000
faror	-0.492	0.896	-4.166	2.593	-0.4911	0.3951
membership						
diversity	-1.106**	0.544	-0.763	0.704	-0.3403**	0.1336
groups	11.055**	5.458	5.635	6.248	3.2036**	1.2876
participation	-0.206	0.212	0.288	0.444	-0.0351	0.0879
erosion	1.160	0.820	-1.703	2.186	0.2736	0.3940
sex	-4.483	3.369	-1.806	1.933	-1.2738**	0.6308
extension	-1.217	0.749	0.741	0.995	-0.1516	0.3342
Constant	0.107		17.755	11.972	0.8873	1.5373
Mills lambda	-0.370**	0.186	-0.168	0.166	0.6314	0.3064
rho	-0.948		-0.756		1.0000	
sigma	0.390		0.223		0.6314	
lambda	-0.370	0.186	-0.168	0.166	0.6314	0.3064
Wald $\chi^2(22)$	79.91		89.36		49.17	

Note: Std. Err. denotes standard error

*P< 0.10, ** P <0.05 and ***P<0.01.