



# Evaluate and compare the sustainability of pure pastoral and its derivative agro-pastoral systems in Borana zone of southern Ethiopia

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TRB-15-2015

East Africa TIRI Research

May 2015

## Research Brief

Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change

### Abstract

In southern Ethiopia of the Borana zone, a shift from pastoral to agro-pastoral farming system has increased in the last decade, despite the Borana community's long history of pastoral livelihoods. Following such a system shift, livestock holding per household and income from livestock has significantly declined. Furthermore, pastoralists that rely on cropping have become more vulnerable to frequently occurring harvest failure. Both processes have posed challenges to the sustainability of pastoral livelihoods. This research brief presents the results of household survey and focus group discussion evaluating and comparing the socio-economic and ecological sustainability of pure pastoral and its derivative agro-pastoral systems. 



Fig 1. Factors triggering shift from pure pastoral to agro-pastoral, declining of livestock holding per household indicated population pressure induced deterioration of rangeland carrying capacity and unable to restock indicated soaring of livestock prices or weakening of pastoralists' capacity in asset building. Source: Beyene Teklu Mellisse, designed from pictures taken during survey.

### Concept of sustainability in pure pastoral and agro-pastoral systems of Borana zone

Although there is no single definition of sustainability, there are major common features that define sustainable agriculture as the ability of farming systems to maintain its productivity and usefulness to society in the long term (Rigby et al., 2001). Sustainable agriculture includes both the long-term viability of farming system itself and the contribution of this farming system to the sustainability of the territory and the communities to which it belongs. However, how to measure agricultural sustainability is under debate. Various researchers have developed a large number of indicators for agricultural sustainability evaluation. Indicators such as average crop yield, income from outside the farm, profitability, education level of household head, and others have been suggested as socio-economic measures of agricultural sustainability (Hayati, 1995; Rasul and Thapa, 2003). Usage of chemical fertilizer or pesticides, crop diversification, and soil quality have further been suggested as ecological measures of agricultural sustainability (Hayat, 1995; Rasul and Thapa, 2003). In the context of arid and semi-arid areas of Ethiopia—where almost all of the communities are driving their means of livelihood from livestock rearing and climate is unpredictable—farmers' immediate concern for pastoral development is how to best utilize the communal rangeland to improve livestock productivity and reduce risk.



## Study Methods to Evaluate Sustainability of Agropastoral and Pastoral Systems

To evaluate the sustainability of both agropastoral and pure pastoral systems in southern Ethiopia a variety of indicators were used. Given the contexts of the study area, livestock holding per household; milk production per year; average crop yield; income from livestock, milk, crop and off farm activities; gross margin; and income diversity were selected as indicators of socio-economic agricultural sustainability while frequency of crop harvest failure and livestock death were used as indicators of ecological sustainability. This study attempts to evaluate to what extent the crop oriented system differed as compared to pure pastoral systems in terms of livestock rearing and cropping practices by comparing the two system from these socio-economic and ecological perspectives.

The study was carried in the Borana zone in the southern tip of Ethiopia. The zone is made up of 13 districts, or woreda, divided between two agro-ecological zones—the semi-arid lowlands to the south and the more humid lands at higher altitudes to the north. Two districts (Yabelo and Dire) encompassing both pure pastoral and agro pastoral associations (PAs) were considered for this study. From each district, two PAs representing one pure pastoral and one agro pastoral association were selected. Survey participants represented pure pastoral communities, which still practice traditional mobile pastoralism and derive almost all of their means of living from livestock, and agropastoral communities, which have highly constrained mobility and about 10% of their means of living derived from crop farming in addition to livestock. Participants were additionally split across three socio-economic class.

A total of 60 households, 15 from each PA, were selected for further interview. Interviews were held with the household head from September to November, 2014. Respondents were asked about number of livestock holdings, milk production, income sources, etc. Respondents were also asked to rank the rate of crop harvest failure and livestock deaths due to severe climatic condition in the last one Geda period (8 years). In addition to the household interview, two focus group discussions were conducted with elders, development agents and key informants with Yabelo and Medecho agropastoral and pure

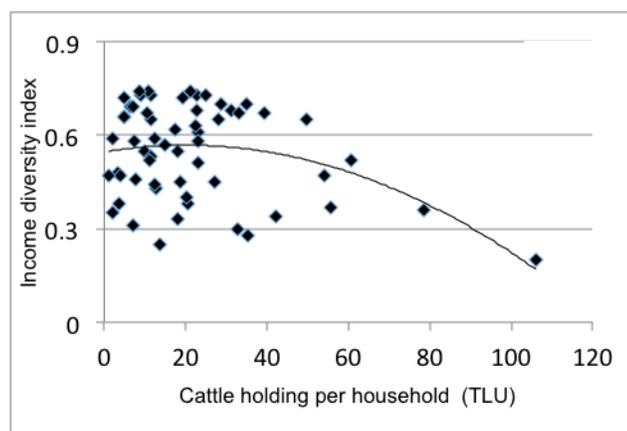


Figure 2: Income diversity index plotted against cattle holding for both pure pastoral and agro pastoral systems ( $N=60$ ).

pastoral associations, respectively. A total of 8-10 participants representing all socioeconomic class and gender were included in each of the focus group discussion. Participants were asked about the effect of drought on livestock and crop productions, factors triggering pastoralist to shift crop cultivation, challenges in crop and livestock production, and rainfall availability trends. To collect the required information, a semi-structured questionnaire was prepared and the initial version of the household questionnaire was pre-tested on 8 randomly selected households with the final version amended before the commencement of actual interview. The collected data was analysed using the Statistical Package for Social Sciences (SPSS; version 22). Descriptive statistics such as mean and percentages were used to measure mean livestock holding size in each farming system and to create graphs of frequency of crop failure and livestock deaths.

## Socio-economic Indicators of Sustainability: Crop and Livestock Productivity

In arid and semi-arid pastoral systems of the Borana, livestock production is the major contributor to pastoral livelihoods. Cattle, small ruminants, and camels were reared by the local community in both pure pastoral and agropastoral systems. The total number of cattle and number of cows per household in pure pastoral systems was significantly higher ( $P<0.05$ ) than that of agropastoral. A lower number of cattle in the agropastoral system may be due to reduced space for grazing and retracted herd mobility. In contrast, there were more oxen in agropastoral systems than pure pastoral. The higher number of oxen in agropastoral systems could be related to the use of oxen for ploughing of land whereas oxen are not used for ploughing purposes in pure pastoral systems. Milk production per year in pure pastoral systems was two times higher than agropastoral systems. The higher amount of milk production in pure pastoral system may be related to the higher number of cows per household in pure pastoral than agropastoral systems.

Cropping, rather than livestock, is mainly practiced in the agropastoral systems of the Borana zone. The survey results showed that about 40% of agropastoralists who have land own less than 2 hectares, with an average holding of 2.7 hectares, in 2014. About 50% of responding agropastoralists have less than 5 hectares, while the remaining 10% have 10 hectares, the maximum size reported in the survey. Wealthier agropastoralists had smaller (1.9 ha) area size of cultivable land, while the poor own larger (3.6 ha) cultivable land. The gap between rich and poor in terms of cultivable land holding was about 47%. This resulted due to the poor—who, in most cases, lost their animals due to drought—attempting to increase their income portfolio by expanding their cropland while the rich—who have large herd size—desire larger rangeland size to feed their animals. The tendency of poor pastoralists to increasingly depend on crop cultivation over livestock rearing might increase their vulnerability as crop production is more significantly impacted by environmental risks than livestock production (Fig 3).

The major crops cultivated by agropastoralists were maize, wheat and teff. The productivity of all crops were higher in the 2013 cropping season than 2014. On average, higher maize yield per hectare was harvested in 2013 compared to maize in 2014, with a similar trend seen for wheat grain yield. The harvested grain yield from these three crops in agropastoral areas of Borana was almost negligible compared

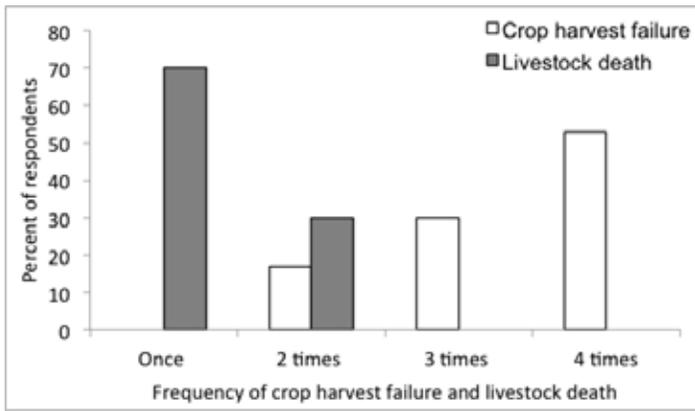


Figure 3: Ranking frequency of crop failure and livestock deaths due to severe climatic conditions in the last eight years (N= 60)

to the farm level average actual yield of maize, wheat, and teff in moisture stress-free central highland areas of Ethiopia. The survey results revealed that cultivation of crops is not only limited in upper altitude agropastoral systems but also lower altitude pure pastoral systems.

### Socio-economic Indicators of Sustainability: Income Diversity

The tendency for rural households to engage in multiple occupations is motivated when farming is unable to provide a sufficient means of survival alone. In the contexts of arid and semi-arid ecosystem where crop and livestock production is constrained by unreliable and erratic rain fall, income diversification is a means of risk spreading and coping with shocks. The result in Fig 2 indicated a higher index value for agropastoral systems than pure pastoral. This means that agropastoralists are engaged in multiple income generating livelihood activities and rely on a range of diversified income sources as compared to pure pastoralists. Income diversification contributes positively to the livelihood sustainability of agro pastoralists by reducing proneness to stress and shocks such as drought. The non-farm/off farm activities from which pastoralists earn income include migration to nearby urban centres in search of paid work, charcoal making, wood work, and hiring out family members to wealthier pastoralist and livestock traders.

Despite the fact that agro pastoralists generate income from multiple sources, livestock production remains the principal source of livelihood both for pure pastoral and agropastoral systems. Livestock production accounted for an average of 80% and 52% of sampled pastoral and agropastoral household income, respectively, while crop cultivation accounted for an average share of 12% for sampled agropastoral households. The off farm income source accounts for an average of 11% and 28% of pure pastoral and agropastoral sampled households income, respectively.

According to group discussants, the major factor driving pastoralists to rely on off-farm activities for income was an inability to restock livestock after drought due to steadily increasing livestock prices. Declining livestock holding per household coupled with increasing livestock prices encouraged pastoralists to continuously engage in other off-farm activities and—when necessary—abandon pastoralism to find other alternative means of livelihood which could be started with less

investment cost such as crop cultivation or moving to nearby towns. The results in Fig 2 showed a negative relationship between cattle holding and income diversity: the higher the number of cattle holding per household the lower the index value. This confirmed that pastoralists tend to diversify their income sources following declines in cattle holding per household, while those who own large numbers of cattle continue to generate their livelihood from livestock.

Thus, income diversification is an important strategy adopted by poor pastoralists, while herd diversification is an important strategy adopted by rich pastoralists to minimise risk exposure. Diversity is closely allied to flexibility, resilience, and stability. In this sense, diverse livelihood systems are less vulnerable than undiversified ones and are more likely to be sustainable over time due to allowance for positive adaptation to changing circumstances. In this context, both pure pastoral and agropastoral systems are sustainable systems since both respectively used livestock diversification and income diversification as strategies to minimizing risk exposure.

### Ecological Indicators of Sustainability: Frequency of Crop Harvest Failure and Livestock Death

In arid and semi-arid ecosystems like Borana, different factors influence the productivity of both crops and livestock. Of these factors, rainfall scarcity most significantly impacts these ecosystems. The level of vulnerability to severe climatic condition such as drought varies for crop and livestock farming. According to respondents, the probability of occurrence of total crop harvest failure due to drought is three to four times per eight years while livestock suffer from drought one to two times per eight years (See Fig. 4). This indicated that crop production in arid and semi-arid ecosystems of Borana zone may be riskier than livestock rearing.

### Future Research areas

More investigation is needed addressing how to enhance income from milk and milk by products based on the surplus amount of milk produced per household per year in both pure pastoral and agropastoral systems. Improving the marketability of milk would strengthen the socio-economic sustainability of both pure pastoral and agropastoral systems through enhancing the capacity of pastoralists to build financial assets which could be reinvested into livelihood diversification. 🐄

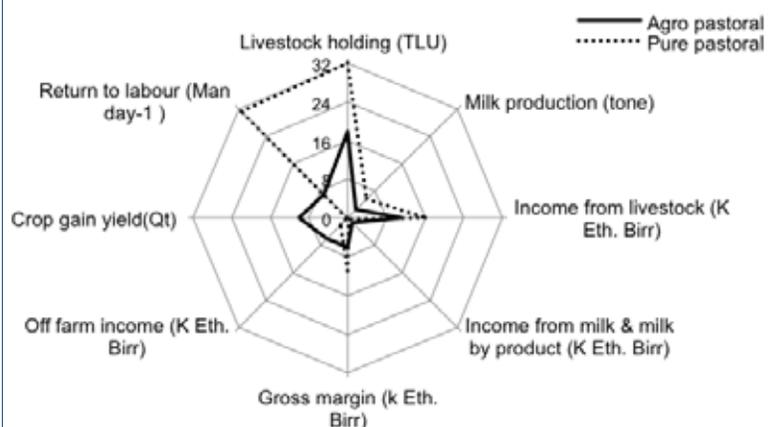
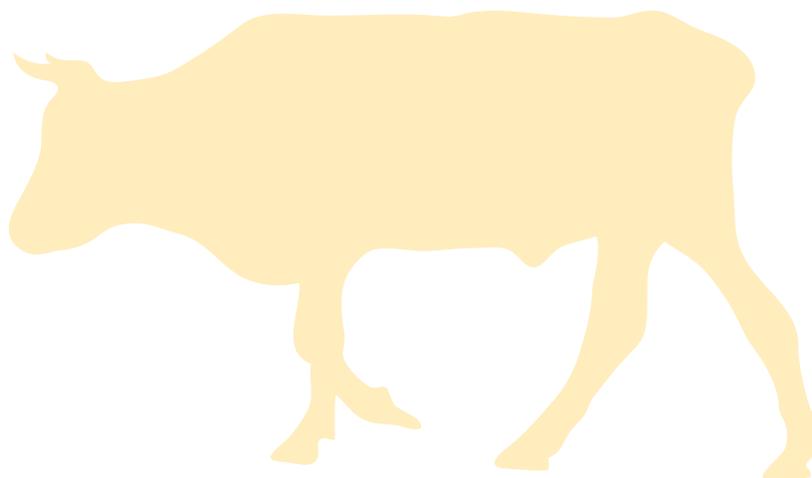


Figure 4: Comparing the sustainability of pastoral and agro pastoral systems; K= thousand, Qt= quintal, TLU= Tropical Livestock Unit (Equivalent to theoretical animal of 250 kg weight, oxen:1, cow: 0.8, sheep/goat: 0.2)

## Acknowledgement

This research was funded by USAID's 'Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change', Colorado State University, USA.



*TIRI, Targeted Investment for Research Impact, identifies early-career researchers who are interested in tackling livestock production problems through innovative approaches and fresh perspectives. This small-grant program is open to early-career researchers (five or fewer years into research career) in any discipline, from student to professor, and from any organization that is engaged in applied research on livestock production in South Asia and East Africa — colleges and universities, government research centers or laboratories, or non-profit organizations.*

*Proposals are selected based on their potential to make livestock production systems more resilient to increasing climate variability and severity. At the end of one year, TIRI scholars are expected to demonstrate concrete outcomes and real potential for future impact. The 10 selected East Africa TIRI scholars and the 18 selected Nepal TIRI scholars are addressing research problems on various livestock and climate research themes.*



**Feed the Future Innovation Lab for Collaborative Research on Adapting Livestock Systems to Climate Change is dedicated to catalyzing and coordinating research that improves the livelihoods of livestock producers affected by climate change by reducing vulnerability and increasing adaptive capacity.**

*This publication was made possible through support provided by the Bureau for Economic Growth, Agriculture, and Trade, U.S. Agency for International Development, under the terms of Grant No. EEM-A-00-10-00001. The opinions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Agency for International Development or the U.S. government.*

