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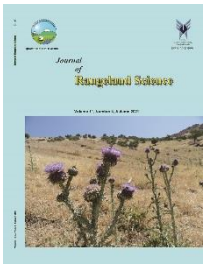

Research and Full Length Article:

Socioeconomic and Ecological Transitions of Pastoral System in Semi-arid Areas of Rift Valley, Fentale District, Ethiopia

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Abstract. Pastoralism contributes significantly to the national economy and livelihoods of pastoralists in Ethiopia. However, socio-ecologically considerable variations exist between pastoral systems of the country in terms of the drivers they are currently experiencing and the impact of these drivers. This study was conducted in Fentale district, Ethiopia, to understand the perceived transitions of the pastoral system and the key factors driving this transition over the last two decades. Data were collected (2013/4) through a household survey (n = 60), focus group discussions, and key informant interviews. The results showed that the decline in livestock holding per household (4.90) and livestock mobility (4.41), expansion of cultivation (4.83), degradation of rangeland (4.79), and migration (4.26) were perceived to occur. The perceived transformations in the pastoral system were primarily driven by population growth (4.81), land (4.76) and water shortage (4.29), adoption of cultivation (4.67), and climate change (3.78). The complex nature of pastoral development makes the isolation of root causes of transformation in the pastoral systems more difficult. The combined effects of the observed transitions and their drivers had been driving pastoralists into non-livestock-based livelihood strategies. Such diversification indicated that livestock alone would not sustainably maintain the livelihood of pastoralists. The intensification of livestock production is also being adopted by pastoralists as a coping strategy for the perceived transitions. The pastoral system needs to be supported by policies that are consistent with existing situations and future expectations. Therefore, an enabling policy environment considering livestock intensification and economic diversification need to put into place. However, a holistic understanding of a pastoral system and its transition and the likely trade-offs associated with different livelihood strategies in this system is a prerequisite.

Key words: Diversification, Drivers, Intensification, Karrayu, Livelihood

Introduction

In East Africa, where pastoralism is significant, a combination of several factors is driving many pastoralists into non-livestock-based livelihood strategies. According to the scientific literature on the transformation of pastoralism, there are two major causes of change in pastoral systems. The first cause is land fragmentation, which is due to interrelated socioeconomic factors such as changes in land tenure systems, agricultural policies, population growth and migration, infrastructure development, agricultural expansion, and changes in institutions (Galvin, 2009). Fragmentation of land is an ongoing process with far-reaching implications (BurnSilver *et al*., 2008). It encourages settlements, which seriously affect livestock mobility. Reduction in livestock mobility can, in turn, weaken the sustainability and resilience of traditional forms of pastoral systems (Müller-Mahn *et al*., 2010). The second cause of change is climate change and variability, which alter vegetation and water access in arid and semi-arid regions (Galvin, 2009). Climate change is both a cause and a direct consequence of rangeland degradation. It also influences ecosystem dynamics and thus exerts a major influence on pastoral livelihood strategies and institutions, and land-use patterns (Galvin *et al*., 2001). However, the potential impact of these drivers, their feedback on each other, and the responses of the pastoral systems to several complex challenges that have never been before greatly vary within and across countries (Steinfels *et al*., 2006), and from region to region (Fratkin and Mearns, 2003).

Despite the social and economic pressures that pastoral systems face in some regions, the sector continues to be vibrant in many countries (Davies *et al*., 2010). It has been a viable mode of production for a significant part of Ethiopia's population regardless of low investment in the sector. The sector is also the most significant component of national economy (Mengistu, 2007; Solomon *et al*., 2007) by providing high-quality livestock and meat for export and domestic markets (Yosef *et al*., 2013). It contributes about 16% of the gross domestic product (GDP), one-third of the agricultural GDP, and 8% of the export earnings to the national economy (Mengistu, 2007). However, the experience of the past two decades shows that the pastoral system has become increasingly unstable, highly vulnerable to minor climatic shocks (Gebru *et al*., 2007), and other multi-dimensional pressures. It is evolving in response to rangeland degradation, as the rates of bush encroachment, droughts, overgrazing, and human population increases (Yemane, 2003; Abule *et al*., 2005; Solomon *et al*., 2007; Kassahun *et al*., 2008), decline in livestock holdings (Desta and Coppock, 2002; Beyene, 2012; Elias, 2014), increasing sedentarization (Tsegaye *et al*., 2013), reducing herd mobility (Wario *et al*., 2016), and agricultural expansion (Schmidt and Pearson, 2016). It is important to note that there is considerable variation between pastoral systems in terms of the drivers they are experiencing and their magnitudes, and how the drivers are affecting pastoral livelihoods. Therefore, a better understanding of these variations is crucial for devising context-dependent and tailor-made policy and development recommendations.

The pastoral system in Fentale district, East-central Ethiopia, is a notable example, where one or more of such transitions and drivers have been observed (e.g., Abule *et al*., 2005; Gebru *et al*., 2007; Beyene, 2012; Elias, 2014). However, this system might have some distinct features compared to other pastoral systems, which are considered to operate under ample resources. For instance, the expansion of large-scale irrigation agriculture and other state development ventures have caused substantial loss of communal grazing land in

Fentale (Gebru *et al*., 2007). The well-watered sections within the former communal grazing land are almost entirely enclosed by individual households (Müller-Mahn *et al*., 2010).

Therefore, this study aimed to investigate the socioeconomic and ecological transitions of the pastoral system in the Fentale district over the past two decades, and the key drivers and challenges, as perceived by the (agro)-pastoralists.

Materials and Methods

Study area

Fentale district, with a total land area of 1340 km^2, is located in the Upper Awash Valley within the central Ethiopian Rift Valley. It is one of the administrative districts under the East Shoa Zone of Oromia Regional State, East-central Ethiopia (Fig. 1). The population of the district in 2007 was reported to be 81,740 (CSA, 2008). The topography of the district ranges from flat to undulating plains and from hills to high mountains. Most parts range from 900 to 1000 m above sea level, with the highest point at Mount Fentale (2400 m above sea level). Lake Beseka, with an area of about 40 km^2, is located at the near distance to Metehara, the capital town of the district (Belay, 2009). Major ethnic groups living in the study area are *Karrayu* and *Ittu* Oromos and few Somalis, but the people are generally called *Karrayu* pastoralists.

The climate of the study area is semi-arid with dry and hot weather throughout most of the year (Beyene, 2012). Mean annual rainfall is 571 mm, ranging from 377 to 742 mm. Rainfall distribution is bimodal (Belay, 2009) with the main rainy season (locally called as *Ganna*) extends from July to September, and the shorter rainy season (locally called as *Arfasa*) extends from February to April (Abule *et al*., 2005; 2007). The dry season, locally called as *Bona*, extends from October to January. Meteorological data of Metehara Meteorological Station for the period of 1989 to 2011 was obtained from Ethiopian National Meteorological Agency (NMA) to determine the mean annual rainfall and temperature of the study area. The area receives the highest amount of rain during July (125 mm) and August (120 mm), with the dry season running from November to January. The average daily minimum and maximum temperatures are 18 and 34°C, respectively, with the highest temperatures occurring in May and June.

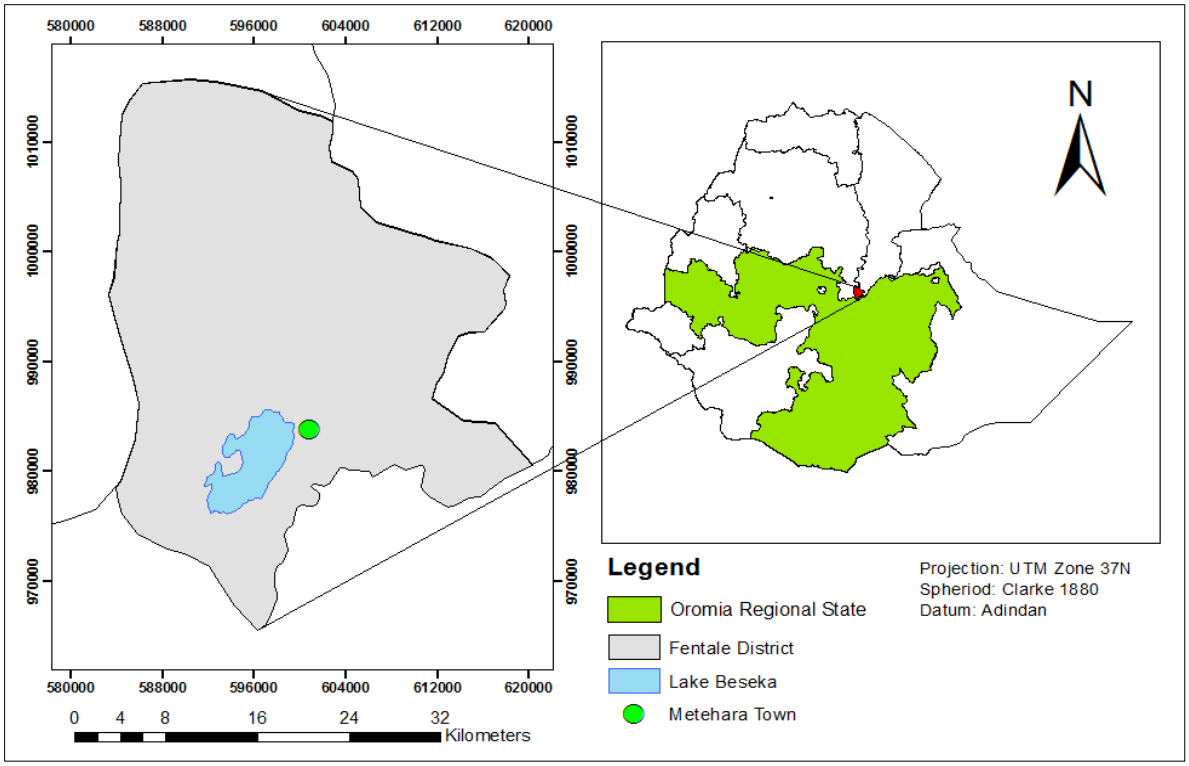

Fig. 1. Location of the study area in Oromia Regional State, East-central Ethiopia

Data collection techniques

Before the actual study, baseline information was gathered from Fentale District's Pastoral Development Office (FDPDO) to have a good picture of the study area. Eighteen *kebeles*, an administrative unit representing the lowest hierarchy, were found within the boundary of the Fentale district. For this study, four *kebeles* were purposively selected based on their proximity to the main and access roads, and their representativeness of the pastoralist and agro-pastoralist communities. *Ebiti* and *Kobo*, and *Gola* and *Turo* were selected, respectively, from *kebeles* inhabited by pure pastoralists and agro-pastoralists (i.e., people who engaged in some sorts of crop cultivation). A total of 60 households (i.e., 15 from each *kebele)* were selected randomly. The heads of the households were interviewed using a semi-structured questionnaire containing both closed and open questions. Closed questions are those questions where the households have a single replay whereas open questions are questions that the respondents have a freedom to give more than one answer to a given question. For open questions, sum of frequencies could be greater than 100%. When available, other members of the household were also allowed to participate during the interview.

The questionnaire mainly included socio-demographics, land ownership, livestock holding, source of livelihood, changes in the pastoral system and their drivers, and the effects of the change. Data on the number of livestock per household for three-time periods (1992/3, 2003/4, and 2013/4) were also collected through interviews to quantify trends over time. Droughts of 1991/2 and 2001/2 in most pastoral areas of the country and the establishment of the EPRDF (Ethiopian People's Revolutionary Democratic Front) regime in 1991 were used as a known

benchmark (see Desta and Coppock, 2002) to enhance their recalling capacity. The number of livestock reported by each household at these points in time is not necessarily precise, but would be sufficient for identifying trends over time (see McCabe *et al.*, 2010). The questionnaires also contained 5-point Likert scale questions to assess the perceived changes in the pastoral system and their drivers over time. Variables related to changes in the pastoral system and livelihood and their drivers in Africa's drylands were identified through a literature review. The identified variables were systematically organized into a 5-point Likert scale, with scores ranging from 1 (not at all important) to 5 (most important) to provide a wider range of responses. In this kind of question, households were asked to provide an index of relative importance for each variable.

Besides, focus group discussions (FGDs) consisting of elders, *kebele* leaders, livestock experts, and development agents (DAs) were undertaken at *Ebiti* (consisting of 13 participants) and *Gola* (consisting of 10 participants) to gain a better understanding of the issues not well addressed by the household survey. Additional information was gathered from the key FDPDO's staff through formal and informal discussions. The study was undertaken by the author and assistant researchers, who briefed about the purpose and the techniques of the study. Information about land-use type and livestock population were also obtained from the FDPDO.

Statistical analysis

Statistical Package for Social Sciences (SPSS) software (IBM SPSS, 2011) was used to analyze the data. The quantitative data were presented using descriptive statistics such as means, standard deviations, and percentages. Information collected through FGDs and open-ended questions were synthesized and summarized. The mean score was used to provide an index of relative importance among the variables. The Kruskal-Wallis test was also employed to compare the scores of different groups on some continuous variables. This test was employed to assess the predictive power of livestock holding and parcels of land per household on the perceived response of the households, and to compare livestock holding per household across different periods. Furthermore, Spearman's Rank Order correlation (Spearman's *Rho*) was applied to compare the strength of the relationship between perceived change in the pastoral system and perceived drivers of the change.

Results

Demographics of households

The average age of the respondents was 48.6±12.5, and 95% of the respondents were male. All respondents were married. About 73% of the respondents were illiterate and had not attended any level of education. On the other hand, only 1.67% of the respondents had high school education. Very few (3.33%) respondents had attended a kind of adult education, and could read and write. Relatively few respondents had attended primary (8.33%) and junior (13.33%) schools. The average household size, defined as a man, his wife, and their children who live together, was 8.80±3.67. Concerning age distribution, households in the study area were dominated by members under 30.

Land ownership and land-use type

Although increasingly dominated by the bushy cover, grazing land was the dominant (59.22%) land-use type in the study area. Arable land covered about 15% of the total land area of the district. All households had both grazing and arable land. Out of the total respondents, 38% had cultivated land that has been used only under rain fed with average size of 1.4±0.95 ha. Similarly, 37%

of the respondents had 0.9±0.54 ha of irrigated land. Few respondents (20%) owned cultivated lands both under rain fed and irrigation with average size of 2.7±1.22 ha. Among the interviewees, only 5% of the respondents rented about 0.4±0.29 ha of irrigated land from others. Both interviewees and group discussants indicated that the communally managed rangeland was presently divided into individual parcels. FDPDO's information indicated that the process of privatization was implemented following the foundation of the Fentale Irrigation Project in 2007/08, where about 3,000 ha of land were irrigated using the Awash River, which crosses the district. Pastoralists had received parcels of land with irrigation access, ranging from 0.5 to 0.75 ha based on their household size.

Livestock holdings

When households were asked about the change, they talked about the changes in livestock holding per household since the early 1990s, they all perceived that the number of livestock per household is declining. Some households were not able to answer the question regarding livestock per household because they could not recall past events of livestock trends. As a result, Table 1 summarizes average number of livestock per household for the three periods with number of respondents less than 60. Present results indicate that livestock holdings per household had declined since 1992/3. A Kruskal-Wallis test revealed a statistically significant difference in livestock holding, expressed as TLU (Total Livestock Unit) per household, during three different times (p = 0.000; Table 1). The TLU conversion factor of 1.0, 0.7, and 0.1 were used for camels, cattle, and small ruminants, respectively. The main reasons given for the decline in livestock holding were the diminishing of rangeland, feed and water shortage, and drought and disease-induced livestock mortality.

Table 1. Livestock holdings of major ruminants (cattle, sheep, and goat) and camel, expressed as TLU (Total Livestock Unit)

TLU	Respondents, *n*	Minimum	Maximum	Mean	SD
1992/3	39	3.0	162.9	46.7[a]	44.5
2003/4	29	1.4	88.5	22.8[b]	23.0
2013/4	52	0.6	42.6	11.3[c]	10.0

[a,b,c] Means with different superscript are significantly different;
TLU conversion factor: 1.0 for camels, 0.7 for cattle, and 0.1 for sheep and goats (Jahnke, 1982).

Sources of livelihoods

In the study area, livestock was the major source of livelihood, followed by crop cultivation. Households integrated cultivation with their pastoral system for their subsistence and income needs. Maize was the main crop as cultivated by 83% of respondents, followed by *teff* (28%) and sorghum (17%). Since households cultivated more than one type of crop, the resulting frequencies are more than 100%. Vegetables such as tomatoes and onions were also important. They were cultivated by an almost equal proportion of households (18 vs. 17%, respectively). Respondents were also involved in other livelihood diversification strategies, including wage-labor (10%), livestock trade (10%), and petty trades, particularly small shops (11.67%). Assuming that crop cultivation has emerged as livelihood diversification earlier than other non-livestock-based livelihood strategy, the period during which each respondent initially started crop cultivation was analyzed by grouping the years into six-time spans, each including five years (Fig. 2). The majority of the respondents had started crop cultivation during the years

between 1992/3 and 1996/7 (21.67%) and from 1987/8 to 1991/2 (20%).

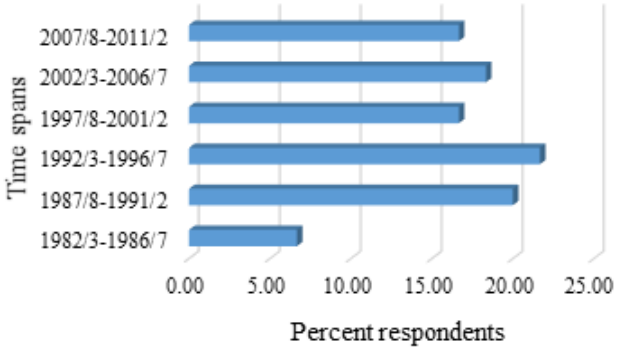

Fig. 2. Percent respondents who started crop cultivation during different periods (1982/3-1986/7; 1987/8-1991/2; 1992/3-1996/7; 1997/8-2001/2; 2002/3-2006/7; 2007/8-2011/2)

Changes in the pastoral system

All respondents perceived that the pastoral system in the study area had been declining in response to changes that took place since 1992/3 (Table 2). The current pastoral system was perceived to be threatened by extremely severe changes, including a decline in livestock holding per household (4.90), expansion of crop cultivation (4.83), and degradation of rangelands (4.79). Respondents also perceived declining herd mobility and migration as severe changes in the study area. The results indicated that the total perceived mean score of changes, which ranged from 10 to 50, was 34.81±4.10, with a grand mean score of 3.48. Kruskal-Wallis test indicated that the perception of households regarding changes in the pastoral system was affected by the number of livestock, and the parcel of cropland they had. The test revealed a statistically significant difference in perceived changes in the pastoral system among pastoralists who had different TLU per household, $p = 0.03$. Respondents with 20 to 30 TLU per household recorded a higher median score (Md = 37.80), followed by respondents who had less than 10 (Md = 26.95), 10 to 20 (Md = 19.06), and more than 30 (Md = 13.00). The total perceived score of changes in the pastoral system was also significantly different within groups of pastoralists who had a different size of croplands, $p = 0.01$. Households who had more than 4 and less than 1 ha of cropland recorded a higher median score of 57.00 and 35.43, respectively. Households who had 1 to 2 ha of cropland recorded a medium median score (Md = 25.11), followed by respondents who had 3 to 4 ha (Md= 17.17) and 2 to 3 ha (Md= 16.33).

Table 2. The perceived score of changes observed in the pastoral system in Fentale district, 1992/3 to 2013/4 (respondents, *n* = 58)

Changes	Mean*	SD*
The decline in livestock holding	4.90	0.31
Expansion of crop cultivation	4.83	0.38
Degradation of rangelands	4.79	0.52
Reduced livestock mobility	4.41	1.09
Migration	4.26	1.07
Animal mortality	3.62	1.14
Infrastructural development	2.48	1.40
Market fluctuation	2.02	1.28
Technological interventions	1.90	1.10
Intensification of livestock production	1.60	0.86

*****Mean score on a 5-point Likert scale: 1 = not severe (NS), 2 = slightly severe (SS), 3 = moderately severe (MS), 4 = severe (SE), 5 =extremely severe (ES).

When households were asked to compare current livestock production and people's livelihood with earlier days, they responded that several variations had existed. About 35 and 12% of the respondents, respectively, indicated that reduced animal productivity and reproductive performance were the major differences observed over the last 20 years. The outstanding reasons for this decline were sedentarization, increased risk of livestock diseases, and feed and water shortages. Interviewees and discussants indicated that the traditional rangeland had been degraded due to the invasion of *Prosopis juliflora* (locally called *Woyane*) into grazing lands, and expansion of Lake Beseka area, sugarcane plantation of Metahara sugar enterprise, and Metahara town into the traditional grazing lands. The key staff of FDPDO also indicated that overgrazing was one of the main challenges that pastoral systems and livestock production face in the study area.

Drivers of the change

Households indicated that increasing human population (4.81), shortage of land (4.76), adoption of cultivation (4.67), and water shortage (4.29) were perceived to be the most important drivers of change (Table 3). The total perceived mean score of the drivers of changes observed in the pastoral system ranging from 7 to 35 was 27.86±3.03, with a grand mean score of 3.98. The Spearman's Rank Order correlation coefficient also indicated that there was a strong positive correlation between perceived changes in the pastoral system and perceived drivers of changes, $r = 0.46$, $n = 58$, $p = 0.0003$.

Table 3. The perceived score of drivers for the observed changes in the pastoral system in Fentale district, 1992/3 to 2013/4 (respondents, *n* = 58)

Drivers	Mean*	SD*
Increasing population	4.81	0.40
Land shortage	4.76	0.68
Adoption of cultivation	4.67	0.51
Water shortage	4.29	1.18
Climate change	3.78	1.41
Socio-cultural changes	3.61	1.55
Technological innovation	1.93	1.07

*****Mean score on a 5-point Likert scale: 1 = not important (NI), 2 = slightly important (SI), 3 = moderately important (AI), 4 = important (IM), and 5 = most important (MI).

Discussion

Transitions in the pastoral system

There are multiple concerns regarding the sustainability of pastoral systems and people's livelihoods in arid and semi-arid regions of Africa. These systems are evolving in response to several social, economic, and ecological drivers and challenges. The decline in livestock holding per household, expansion of crop cultivation, degradation of rangelands, reduced herd mobility, migration, and animal mortality are highly perceived changes by *Karrayu* pastoralists (Table 2). The perception of the households about these changes was significantly affected by the number of livestock per household and parcels of cropland. Households who have 20 to 30 TLU per household and more than 4 and less than 1 ha of cropland have experienced the real changes better than others. The total perceived mean score of changes observed in the present study (34.81±4.10, with a grand mean score of 3.48) also suggests that severe changes have occurred. Given the current changes, pure pastoralism may no longer be viable in the study area. The economic diversification by pastoralists supports this evidence, suggesting that livestock alone could not support their livelihoods as livestock productivity is declining. Reasons given to explaining the decline in livestock productivity include sedentarization, animal diseases, and feed and water shortages owing to the alienation of rangelands.

Similar to previous studies in different parts of Ethiopia (Desta and Coppock, 2002; Angassa and Oba, 2007; Gebru *et al*., 2007; Yosef *et al*., 2013) and in northern Tanzania (McCabe *et al*., 2010), per household livestock holding in the current study is perceived to decline. The number of livestock per household has declined by about 35 TLU within the last two decades (Table 1). The decline in number of livestock per household could be related to changes in land-use patterns and shrinkage and degradation of communal rangelands. The livestock number per household reported in this study suggests that households have fewer animals than the minimum requirement for the long-term viability of pastoralism. Thus, livestock alone is becoming insufficient to support households' livelihoods, driving pastoralists to non-livestock livelihood strategies. The transition to a more diversified economy has also been observed in other pastoral systems in Africa (McCabe *et al*., 2010). However, this does not mean that pastoralists leave livestock behind as they engage in new livelihood activities (BurnSilver, 2009).

Although areas that receive 500 to 700 mm of annual rainfall are considered marginal for rainfed agriculture (Yemane, 2003), cultivation was perceived to expand as a livelihood diversification strategy. The perceived expansion could be due to population pressure and encroachment of the rangelands by agrarians from the adjacent highland areas. Tsegaye *et al*. (2010) also indicated that a high influx of migrants from the Tigray highlands to Northern Afar rangelands has resulted in an expansion of cultivation into the alluvial plains of the Afar region. This expansion could ultimately lead to the loss of quality grazing lands and water resources for extensive pastoral production. The study also indicates that agro-pastoralists adopted cultivation earlier than pastoralists in 1982/3 from *Ituu* Oromos, the migrants who moved to the study area in the early 1950s. Similar to other countries in Africa, Asia, and Latin America (Davies *et al*., 2010), the government lead by EPRDF was encouraging cultivation by forming pastoral associations, thereby pastoralists started to sedentarize. In line with this study, Müller-Mahn *et al*. (2010) indicated that *Karrayu* pastoralists have settled and taken up farming due to the expansion of irrigation agriculture in areas along the banks of the Awash River. They settled in the surrounding area of Metahara town in an

attempt to claim the land and to prevent further encroachment by the state farm or migrants from the highlands. Sedentarization of pastoralists, whether forced or spontaneous, has resulted in severe land degradation in semi-arid rangelands (Niamir-Fuller, 1999).

The current results indicate that among the respondents who started cultivation between 1992/3 and 1996/7, more than one-third (39%) did so within a year (1992/3). Similarly, among the households who started crop cultivation from 1987/8 to 1991/2, 58% did so within a year (1990/1). This result confirms that the adoption of cultivation was associated with the droughts of 1991/2 and 2001/2 in most pastoral areas of the district. In line with the current study, Müller-Mahn *et al*. (2010) reported that most of the agro-pastoralists in Fentale pursue a mixed livelihood strategy of growing maize for subsistence, selling goats and sheep in case of a consumption gap, and generating additional income through wage labor and the sale of firewood and charcoal. Some households also concentrate almost exclusively on market-oriented production of vegetables such as tomato and onion. Similar practices have been reported by BurnSilver (2009) for Maasai communities in Amboseli. Although migration, settlement, and cultivation are means of adapting to adverse conditions, they have created serious environmental and socioeconomic problems (Niamir-Fuller, 1998). These changes imply a decline in the number of livestock that can be maintained on small individual parcels, thus pushing pastoralists to substantially change their livelihood strategies and the way they raise livestock (BurnSilver, 2009). The privatization of communally managed rangelands has resulted in the gradual weakening of the predominantly communal land tenure system and increases in land scarcity in the district (Müller-Mahn *et al*., 2010). These authors further added that local wealth criteria have shifted from livestock as a main criterion towards the type and amount of crops planted associated with the new monetary value of the land.

In arid and semi-arid lands, mobility can avoid rangeland degradation as it allows pastoralists to move their animals around and, thus balancing the stocking rate with the available rangeland resources (Ayantunde *et al*., 2011). The perceived degradation of rangelands in the current study area could reflect the decline in livestock mobility. As a consequence of these factors, the total livestock population would exceed the net carrying capacity of grazing lands. Similar to these results, Yemane (2003) and Abule *et al*. (2007) indicated that rapid expansion of less desirable plant species (e.g., *Prosopis juliflora*) leads to the degradation of rangelands. *Prosopis juliflora* is a thorny, drought and salt-tolerant plant, which was introduced by the Ethiopian government in the late 1980s around state farms and settlements to improve the microclimate (Rettberg, 2010). Rettberg (2010) further added that its spread grew totally out of control after the collapse of state farms at the beginning of the 1990s. Consequently, grazing lands have become more limited.

Reasons given by the respondents for the decline in livestock mobility were sedentarization, fragmentation of rangelands, and expansion of crop cultivation and large investment projects into the grazing lands. Similar results were reported by Adriansen (2006) for the Fulani of Senegalese. Gebru *et al*. (2007) and Solomon *et al*. (2007) indicated that reduced livestock mobility leads to a concentration of grazing pressure on particular areas. Reduced mobility also indicates continuous grazing around the settlements, resulting in reduced vegetation diversity and soil degradation (Niamir-Fuller, 1999). In their review, Fratkin and Mearns (2003) explained that loss of grazing lands to game parks and large farms has drastically reduced herd mobility, thereby forcing pastoralists into greater competition

for land. Reduced herd mobility may also lead to an increase in livestock disease (McCabe *et al*., 2010). Livestock disease will significantly cause high livestock mortality. This suggests that reduced livestock mobility can affect the pastoral system in several ways. The present study reveals that pastoralists still commonly practiced short-distance mobility, herd movements restricted within the district, and adjacent vicinities. Similar to the findings of Gebru *et al*. (2007) and Elias (2008), *Karrayu* pastoralists have practiced long-distance camel mobility to other districts and zones within the Oromia Regional State, as far as 300 km from their homestead. The decline in the frequency and distance of livestock mobility is largely due to agricultural encroachment onto rangelands, which leads to a general shortage in grazing land and blocking of traditional transhumance routes (Niamir-Fuller, 1999).

Drivers of the change

It is difficult to isolate the root causes of transitions in pastoral systems due to a multiple series of links in an elaborate chain of causes and effects (Davies *et al*., 2010). Households perceived that population growth, shortage of land, adoption of cultivation, water shortage, and climate change were the main drivers of the changes observed in Fentale district (Table 3). The correlation coefficient results suggest that a higher level of perceived change is associated with a higher level of perceived drivers of change. In line with the current results, empirical evidence from different pastoral areas of Ethiopia (Coppock, 1994; Desta and Coppock, 2002, 2004) and East Africa (Galvin *et al*., 2004; Ekaya, 2005) shows that pastoral populations have been growing. Coppock (1994) and CSA (2008) reported annual population growth rates of 2.5% for Borana of southern Ethiopia and 2.9% for the Oromia region between 1994 and 2007, respectively. Some empirical evidence specific to the study area shows that total rural population has increased from 48,114 in 1994 (CSA, 1996) to 61,708 in 2007 (CSA, 2008), an overall increase of 22%. Baseline information gathered before the commencement of this study also indicates that the human population was estimated to be 70,844 in 2013, suggesting that population growth rates have increased in recent times. Growth in the human population could partly be associated with the sedentarization of pastoral people.

Population growth within pastoral systems, as a function of both natural growth and large immigration of agrarians, has been a fundamental issue in the field of pastoral development (Prior, 1994). It affects the pastoral system in several ways. Population pressure has resulted in rapid structural and functional changes in livestock systems, including increased competition between rangelands and cultivation (Yemane, 2003; Ekaya, 2005; Seré *et al*., 2008), and rangeland degradation (Prior, 1994; Abule *et al*., 2005, 2007). The competition between rangelands and cultivation, in turn, has resulted in an expansion of cultivated lands into rangeland and land fragmentation, thus leading to substantial losses of grazing lands. Because of population pressures and agricultural expansion, there will be no place for extensive pastoral systems (Moritz, 2008), thereby pastoralism will likely disappear (Solomon *et al*., 2007). Population pressure has also increased the risk of food insecurity among pastoral communities (Prior, 1994; Desta and Coppock, 2004). Due to its strong interrelationship with the transition of pastoral systems, any pastoral system studies should take population trends and their consequences into account.

Prior (1994) argued that development has historically encouraged the transfer of pastoral land to more financially rewarding uses and more politically powerful land users. Agro-pastoralists in the Fentale have lost extensive grazing lands due to the

establishment of Awash National Park and the development of large-scale projects. They have lost about 22,000 ha of land to sugar cane plantations of the Metahara sugar enterprise (Yemane, 2003). Following the establishment of the enterprise and its series of irrigated sugarcane plantations in the early 1950s, the pastoralists were forced to leave the fertile floodplains and inhabited the marginal lands around the hills that are less suited to sustainable pastoral production (Elias, 2008). As reported by Elias (2008), pastoralists in Fentale have also lost about 75,000 ha to Awash National Park. These sites together represent some of the best dry season grazing areas along the Awash River (Elias, 2008). Consequently, pastoralists tend to look for other livelihood strategies instead of depending on livestock alone for their livelihoods.

Households perceived that shortage of water was a serious challenge in the study area due to the negative impacts imposed by drought and environmental degradation; in turn, it leads to substantial animal mortality, as also reported by Desta and Coppock (2002). Shortage of water as a common challenge was also reported in other pastoral systems of East Africa (Nyariki *et al*., 2009; Rufino *et al*., 2013), Fentale (Abule *et al*., 2005), and other pastoral areas of Ethiopia (Yemane, 2003), suggesting that water shortage is a big challenge in almost all dryland rangelands. Although it is difficult to identify its effects from other drivers, households perceived that climate change could affect the pastoral system in several ways. These include feed and water shortages, livestock mortality, increased disease risks, and reduced livestock productivity and reproductive performance, as also supported by Galvin (2009), who indicated that climate change is one of the sources of transformations in the pastoral system.

Loss of livestock owing to a decline in livestock holding per household and severe recurrent droughts caused by unpredictable rainfall patterns are highly likely expected. These have profound implications for the future of pastoral systems (Abule *et al*., 2005), as also perceived by households in the present study. Households responded that livestock intensification is the best coping and adaptation strategy in response to perceived challenges for the prospects of the pastoral system. They defined livestock intensification as the use of adaptive and relatively productive genotypes along with improved management practices (feeding, housing, and health management). In summary, some of the factors discussed are changes, some are drivers of change, and some are results of change. However, it is important to note that each of the factors can be drivers, changes, and responses depending on one's point of view, and each contributes to the realization that pastoral systems are complex, dynamic, and ever-changing (Galvin, 2009).

Conclusions and Policy Implications

Though contribute significantly to the national economies and the livelihood of pastoralists, pastoralism in Fentale has faced several challenges and changes to the traditional pastoral system and livelihoods. Privatization of rangeland and transfer of communal grazing land to more beneficial land-uses has changed the traditional land-use patterns and significantly altered land rights. Land-use change, coupled with the growing human population, has increased pressure on pastoral communities because there is increased competition between rangeland and crop cultivation. At the same time, increases in crop cultivation and associated sedentarization have reduced available grazing lands and livestock mobility, which are the critical factors for the sustainability of the pastoral systems. The pressure of these often-interrelated drivers would likely continue to affect the pastoral system for some decades to come,

but uncertainly and unpredictably. Thus, the concern and question that remains important is the sustainability of the pastoral system in the study area.

The extensive pastoral system is no longer a sustainable livelihood option for pastoralists in the study area for several reasons. First, changes in the land-use pattern will likely continue due to both external and internal pressures on rangeland, particularly expansions of Lake Beseka and large-scale irrigated agriculture into the fertile rangeland and the surrounding areas. Livestock mobility and the migration routes of the pastoralists would be restricted. The expansion of large-scale irrigation agriculture is happening in Fentale because it is closer to the urban and central market, and the fertile rangeland is an essential resource for successful crop cultivation. Second, there will be no place for the extensive pastoral system due to the growing human population, rangeland degradation, and expansion of crop cultivation into the rangeland. Livestock holdings per household will continue to decline as the rates of rangeland degradation exceed the carrying capacity of grazing lands to support the existing livestock population. Therefore, a sustainable option that accommodates the existing situation and future expectations need to be suggested, without undermining pastoralism.

Though livestock is still the source of livelihood for most pastoral households, economic diversification is undeniably occurring rapidly in the current study area. Intensification of livestock production is also an emerging strategy elsewhere in Africa as households struggle to increase outputs under conditions of declining mobility. An enabling policy environment for pastoral development needs to be created by considering these strategies. However, an examination of available opportunities and the likely trade-offs associated with economic diversification and livestock intensification in pastoral systems is required. At the same time, any single research approach cannot cover the assessment of changes and their impacts on the pastoral system, and people's livelihoods. Thus, a better understanding of the pastoral system as a whole requires a multidisciplinary study approach comprising of disciplines including ecology, anthropology, socioeconomics, and livestock systems.

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