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Is Poverty Driving Borana Herders in Southern Ethiopia to Crop Cultivation?

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Abstract This study addresses whether or not crop cultivation by Borana herders in southern Ethiopia is motivated by poverty since 80% of the households belong to poor wealth classes (i.e., poor, very poor and destitute). Yet our findings showed little evidence that Borana communities have become self-sufficient in grain production. Compared to wealthy households, poor households generally cultivated the least land and sampled households, producing yields only 31% of the Ethiopian national average. Grain per capita met only 26% of the annual requirement per person, equivalent to three to four months of self-sufficiency per household. The livelihood response model (LRM) developed for testing the relationship between extent of croplands and household wealth showed that poverty alone cannot be motivating herders to cultivate crops. Factors such as shortage of labor, lack of sufficient traction animals, and unreliable rainfall also need to be considered. Crop cultivation has not enabled self-sufficiency, but it has resulted in fragmented grazing lands. Future policies address changes in land use, including improving soil fertility through manure-nutrient transfers, by promoting better integration of crop cultivation and pastoralism. Research is needed to (a) understand household time allocation between crop cultivation and livestock management, (b) improve the LRM by considering temporal variability in the wealth of households and extent of cultivated lands, and (c) understand the role of poverty in motivating the adoption of alternative livelihood coping strategies.

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Introduction

Pastoral communities throughout East Africa are turning to crop cultivation in addition to livestock management (Campbell 1999; Little *et al*. 2001; Berhanu and Colman 2007; Lesorogol 2008; McCabe *et al*. 2010). Although the participation of pastoral households in crop cultivation is generally accepted as livelihood diversification in response to economic stress, few studies have ever attempted to test if poverty is the sole driver for such diversification. In this study, we were particularly interested in understanding the relationship between the extent of cultivated land and the wealth of households (a proxy of poverty) as an indicator of motivation for participation in crop cultivation. We considered the motivations involved from the perspectives of vulnerability to poverty, livelihood assets and adaptations needed to mitigate the risks that threaten livelihood coping strategies (Berhanu *et al.* 2007). Contextualization is instrumental in developing an understanding of how households of heterogeneous wealth respond to building sustainable livelihoods that include crop cultivation (Little *et al.* 2001). We suspect that households of different wealth categories might be motivated by varied criteria to participate in crop cultivation as opposed to relying entirely on livestock for their livelihood; however the mechanisms involved may be complex and may reflect diverse options and outcomes.

In this study, we address the adoption of crop cultivation as part of the comprehensive internal societal response to livelihood diversification and externally induced methods

of promoting food self-sufficiency through three questions. First, is crop cultivation motivated by poverty? Second, could crop cultivation be a strategy to improve self-sufficiency in food supplies? Finally, is crop cultivation, in addition to these two factors, promoted by government policy? Our assumption is that livelihood diversification varies in correlation with the changing economic fortunes of each household (Ellis 2000; Fratkin and Means 2003; Davies and Bennett 2007). Declining assets can trigger livelihood diversification, and families that fail to adopt new measures, perhaps due to cumulative economic shocks, must then rely on external interventions such as social networks and food aid (Devereaux 2006). This could mean that poverty is an important driver of livelihood change.

We also considered the alternative that internal drivers may promote participation in alternative livelihood coping strategies, and would, in addition to crop cultivation, constitute part of the comprehensive social response to poverty. Such alternative coping strategies could include livestock and petty trade, seeking informal jobs in peri-urban and urban environments, and educating children (Doti 2005; May and Ole Ilkayo 2007). External drivers, such as government land use policy, may also motivate households to increase participation in crop cultivation (Campbell 1999; Homewood *et al*. 2006). Participation in crop cultivation must, however, be weighed against the risks of failure due to rainfall variability (Okuniwa *et al*. 1996; Berhanu and Colman 2007; Lesorogol 2008), and lack of labor and traction animals. Climate variability and risks of crop failures tend to negatively affect the expansion of crop cultivation (Andriansen 2006).

In pastoral areas, crop cultivation fragments grazing lands and creates conflicts by impinging on key grazing landscapes (Powell *et al*. 2004; Thornton *et al*. 2007) and competing with herd management for time and labor (Boone *et al*. 2005). Although these conflicts are well documented in the literature, there have been fewer attempts to gauge how these choices are made at the household level (Mace and Houston 1989). Various choice models have been applied in order to understand the external and internal drivers that motivate households to participate in livelihood diversification (DFID 2001). The mathematical and spatial model of Mace and Houston (1989) is well known. Other robust models, such as those of Mace (1993) and Thornton *et al.* (2007), have been applied to pastoral and agro-pastoral systems respectively. Some researchers have used more descriptive spatial models (see Little *et al*. 2006). None of these models have used simple scenarios to test whether or not poverty is the main driver of crop cultivation by pastoral households, using proxy variables such as wealth and cropland sizes.

In this study, we investigated if poverty is driving Borana households in southern Ethiopia to engage in crop cultivation. The Borana pastoralists are known to have had one of the most sustainable pastoral production systems in East Africa prior to the 1980s (Cossins 1988). Droughts that resulted in the decline of livestock holdings, combined with external drivers such as government policy that induced changes in land use, are believed to have increased the risk of livelihood losses (Desta and Coppock 2004; Kamara *et al.* 2004; Angassa and Oba 2007). Such external drivers may have contributed to changes such as the adoption of crop cultivation in addition to traditional livestock management. Despite previously being a source of surplus livestock for internal and external markets (Desta 1999), the Borana are gradually shifting towards subsistence agriculture (Coppock 1994; Kamara 2001; Angassa and Oba 2008). This is not dissimilar to other areas in East Africa where pastoralists are engaged in crop cultivation (Campbell 1999; Little *et al.* 2001; McCabe *et al.* 2010). However, we lack information as to the extent to which poverty drives crop cultivation. We considered the following research questions in order to understand if poverty-related factors influence involvement in crop cultivation: (1) Is poverty the driving motivation of herders to expand crop cultivation? (2) What are the relationships between cropland sizes and yields of the main crops? Do the grains produced meet requirements for self-sufficiency? How does the allocation of grains by households vary? (3) What are the relationships between sizes of croplands and livestock holdings as proxies of poverty? (4) Does poverty serve as the main motivating factor for households engaged in alternative livelihood coping strategies?

Livelihood Response Model Framework

We developed and tested a scenario-based livelihood response model (LRM) that describes the relationship between sizes of land under crop cultivation and livestock holdings, in order to understand household motivation for participating in crop cultivation. The model was tested using four economically heterogeneous communities of Borana in southern Ethiopia. To test the assumption that participation in crop cultivation is motivated by poverty, the LRM was applied to four scenarios (Fig. 1). In Scenario I, it is assumed that increased participation in crop cultivation is a result of two economic conditions: Firstly, poor households engage in crop cultivation as a result of a decline in herds. Secondly, crop cultivation is a form of economic diversification, with households engaging in farming with the intention of supplementing food supplies. Given the risks to crops and livestock due to droughts, and the subsequent decline in livelihood, households engage in farming as a means of mitigating food deficits, as well as safeguarding their livestock from depletion through forced sales (Fig. 1, Line *a*). In Scenario II, changes in farm sizes

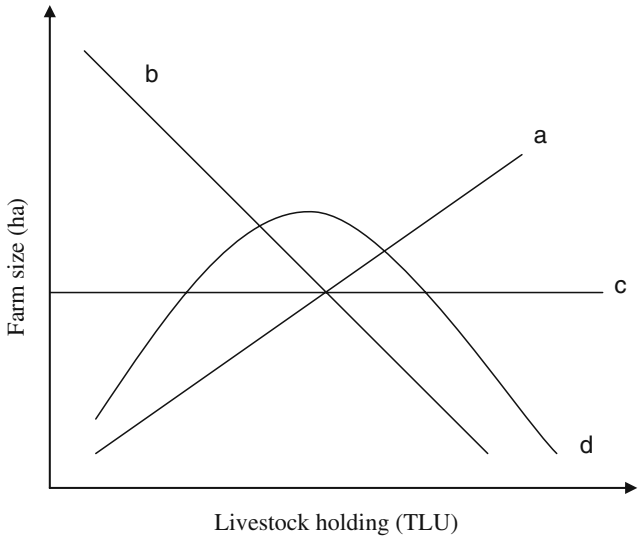

Fig. 1 The livelihood response model (LRM) showing scenarios of household responses to crop cultivation. Scenario I (Line *a*): The adoption of crop cultivation to supplement livestock production; Scenario II (Line *b*): The adoption of crop cultivation motivated by poverty, showing an inverse relationship; Scenario III (Line *c*): Crop cultivation motivated by other factors, independent of livestock holding; and Scenario IV (Line *d*): The direct link between livestock holding and crop cultivation up to a certain optimal level

are poverty driven (as opposed to other factors such as population growth), suggesting an inverse relationship between sizes of livestock holding and sizes of cultivated land. This relationship might suggest that the poorer households engage exclusively in farming, perhaps providing evidence of risk to a decline in livelihood. The wealthy herders, for their part, have little motivation to invest their time in crop cultivation (Fig. 1, Line *b*).

In Scenario III, farm sizes might be independent of livestock holdings, suggesting that neither poverty trends, nor changes in herd sizes, motivate the households to expand land under crop cultivation. This scenario assumes that the motivation for crop cultivation is due to factors outside the pastoral system (Fig. 1, Line *c*). Scenario IV suggests that a direct correlation may exist between farm sizes and livestock holdings, at least when the herds become insufficient to support the food requirements of the household. Once the herds have been restored to optimal levels, the households reduce their participation in crop cultivation and return to pastoralism (Fig. 1, Line *d*). Such a scenario might occur under drought-induced conditions. Livestock losses during drought episodes increase the loss of wealth and the risk to livelihood, which results in households investing their time in crop cultivation during the recovery phase. After livestock recovery is achieved, and the produce of the herds once again meets the household subsistence needs, crop expansion for the purposes of food security becomes unnecessary. It would then be more cost effective for households to rely on local markets for their grain supplies. In scenario IV, therefore, household motivation is regulated more by internal economic factors than by externally driven policies in support of crop cultivation. However, the four scenarios may not capture all factors that influence household decisions in terms of livelihood diversification. Additional explanations may be sought from alternative livelihood coping strategies.

Methods

The Survey

The Borana are culturally cattle pastoralists. Their livelihood and sources of wealth are traditionally measured by the number of cattle available, as opposed to other forms of accepted economic measurement. Aside from pockets of semi-humid zones, the remaining semi-arid grazing lands were, until three decades ago, reserved for pastoral use. The region has highly fluctuating rainfall, with an annual average of below 600 mm (Angassa and Oba 2007). The pastoral management system has adapted to the rhythm of changing seasonality and increased variability[1] in forage production (Cossins and Upton 1988). Drought is a recurrent phenomenon.

We interviewed a total of 330 households from Dida Hara, Harweyyu (in the Yaballo District), and Dubuluq and Harallo (in the Dirre District) between June 2005 and September 2006. We used semi-structured questionnaires, key informant interviews and our long-term familiarity of the region and the communities to develop rapid but reliable methods for generating data. Both authors have previously conducted research in this region and have used these experiences to gauge changes in societal motivations in response to poverty. The communities in Dida Hara were comparatively wealthier in terms of livestock holdings and had the most diversified livelihood activities, including pastoralism, itinerant livestock trade and crop production. The communities in Harweyyu engaged predominantly in pastoral production, with evidence of recent adaptations of crop cultivation while maintaining livestock mobility. The community of Dubuluq comprised an impoverished peri-urban population that had lost the greater part of their livestock economy during the droughts of 1999 and 2000. The Harallo community is an old population of destitute people who were resettled to do farming after suffering economic dislocation during the Ethiopia and Somalia

[1] Rainfall is highly seasonal, divided between the long rains (*ganna*) from March to May, the interim cool period (*adoolessa*), the short rains (*hagayya*) from September to October, and followed by the very hot and dry season (*bona hagayyaa*) from November to March. The *hagayya* rains are always unreliable, creating periods of extended dryness, even during non-drought years.

Ogaden war of 1977-1978. However, among the sampled households in Harallo, there were some that still relied on livestock production. All the households had experienced major livestock loses during the droughts of 1992, 1995 and 2000, in each case shifting the household wealth composition towards predominance by the poor categories.

The households were requested to reconstruct household livestock wealth for the periods between 1984 and 2006 using the *gada* timeline (Legesse 1973; Angassa and Oba 2008).[2] The traditional livestock indicators of wealth[3] (camels, cattle and small stock) were converted into Tropical Livestock Units (TLU) (1 camel=1 TLU, cattle=0.7 TLU, and small stock=0.1 TLU). Previous researchers collecting recall data have used age sets and other methods similar to the *gada* timeline. These methods have been found to reconstruct events related to pastoral production and adoptions of farming with fair accuracy (McCabe *et al.* 2010). For each household interviewed, we enquired about access to croplands, sizes of cultivated plots and annual grain yields for the growing season of 2005, which was the last rainy season before the survey. The main crops were maize, beans and wheat. The households also described the use of grain harvests in terms of proportions allocated for consumption, sales in local markets, social reciprocity networks, seed for planting, grain storage for food security, and grain loans. The relationship between farm sizes and yields, and farm sizes and livestock wealth, were used to understand the motivation for crop cultivation. We asked the households about alternative livelihood coping strategies, data which might prove useful for inferring responses to poverty.

Data Analysis

We analyzed changes in wealth ranks across the communities using the Chi-square test (χ^2). The sizes of cultivated plots by households in relation to wealth ranks and crop yields were determined for each community, and linear regression was used to understand the relationships between farm sizes and grain yields. Grain yields per capita were calculated and the data were analyzed using the General Linear Model (GLM) in SAS (SAS 2003). The number of months of self-sufficiency per household and grain allocations (e.g., for household consumption, sales in local markets, social reciprocity networks etc.) were also determined. The relationship between farm sizes and livestock wealth was used to understand the motivation for changes in livelihoods using the LRM. The model is based on the conditions in 2005, without considering temporal variability, and using each community as an independent variable. The model was fitted to linear and quadratic terms for determining whether or not poverty was driving the households in different communities to participate in crop cultivation. Finally, we analyzed communities' alternative livelihood coping strategies using the Chi-square test (χ^2) and simple frequencies (%).

Results and Discussion

Shifts in Wealth Ranks

The data show that individual wealth ranks experienced considerable shifts over time, with the exception of the destitute category. The greatest shifts were in the composition of the very poor and the very wealthy categories (χ^2 all $P<0.01$, Fig. 2). The household wealth ranks showed periods during 1984 and 1988 when there were high frequencies of the wealthy and rich categories, and lower frequencies of the poor and very poor categories (Fig. 2). After 1992, there was a progressive decline in the proportion of wealthy and rich households, when these household categories accounted for only 10% of the total population. Greater accumulation of the poor category (i.e.,

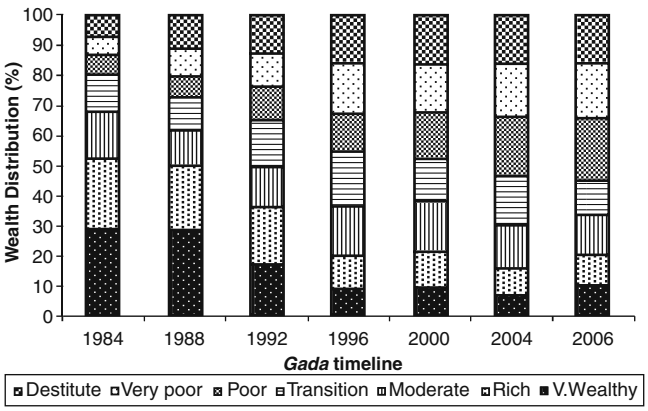

Fig. 2 Shifting wealth distributions of the four communities showing proportions of very wealthy, rich, self-reliant, transitional poor, poor, very poor and destitute in sample communities in Borana, southern Ethiopia

[2] The Borana Oromo community uses *gada* time to record ritual performance, social and political passage, age, marriage, and to organize child naming and ceremonies for the dead, among other rituals. Using this method Legesse (1973), reconstructed a 400 year event calendar. The use of *gada* time in recall data has been shown to be empirically sound for gathering baseline information and monitoring household production in rural environments where written records do not exist. In this study, we concentrated on a few decades within the memory of the living population.

[3] The wealth ranks are based on the Borana's own descriptions of wealth distribution. Wealthy households (*duuresa ciccitaa*) have an estimated 179 TLU household^{-1}; rich (*dureessa*) have 58 TLU household^{-1}; self-reliant (*nama ufirraa bulu*) have 30 TLU household^{-1}; transitional (*harka qalleessa*—'has weaker capacity') have 11 TLU household^{-1}; poor (*deega*) have 7 TLU household^{-1}; very poor (*deega bombii*) have 5 TLU household^{-1}; and destitute (*qollee guutuu hiikanaa*) have less than 2 TLU household^{-1}.

transitional, poor, very poor and destitute) adversely affected the capacity of households to mitigate against risks to their livelihood during periods of droughts and when there was greater evidence of poverty (*cf.* Little *et al*. 2001).

Considering the changes in wealth dynamics, social debts are likely to remain unmitigated due to the wealthy households' declining capacity to provide support for the additional numbers of poor households following each disaster. According to the Borana view of wealth, the poor households have lost their self-identity by straying from pastoralist activities. Such economic dysfunction has implications for the future sustainability of individual households in the pastoral system, which perhaps triggers the need to participate in crop expansion. The wealthy and the rich households, who retain residual livestock, remain optimistic that recovery will be possible. In this system therefore, a reduction in the number of poor households and an increase in the rich and wealthy can be considered signs of wealth recovery (Little *et al*. 2006). Conversely, a greater accumulation of poor and destitute households and an increasing shift away from the pastoral system, signify a potential collapse of the traditional wealth system. At the time of the survey, the poor household categories (i.e., the transitional poor, the poor, the very poor and the destitute) constituted 80% of the total household composition, suggesting that the threat of pastoral wealth decline is a reality. During the 1997/1998 regional surveys in the Borana plateau, Kamara (2001) also reported that the households in the poor classes (i.e., the poor, the very poor and the destitute) amounted to about 80% of the population. This suggests that conditions have not improved. From the nature of the wealth data, we suspect that pastoral poverty is driving households to participate in crop cultivation. We therefore posed the question as to whether or not the sustained poverty (for nearly two decades) has triggered livelihood changes that included crop cultivation.

Crop Cultivation

A high proportion (95%) of the households was involved in some level of crop cultivation. The impoverished communities in Dubuluq reported comparatively low rates of participation in crop cultivation (58.8%) and were more involved in petty trade (21.6%), the latter figure being comparable only with the community of Harweyyu (Table 1). The acreage under cultivation was greatest in Harallo (*F*-test, $P<0.001$, Fig. 3a). Across the four communities, cultivated plot sizes varied according to wealth ranks, with the wealthy households generally owning larger plots [1 to 3.6 ha] than the poor households, the majority of which had plots of less than 1 ha (Fig. 3b). On average, the sizes of the cultivated plots were similar to those reported in previous studies, namely 2.4 ha by Kamara (2001) and 0.2–1.8 ha by Desta (1999). The inference we drew from our data is that poverty did not result in an increase in the acreage of land under crop cultivation. Rather, the poor classes may have lacked the capacity to expand their plots. If so, then it is the wealthier classes that have the capacity to expand croplands. However, the wealthy households also experienced conflicts between cropping and livestock management due to labor demands. During periods of sufficient rainfall, more households were involved in crop cultivation, as opposed to periods when rains were insufficient and focus shifted to livestock management. Poverty and uncertainty of rainfall are likely to impair cropland expansion but not the numbers of individuals involved in crop cultivation.

In principle, an increase in farm size should lead to a corresponding increase in yields. Our projections show a linear correlation between farm sizes and potential total grain harvests (Fig. 3c, $r^2=0.62$, $p<0.001$). From the evidence, we deduce that the expansion of crop cultivation might be motivated by the food security it provides. However, temporal dynamics are also involved in crop cultivation, and most probably, in yields. The reason for this is that the cultivation of crops in the Borana rangelands has been highly erratic; crop yields vary between wet years when farming expands, and drought periods when farming is reduced. Other important factors, such as low soil fertility due to lack of using cattle manure as a source of farm fertilizer, the crop varieties grown, and their sensitivity to environmental stress and pests, were probably responsible for the low grain yields.[4]

Our overall results show that the performance of crop cultivation was dismal. Yields for the three main food crops were variable across the four communities (*F*-test all $P<0.001$; Fig. 4a). Total yields were equivalent to 26.3 metric tons of grains per household year^{-1}, which is an average harvest during years of favorable rainfall.[5] In terms of yield, the average for the communities was 960 kg ha^{-1}. The implication of lower grain harvests became clearer when we expressed yields per capita—this is equivalent to 94.6 kg person^{-1} year^{-1}, or 7.9 kg person^{-1} month^{-1}. This amount meets an estimated 26% of the annual grain requirements per person and on average provides only three to four months of self-sufficiency. The rest of the required grain must be purchased from the market. The grain harvests were about 31% of the Ethiopian national average of 1,834 kg per household (e.g., Getahun 1978; Berhanu and Colman 2007). Although we did not separate grain yields by wealth ranks, based on farm sizes we

[4] Deduced from interviews

[5] From key informants we deduced that over 26 years of farming history (1980–2006), the community had achieved successful harvests only 19% of the time.

Table 1 Household participation (%) in major economic activities in the central districts of Dirre and Yaballo in the Borana zone, southern Ethiopia

Peasant associations	Animal husbandry	Crop cultivation	Livestock trade	Petty trade
Dida Hara	100	96.1	10.2	13.4
Harweyyu	97.1	97.1	11.4	21.4
Dubuluq	64.7	58.8	7.8	21.6
Harallo	89.0	95.1	6.1	17.1

inferred that the poor and the very poor had smaller harvests than the wealthy households (cf. Rovere *et al.* 2005).

Grain allocations show that the households consumed the greater portion of their harvests, followed by the amounts sold, the amounts saved for household food security and finally the amount used for seeds (Fig. 4b). We did not estimate the proportion of income from crop sales by households of different wealth classes. When studying the same region, Berhanu and Colman (2007) found that the very poor households sold 4.1% of their total grain harvests, compared to the rich households who sold 2.7% of their total harvest. These figures support our finding that much of the grain harvests was reserved for home consumption. The four communities did not practice grain loans in bulk but sold grains soon after the harvest (Oba 1998). The evidence shows that the contribution to food security by self-grown crops was limited. If crop cultivation is motivated by poverty then we would expect various possible responses in terms of the relationships between sizes of the cultivated land, the crop yield and the household wealth, as expressed by the scenarios in the LRM.

Livelihood Response Model

The relationships between cropland sizes and livestock wealth supported three of the four LRM scenarios (see also Figs. 1 and 5). For Scenario I, which assumes that the sizes of the herds were the driver for crop cultivation [Fig. 1 Line *a*], the quadratic function between total livestock holdings and farm sizes explained about 26% of the households' motivation for crop cultivation (r^2=0.26, p<0.05; Fig. 5). This implies that 74% of the variability is not explained. We suspect that the remaining unexplained variations represent other possible responses. We know that the majority of this wealth category of households had dropped

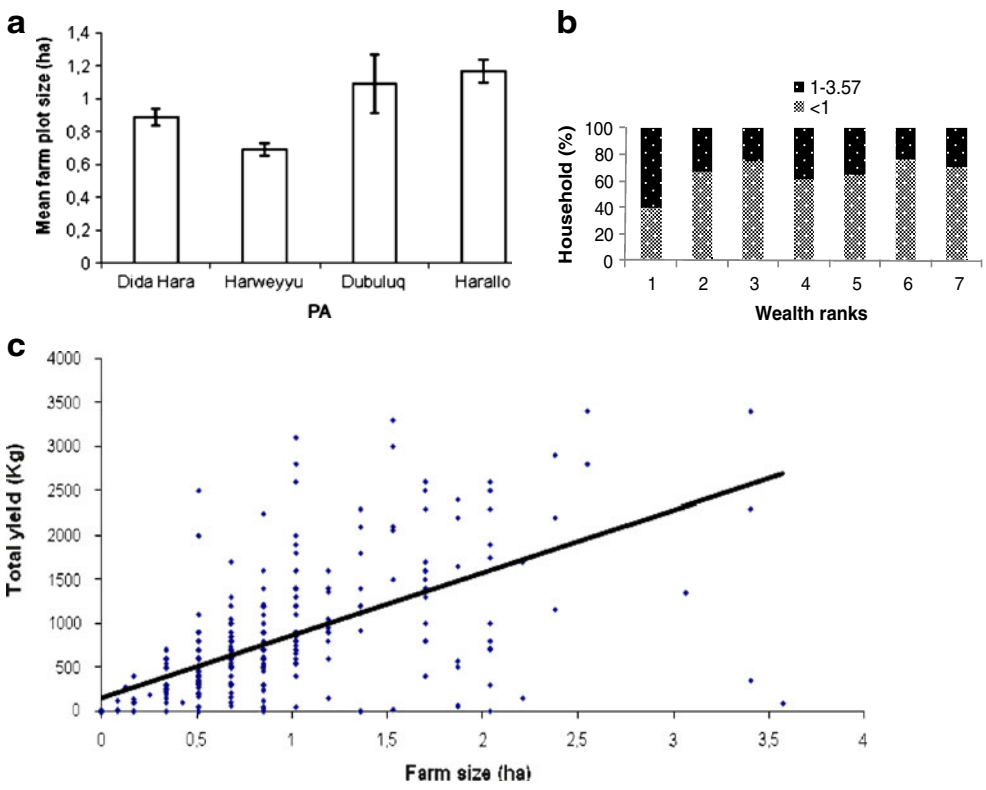

Fig. 3 **a** Mean farm plot sizes for the four communities, **b** Relationships between farm sizes and wealth ranks representing: (1) very wealthy; (2) rich, (3) self-reliant; (4) transitional poor; (5) poor; (6) very poor and (7) destitute in sample communities in Borana, southern Ethiopia. **c** Relationships between household farm sizes and grain yields for the three major crops in Borana, southern Ethiopia

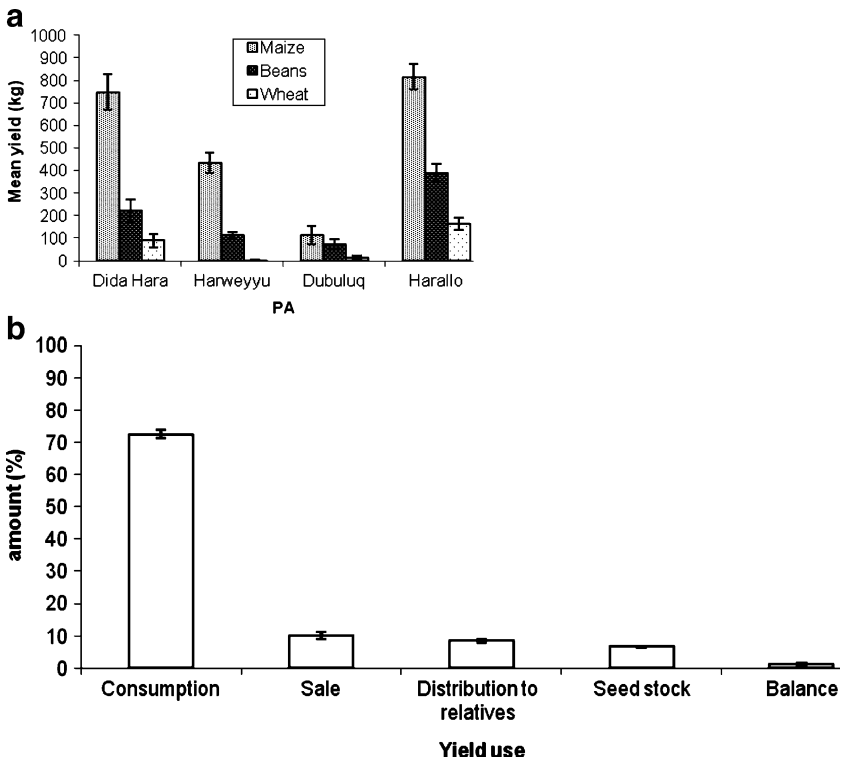

Fig. 4 **a** Mean grain yields for the four communities of Dida Hara Harweyyu, Dubuluq and Harallo, and **b** Proportions of grain yield allocations by individual households

out of the pastoral system. Most of them were in the very poor and destitute wealth ranks, owning <5 TLU. Therefore their participation in crop cultivation is likely to be influenced by poverty (e.g., Dubuluq; see Fig. 5). For this type of household, the lack of access to food from the traditional pastoral economy probably motivated them to cultivate crops. Some of the households involved had large croplands but very small grain harvests (Fig. 4a), suggesting that the problem was not shortage of land but the lack of capacity to grow crops. Consequently, greater reliance was placed on food aid and other livelihood coping strategies (see below).

In Haraweyyu (also supporting Scenario I, Fig. 1, Line *a*) the sizes of farms and livestock wealth were positively related but not significant (r^2=0.064, p>0.05, Fig. 5). The increase in livestock holdings up to 60 to 80 TLU was followed by an increase in crop cultivation. Taking into consideration that the sizes of herds and the extent of land under cultivation explain only 6% of the household motivation, we suspect that farming is a newly adopted livelihood diversification strategy. For these households poverty is not the only driving force for participation in crop cultivation. They may view farming as being inferior to livestock management. Conflicting time allocations between farming and herding undermine the commitment to grow crops beyond subsistence requirements.

Our data did not support Scenario II which proposed a linear negative relationship between cropland sizes and livestock wealth (see Fig. 1 and compare the relevant lines for scenarios I and II—Lines *a* and *b*). The absence of this scenario suggests that in general, the Borana in southern Ethiopia have accepted a mixed farming and livestock economy as a strategy to mitigate against risks to their livelihoods. Such general acceptance might imply the influence of external drivers, such as government policy.

The responses by the community in Dida Hara supported Scenario III (see Fig. 1, Line *c,* and Fig. 5). Here farm sizes were less influenced by livestock holdings (r^2=0.0492, p>0.05; Fig. 5) than in other communities. Economic

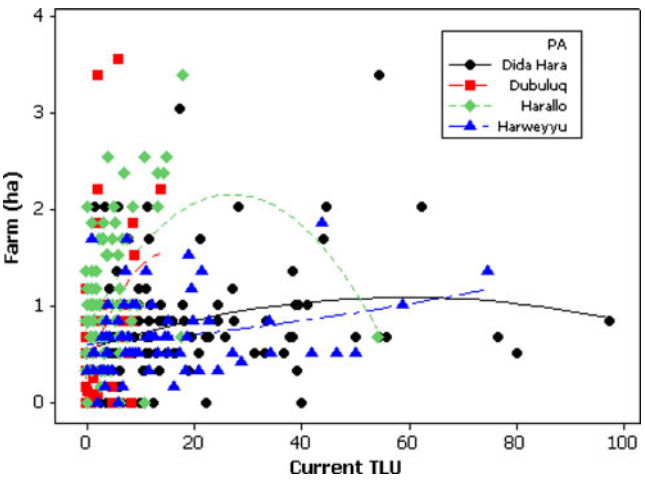

Fig. 5 Linear and Quadratic responses in the LRM between farm sizes and livestock holdings (measured in TLU) in Borana, southern Ethiopia

diversification and wealth accumulation probably explain this. The fact that livestock wealth explains only about 5% of the variation implies that the adoption of crop cultivation is influenced by other factors such as marketing opportunities, growing populations and the availability of suitable landscapes for cultivation.

Scenario IV, which assumes that poverty drives crop cultivation, up to some optimal herd size (see Fig. 1, Line *d*), is supported, although not strongly, by the responses of the community in Harallo (r^2=0.096, p<0.05; Fig. 5). At approximately 20 TLU, participation in crop cultivation apparently declines. The households' motivation to expand cropping explained only 10% of the variation. This community has a history of economic deprivation, and farming was introduced through the intervention of the state as opposed to internal adjustments by households. From observation of the four scenarios, we offer the following interpretations of their performances.

Firstly, the relationships between cropland sizes and wealth might be indirect, suggesting that poverty may not be the only reason for herders to participate in crop cultivation. Other factors such as shortage of labor and lack of sufficient traction animals might limit the sizes of cultivated plots. Therefore, the large number of participants in crop cultivation did not necessarily translate into larger pieces of cultivated land. Rather, farm plots were small and fragmented. It should be understood that the present relationships lacked temporal variability. During times of drought, focus shifts to the protection of livestock assets and engagement in alternative livelihood activities. The loss of livestock assets would expose households to greater risks of poverty (Mace 1993). Very poor households, who do not cultivate crops, would suffer in two ways: first by being exposed to greater risks of starvation, and second by depleting their remaining herds, resulting in chronic poverty. Our data may not have accounted for all the perceived relationships, partly because we examined only the spatial dynamics of farm sizes in relation to livestock holdings. An improved model that accounts for time and environmental variables affecting crop dynamics might disclose more sensitivity to poverty driven variables.

Secondly, the low explanatory variables might inform us that poverty is not the only driver of cropland expansion. Government policy might have had an important role to play, especially in herd-owning households that have adopted crop cultivation in addition to other livelihood strategies. However, such a policy would not motivate the poor households whose meager means allow them to cultivate only small plots. We would suggest that the poor households lack the resources to mobilize labor for clearing land, planting crops and weeding. More often than not, the lack of traction animals does not allow them to expand the sizes of their cultivated plots. By comparison, the wealthy households do have these resources and are therefore able to cultivate larger pieces of land. Another factor is insufficient bottomlands, which means that crop cultivation cannot be expanded indefinitely (Coppock 1994; Angassa and Oba 2008). The poor are unlikely to be able compete effectively for the limited amount of space.

Thirdly, other factors such as rainfall variability might have an influence on the motivation of households to participate in the expansion of crop cultivation. When rainfall becomes sporadic and exposes earlier crops to drought, they invest less in labor for crop planting and weeding. According to the interviews, such failures appeared to be broken by fewer years with sufficient rainfall to support extended plant and crop growth. As a result, only a fraction of the households prepare land for the planting season (Berhanu *et al.* 2007). These conditions probably have a great effect on the outcome of growing crops, and might serve as a de-motivating factor in expanding crop cultivation. The choice between expanding crop cultivation and the risks of crop failures, land fragmentation, losses of livestock due to feed shortages, and future opportunities for changing land tenure, were probably among the considerations that created the existing cropland dynamics. For the majority of the communities therefore, the unexplained responses could be accounted for by alternative livelihood coping strategies, including livestock husbandry, cropping and livestock and petty trade (Table 1).

Other Livelihood Coping Strategies

For the majority of the households, petty trade was more important than livestock trade (Table 1). In various communities however, income from livestock sales continued to be higher than income from petty trade. The society is integrated into the cash economy through livestock sales and petty trade (Table 2). The households suggested that a major reason for selling livestock was to enable them to purchase grains from the market. Increased livestock sales during droughts occurred when animal market values were low (McPeak and Little 2006) and grain prices were higher (Cossins 1988). Some households saved money with retail shops in order to create credit worthiness, or sought help from relatives, friends and clan members (Table 2). Additionally, the households reduced expenditure by reducing the number of meals and activating social networks (Table 2). The inter-household system of food sharing between the wealthy and the poor is widely practiced by the Borana (Oba 1994; Webb and von Braun 1994). During periods of economic stress, social security networks are weakened in general, since both poor and wealthy households lack resources for distribution and sharing (Little *et al.* 2006).

Table 2 Households' long-term livelihood response strategies in the central districts of Dirre and Yaballo in the Borana zone, southern Ethiopia

Livelihood strategies	Household participation (%)
Frequent livestock sales	81
Use of monetary savings	69
Reduction of household expenditure	25
Support from relatives	82
Employment as migrant laborers	74
Sale of forest products	81
Food aid	90
Child education	65

Many households reported that their members were involved in unskilled labor migration to peri-urban areas (Table 2). The dependence on informal labor was highest among the destitute community of Dubuluq (51%). This community also had the greatest numbers of households dependent on food aid (85%). In Dida Hara, participation in wage labor was the lowest (8%), suggesting that the pastoral sector is still capable of supporting surplus household labor. A high proportion (74%) of the households from all four communities reported that their members were willing to participate in urban labor migration. Labor migration is becoming an attractive livelihood coping strategy for young men (see also May and Ole Ilkayo 2007). Studies of the Borana people in Kenya reported a high proportion of unskilled labor migration from the pastoral areas to towns and cities (Doti 2005). The trend is similar to that in other pastoral communities in Africa, such as the Maasai of Tanzania, where the young warriors migrate to urban areas with the aim of rebuilding their herds (May and Ole Ilkayo 2007). A large proportion of migrant laborers both in Tanzania and Kenya are employed as night watchmen in rural towns and cities. However, for the Borana in southern Ethiopia it has been suggested that the contribution made by urban labor migration "… [remains an] extremely feeble pathway to a source of livelihood …." (Berhanu *et al*. 2007: 877). From the present data, it is impossible to make conclusive remarks about the trend of labor migration from southern Ethiopia as a coping strategy for mitigating the risks to livelihoods. However, given that the community is experiencing a transitional socio-economic transformation, this remains an important research problem.

An alternative to migrant labor is to rely on the sales of forest products, such as charcoal and firewood (Table 2). Culturally, these are activities associated with families who have dropped out of the pastoral system. In our sample, about 17% of the households were involved in selling incidental food stuffs, such as tea leaves, sugar, salt and the stimulant khat (*Catha edulis*), and 81% were involved in the sale of forest products. A large proportion of the households depend on food aid (Table 2). The impact of food aid on self-grown crop production is unknown. The society is aware, however, that reliance on unskilled labor and sales of forest products will not safeguard their future economic well-being. As a long-term strategy, most households reported that they were using the education of their children as an investment in the future (Table 2). As evidence of the benefits of education, interviewees cited families whose children had received education and were subsequently employed with better earnings.

Policy Direction

From the perspective of government policy, crop cultivation may be motivated by both external and internal factors related to poverty (cf. Getahun 1978; Kamara *et al*. 2004). Presently, adjustments to loss of livelihoods are mostly internally driven without much external support from the policy regimes. Policy tends to be focused on emergency food aid rather than providing the means for facilitating internal self-adjustments in order to mitigate against poverty. Although past solutions to pastoral poverty involved crop cultivation, there is little evidence that it played any more than a supplementary role. Low crop yields and low grain per capita implied that there was no surplus of grain and therefore a strong reliance on the external market remains. Promoting crop cultivation in the rangelands might aggravate the conflict with pastoralism (Homann *et al.* 2008).

The presumed link between poverty and participation in crop cultivation is weak and likely to be indirect. Poverty might be an interim, but not a long-term driver, since in the short-term it might have an influential role in improving livelihoods. We found no evidence that increasing the amount of land under cultivation corresponded directly with loss of wealth. Rather, the poor often have limited capacity to expand crop cultivation. The poor households therefore need external support for alleviating poverty. The lack of such support is what drives them to participate in crop cultivation. Our data tend to confirm that multiple drivers were involved in the expansion of crop cultivation. Firstly, the demand for grains in the diet of the pastoralists is increasing and much of the requirements are currently supplied from local markets and from food aid. Secondly, it is likely that the Borana households in different wealth ranks have different objectives for involvement in crop cultivation. The poor might simply want to grow food to meet their immediate requirements, whereas the wealthy might want to hedge against having to sell livestock to buy grains (Little *et al*. 2006; McCabe *et al*. 2010).

The problem remains that in the Borana lowlands, crop growing is still experimental and opportunistic because herders have not fully integrated cropping and livestock management as complementary production systems. For example, huge quantities of livestock manure are going to waste instead of being utilized on the farms to improve soil fertility, which is perceived to be part of the cause of low crop yields. Environmentally, cropping remains a risky enterprise as it is poorly adapted to the semi-arid conditions of the Borana rangelands. Taking into consideration the low success rates of crop production, communities continue to place emphasis on livestock management. Consequently, Borana participation in crop cultivation may be the society's attempt to embrace change, which cannot be divorced from influences by government policies. The motivation for participating in crop cultivation could be in anticipation of future changes in land tenure that might shift land use towards fully agro-pastoral production (Desta and Coppock 2004; Kamara *et al.* 2004). Still focusing on a futuristic scenario, land markets might motivate individuals to expand their plots of land. The present Ethiopian constitution and agricultural land use policy may be against the capitalization of land for farming purposes, but the extent to which this may change in the future, through programs of alternative investments, cannot be discounted (Beyene 2010). Indeed, in scenarios where there is marked population growth, rangelands closed off from the communal grazing lands will result in land fragmentation and increase market speculation in terms of alternative investments.

However, the promotion of crop cultivation to the detriment of pastoralism poses future risks of loss of livelihoods. Informants regard crop cultivation in the rangelands as an act of self-predation for two reasons. Firstly, the Borana herders are aware that croplands fragment grazing lands. Secondly, by expropriating the most productive landscapes for the purposes of crop cultivation, they are exposing livestock to greater risks of drought-induced mortalities. The cultivation of rangelands undermines drought coping strategies, and creates competition for land and labor allocations.

We have shown that greater efforts by households in terms of livelihood diversification were related to alternative strategies such as trade and labor migrations. However, government policy does not appear to support these internal dynamics for improving livelihood coping strategies. Alternative investments, such as education for future generations, are highly desirable. Consequently, policies designed to promote sustainable livelihoods should consider the following approaches: (a) facilitate and support gradual adjustments in land use changes by regulating the conversion of grazing lands to croplands, (b) promote better integration of crop cultivation and pastoralism through nutrient transfer by promoting the utilization of livestock manure to improve soil fertility, (c) make assessments of better integration of livestock management with crop expansion, and (d) use the LRM (and its improved variant) to account for time, status of farms (fallow or active), and alternative livelihood coping strategies.

Conclusions

Among the four communities surveyed accumulation of households of the poor wealth classes led us to suspect that poverty might have motivated households to become engaged in crop cultivation. Although crop yields were projected to increase correspondingly with plot sizes, the actual yield per household land unit was only 31% of the national average. Grains per capita were sufficient for only 26% of the annual grain needs. Crop cultivation therefore does not appear to be a strategy for mitigating poverty, but it might provide an opportunistic livelihood coping strategy. This can be inferred from the LRM, which showed partial success in three out of the four scenarios predicting household behavior towards the adoption of crop cultivation. We have shown that crop cultivation could be a livelihood diversification strategy to supplement shortfalls in livestock production, but poverty alone cannot account for household involvement. The different communities disclosed different capacities and varied goals, each reflecting the extent to which they had experienced economic stress. From the LRM we deduced that farming is just one source of livelihood diversification utilized by the four communities. In most cases the relationships between farm sizes and livestock wealth partially explained household motivations for crop cultivation and engaging other means of livelihoods. The majority of the responses were explained by other livelihood coping strategies. We cannot, however fully address the question without (a) improving our understanding of the impact of crop cultivation on pastoral land use and how the two systems are directly and indirectly related to the factors considered, (b) improving the predictive power of the LRM by incorporating temporal variability in the livelihood drivers, and (c) including alternative livelihood coping strategies in the LRM as indicators of wealth decline.

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