

The recent decrease in the number of livestock and its cause for the farmers in the Ethiopian highland —From the cases in Kilite Awlaelo district in Eastern zone of Tigray region—

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Abstract: The purpose of this research was to study in the Tigray highland of Ethiopia 1) to understand the change in the land utilization, the grazing patterns, and the change in the number of livestock, in light of the recent natural and social environmental changes, 2) to analyze the decrease in the number of livestock and its contributing factors, and 3) to discuss that the decrease in the number of domestic animals has a negative influence to the nutrition intake of local farmers. The field research while staying with a total of eight households and the survey questionnaire on a total of 14 households were conducted in September 2016 and July 2017, and the study on the farmer's nutrition was also performed in March 2015 in the study area. From the imperial era through the socialist era, most of the land was still made up of grasslands and forests, which were available for grazing and logging. Each household raised from 10 to 30 cattle, making them rich financially and nutritionally. With the increase in population in the democratic era, however, there was a shortage of farmlands, and the grasslands and forests rapidly shrunk as more and more those communal lands was developed into farmlands. The grasslands and forests that had been used for grazing year-round shrunk even more when the government expanded the areas of seasonally-closed grazing land, prohibited grazing lands and protected forest lands. Furthermore, there was a shortage of herd boys who are in charge of grazing once schooling began in the villages. As a result, the number of livestock raised by a household began to dwindle. Since the farmers were only able to raise a few cattle, they could no longer obtain milk throughout the year, which led to a decreased consumption of milk products. The milk product's contribution to their nutrition has become limited. The decrease in the amount of feed resources and the shortage of herd boys limited the number of livestock that could be raised by each household, and will mostly likely continue to be a major contributing factor in limiting the subsistence of the farmers in Tigray.

Keywords: Ethiopia, livestock, school education, drought

1. Introduction

A third of the population starved to death and 90% of the livestock died in Ethiopia in the 1988 and 1989 East Africa drought (Edossa *et al.*, 2010). There is a trend of frequent droughts in the recent years, including the drought in 1965, 1972-1973, 1983-1984, 1987-1989, 1992, and 2005-2006 (Seleshi and Zanke, 2004; Pantuliano and Wekesa, 2008; Gebrehiwot *et al.*, 2011; Conway *et al.*, 2011). These frequent droughts have affected the highland region of northern Ethiopia, specifically resulting in damages to agricultural products and a decrease in feed resources (Gray, 2011). There was soil degradation from drought, soil erosion, decreased forest

areas, vegetation regression, inappropriate cultivation, and increased number of livestock (Hurni, 1988; Shiferaw and Holden, 1999; Taddese, 2001; Bishaw, 2001). In addition, a shortage of farmland from increased population (Pender and Gebremedhin, 2006), as well as a shortage of food supply from soil degradation, increased population, drought, and lack of technology development (Holden and Shiferaw, 2004) had been identified, leading to various government and NGO aids (Holt, 1983; Barrett *et al.*, 2002; Quisumbing, 2003; Mosley *et al.* 2004; Yamano *et al.*, 2005; Levinsohn and McMillan, 2007, Sachs, 2008; Nyssen *et al.*, 2009).

The average rainfall in the northern Ethiopian highland is about 572 millimeters (National Meteorological

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Agency, 2012), the De Martonne (1926) aridity index (I_{ar}) is $19.4 \text{ mm} / (^\circ\text{C}+10)$ which shows semi-arid (Ives, 1929), making it possible to farm using rainwater. The main subsistence of the Tigray people from the northern Ethiopian highland is mixed-farming, a combination of crop cultivation and livestock keeping, where they raised livestock while they farmed. In Tigray, the cattle are raised to produce milk and meat, to sell at a market, and also are used to plow the fields. With the further growth in population leading to a shortage of farmlands and fewer livestock per household, it is presumed that their subsistence would not be viable for long. There is a report on how the droughts decreased the number of livestock per household (Tegebu *et al.*, 2011), but there have not been enough discussions about how the natural and social environmental changes affected the number of livestock. It is very important to analyze the recent trend in the number of livestock from the perspective of natural and social environment in order to discuss the future ways of mixed-farming in the Tigray highland. Furthermore, since the change of political regime in Ethiopia would revise the land management system and consequently there is possibility to affect the number of livestock held by local farmers, it is necessary to understand land utilization, grazing patterns, and the number of livestock according to the political regime.

This research, which took place in the northern Ethiopian highland, aimed 1) to understand the changes in land utilization, grazing patterns, and the number of livestock, in light of the natural and social environmental changes through the imperial era, the socialist era, and the democratic era, 2) to analyze the recent decrease in the number of livestock and its contributing factors, and 3) to discuss that the decrease in the number of domestic animals has a negative influence on nutrition intake.

2. Study area and research households

2.1. The location and the natural environment of the study area

The study area was at the three villages (*Kushet*) in Debre Birhan community (*Tabia*), Kihen community, Agulae community in Kilite Awlaelo district (*Woreda*), Eastern zone, Tigray region in northern Ethiopia (**Fig. 1**). The average monthly temperature in Wukro town where is located in the central-eastern part of the district is about 20°C year-round. The climate is stable all year because of its proximity to the equator. The average highest monthly temperature is about 30°C

and the lowest monthly temperature is about 10°C . The temperature varies much more in a day than in a year. Wukro is on a semi-arid land with an average annual rainfall of 572 mm from 1992 to 2013. The rainfall fluctuates from year to year, however, as the region received 984 mm of rain in 2000, but 1992 was a year of the drought with only 305 mm of rainfall. July and August mark the rainy season and September through June is the dry season. There could be significant amount of rain from April to June depending on the year. The study area in the northern Ethiopian highland is located near the equator, but it is located around 2000-2300 m above the sea level, which experiences a warm and stable temperature throughout the year. This semi-arid region has both a rainy season and a dry season with a large disparity in the amount of rainfall each year.

2.2. The research households and the research method

The researchers conducted a research while staying with a total of eight households in September 2016 and July 2017 to study the changes in the livestock number, the farmland expansion, and social situations in the imperial era (before 1975), the socialist era (1975 to 1990), and the democratic era (after 1991). At village A in the Debre Birhan community, we interviewed a 54-year-old male, the head of the house of the GG household (case 1), a 47-year-old female, the wife of the GN household (case 2), an 86-year-old female, the elder of the EG household (case 3), and an 89-year-old male, the elder of the GW household (case 4). At village B in the Kihen community, we interviewed a 52-year-old male, the head of the house of the MT household (case 5) and a 78-year-old male, the elder of the BH household (case 6). At village C in the Agulae community, we interviewed a 51-year-old male, the head of the house of the GH household (case 7) and a 73-year-old male, the elder of the MY household (case 8). These households were selected from the point of the existence of elder farmers and/or farmers who were familiar with local conditions to get the information from imperial era. Furthermore, the researchers conducted a survey questionnaire on a total of 14 households from the Debre Birhan and Kihen communities in September 2016 to understand the change in the number of livestock per household (cases 9-22).

The researchers also performed a study on the farmer's nutrition in March 2015 to find out how much of

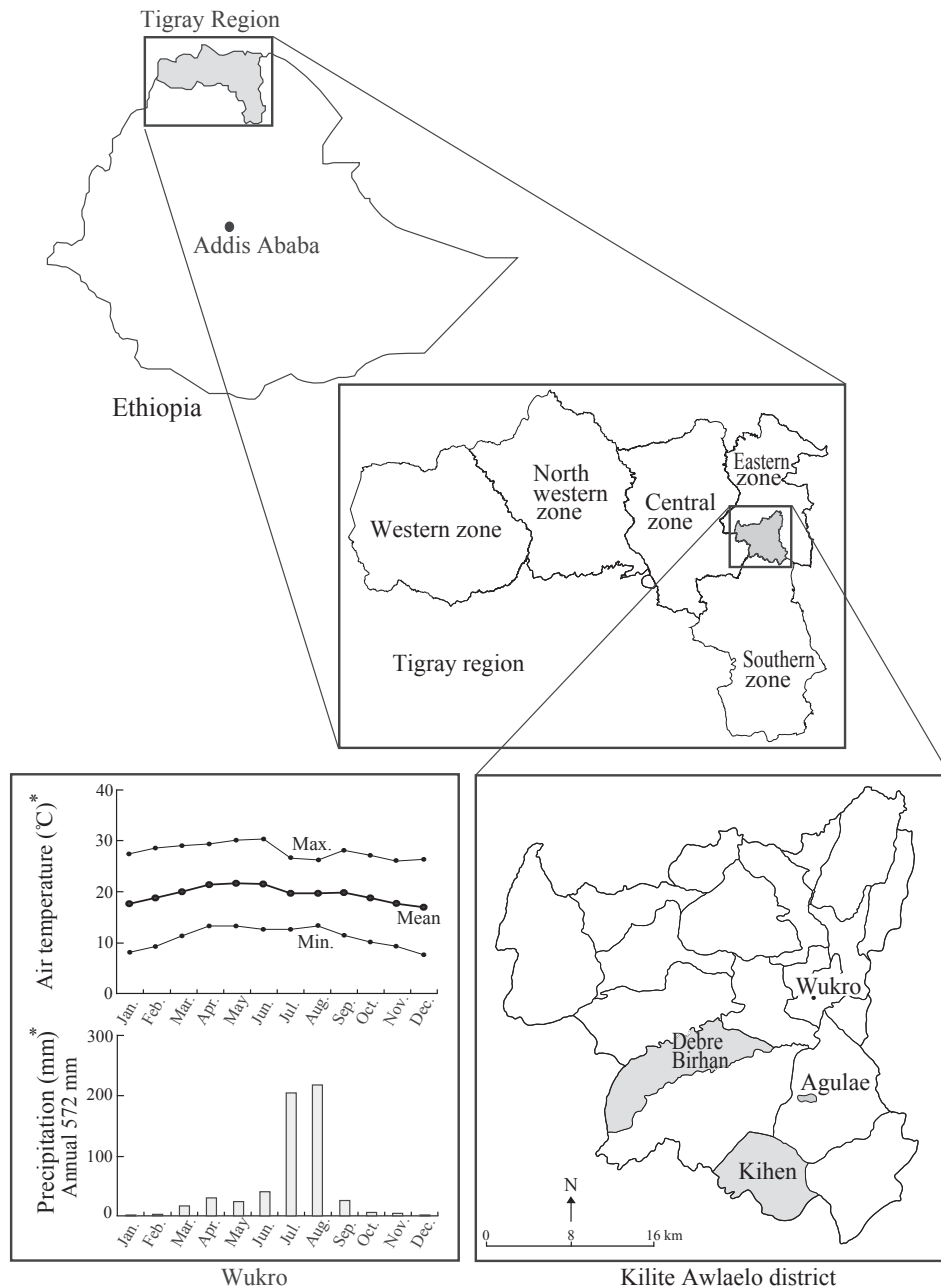


Fig. 1. Air temperature (°C), precipitation (mm), and survey area (■) in Kilite Awlaelo district, Eastern zone, Tigray region in northern Ethiopia.

*: Air temperature and precipitation are the 22 years' average from 1992 to 2013 (National Meteorological Agency, 2012).

their meals were made up of raw milk that their livestock produced. In Village A in Debre Birhan, we followed the diet of a 11-year-old female, AG, the second daughter from the GB household, for five days. This research was conducted during the period when the cows were lactating and the GB household could obtain raw milk. We tracked AG's diet by logging the food items and measuring the quantity using a portable food scale (AND HL-4000). The Tigray farmers shared their meal with the rest of their family and relatives and rarely dined alone. Therefore, to determine AG's portion, the dishes

were weighed before and after the meal and the amount eaten was divided evenly by the number of people at the meal. In terms of the amount of individual ingredients AG ate, the researchers measured the total weight of each ingredient used in the dish and then calculated the amount based on the ratio of the total weight of the meal and the amount consumed by AG. The macronutrients that AG consumed in a day was calculated using the food composition table (Kagawa, 2006; Jenness and Sloan, 1970) to find the calories, protein (g), fat (g), carbohydrate (g), and ash content (g).

2.3. The land utilization and the farmlands

Ethiopian imperial government was overthrown in a coup d'état by the Provisional Military Government known as the Derg in 1974 and became a socialist country. The new government announced that all farmlands will be nationalized, transferring land ownership to the state and banning private land ownership. The farmers were granted the right to use the farmlands (Cohen and Dov, 1975; Bereket, 2002). This system of land belonging to the state still continues to this day. The amount of farmland allocated to an individual farmer was determined by the local community association based on the amount of land area, the number of households and the family composition in the region. If a head of the house passed away, his wife took over the previous land tenure and managed the farmland if she was able and healthy. If a head of the house died and his wife was not able to manage the farmland, the land was returned to the local community association. The sons of the head of the house did not have the right to inherit the use of the land. Most of the attempts to socialize agriculture failed in the 1980's, resulting in a food crisis in Ethiopia (Dessalgen, 1992). In 1991, the Ethiopian People's Revolutionary Democratic Front (EPRDF) ended the reign of the Derg and Ethiopia became a democratic country. After democratization, the farmers were able to lease the land or pass the land down to other family members even though the land remained in the state's ownership (Yigremew, 1999).

The Wirsi system was implemented in around 2010 in the southern region of Kilite Awlaelo district in Tigray. This system made it possible for the children of the farmers to inherit the land that had been used by the household (Alemu, 2012). Although the sale and purchase of farmlands was still prohibited, they were now allowed to rent and lease the lands as well. The implementation of the Wirsi system, in addition to the growing population, radically reduced the amount of farmlands returning to the local community association, leaving less farmland that could be distributed to young, newly-wed households. In village A in Debre Birhan in about 2012, a young, newly-wed household could request and receive the right to use about 1 to 2 *timad*^{Note 1)} of farmland from the local community association. In 2017 today, they do not receive any farmland even when requested. As it stands, there is no more farmland left to distribute to individuals due to the population increase and the change in the farmland inheritance system.

3. Decrease in the number of livestock and expansion of farmlands

3.1. The imperial era (Before 1975)

3.1.1. The development and expansion of farmlands from grasslands and forests

In the imperial era, the grasslands and forests were maintained by the local community associations. The farmers were free to develop the natural grasslands and forests into farms and they were able to privately own and use these farmlands. The household from case 4 stated that the farmlands in Debre Birhan were used for large-scale farming by landlords, which was called *resti*, and small-scale farming by individuals, which was called *chiguraf goses*. In the *resti* system, the landlord used extensive areas of farmland, hiring his relatives as peasant farmers for plowing and planting crops. Such relatives who worked as peasant farmers were out-of-town relatives who did not live in Debre Birhan. The landlord seemed to have severed ties with his blood relatives in Debre Birhan and operated the farms on his own. The landlord kept $\frac{3}{4}$ of the farmed products while the peasant farmers received $\frac{1}{4}$ of the farmed products. Even a quarter of the farmed products were plenty for the peasant farmers to live comfortably for the year. They were able to produce 1,500 kg of wheat in 2 *timad* of farmland in the years they had enough rainfall. This meant that the peasant farmers received about 400 kg of wheat when they planted wheat on 2 *timad* of land. Currently, they are only able to produce 200 to 600 kg of wheat per *timad*, even with the use of a fertilizer and sufficient rainfall. Productivity was much higher in the imperial era than it is today.

In the *chiguraf goses* system, the small-scale farmers' households living in Debre Birhan each had their own farmlands where they planted crops. The household in case 4 expanded their farms to 15 *timad*. At the end of the imperial era, there were about 200 households residing in village A in Debre Birhan, and each owned about the same amount of farmlands. Based on the statement from case 4, the 200 households used about a combined total of 3,000 *timad* of farmland under the *chiguraf goses* system by the end of the imperial era. The ratio of farmland to the land in the region was still very minimal, even when combining all the farmlands used by the landlord and the households. Up to this point, most of the land in Debre Birhan remained a grassland and forest available for grazing or logging.

In the Agulae Community, the church owned large areas of farmland instead of a landlord. According to the statement from case 8, a church operated the large-scale farms, which was called Rim and individuals operated the small-scale farms, which was called *resti*. The *resti* system meant a large-scale use of farmland by a landlord in Debre Birhan, but in Agulae, it meant a small-scale use of the farmland by individuals. In the Rim system, the government assisted the church to extensively develop farms on the flat and productive land along the Hangug river, which flows through the center of Agulae. The church was staffed with congregation members in addition to a priest and a deacon, who were each involved in their own agricultural activities at the farms. The priest, the deacon, and the congregation members each owned enough land to live comfortably. Case 8 in village C was deacon who used about 20 *timad* of farmland. They each paid taxes to the government and in return, the government supported the church operations.

In the *resti* system, the farmers used the areas that were not used by the church. In other words, many of them had to use the farms in the hills, instead of the flat and productive lowland along the Hangug River. It was difficult for the households to obtain enough farmland in the village to make a sufficient living, because flat land was limited on the hills. Therefore, they needed to go beyond the hills and the valleys to develop farmlands in the grasslands and forests far from the village. Under the *resti* system in Agulae, the people living in the village on the hills ended up owning widespread areas of farmland on either side of the river basin.

According to the statement from case 6, there were no landlords in village B in the Kihen community. All the households each developed their own small-scale farms from the grasslands and forests and grew their own crops. In case 6, the household used 15 *timad* of farmland. The village began with three households, but by the end of the imperial era in 1975, there were almost 40 households. This meant that there were only about 600 *timad* of farmland developed at the end of the imperial era and most of the land in the region was still undeveloped grasslands and forests.

3.1.2. The grazing system

As stated by case 4 from Debre Birhan, the farmers fundamentally raised their livestock by grazing them in grasslands, natural forests or harvested farmlands. They rarely fed livestock by crop residues or hay that they

collected from grasslands.

There were some seasons when the farmers did not return to the village, but stayed at the grassland and forest for several months to graze the herd (Fig. 2). They said that staying at the grasslands and forests and caring for the herd was easy, because there were many children available to help. Children were typically in charge of the herd at the grasslands and forests. Once a child turned 10 years old, he started taking part in the grazing of livestock. The households with fewer children had to take day trips to the grasslands and forests.

According to case 4, there were seasonally-closed grazing land called *hizaeti meret* in village A in Debre Birhan since the imperial era. *Hizaeti meret* was established independently by the local community association of village A in Debre Birhan. The grazing was prohibited from mid-July to mid-September in *hizaeti meret* in the imperial era. This period fell on the rainy season and corresponded to the rainiest time of the year. The ban on the use of the grasslands and forests from mid-July to mid-September targeted the time when plants sprouted and grew following the rainy season, with the intent to secure sufficient amount of vegetation as feed resources. Even during the off-season when *hizaeti meret* were open, the farmers only took their oxen they used for plowing to *hizaeti meret*. Despite what it seems, *hizaeti meret* was not necessarily a system to maintain vegetation conservation at the grasslands and forests, it was a land utilization plan instituted by the local people to be able to secure enough feed resources for their oxen used for plowing. It is easily understood that the establishment of the seasonally-closed grazing land called *hizaeti meret* was closely linked to the farming activities. The location of *hizaeti meret* was selected for its proximity to the village and also its proximity to a water source. The cows were never taken to *hizaeti meret*, but were taken to the free grazing land year-round called *habar meghatsi meret* where grazing in the grasslands and forests was allowed throughout the year.

According to the statement from case 6, there were *hizaeti meret* in Kihen since the imperial era as well. The grasslands and forests closed at the beginning of July when the rainy season began and there were absolutely no grazing activities until the end of December. The farmers grazed just the oxen at the beginning of January when the feed resources started to dwindle in the dry season. In village B in Kihen, the farmers grazed the cows in *hizaeti meret* in May and June. Depending on the

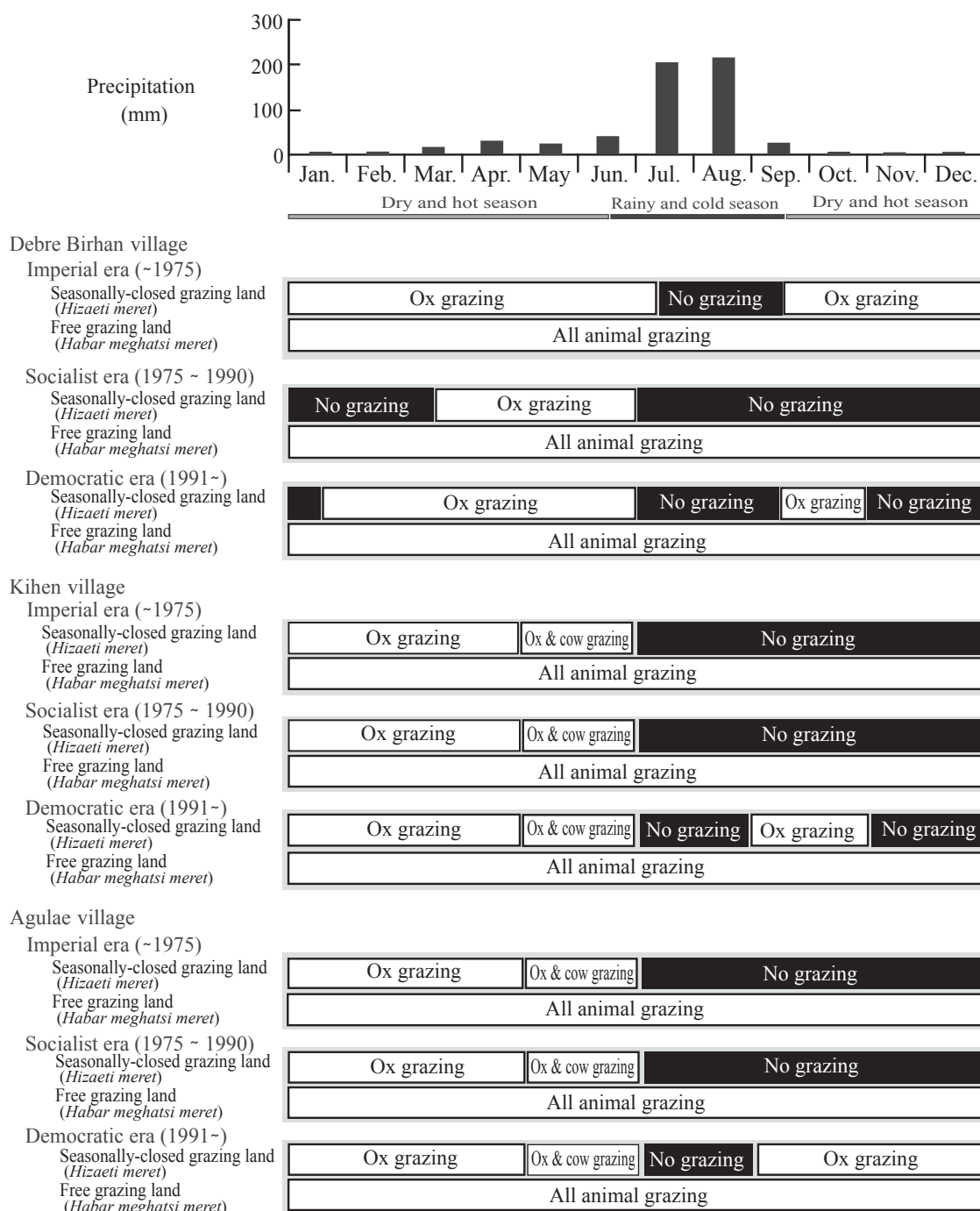


Fig. 2. Grazing management in grazing land of Debre Birhan, Kihen and Agulae villages in Kilite Awlaelo district during imperial, socialist and domestic eras.

season, the farmers stayed at free grazing land, *habar meghatsi meret* for several months at a time while the herd boys milked the cows and processed the milk. After months of stay at *habar meghatsi meret*, the herd boys brought the herd back to the village with some butter oil. According to the statement from case 8 in the village C in Agulae, the farmers in Agulae also used the same system as *hizaeti meret* in Kihen.

According to case 6, eucalyptus trees were once

planted in the imperial era when vegetation began rapidly regressing in some of the areas used by the people of village B in Kihen. This was a government-led initiative and the region was administratively designated as the lands of prohibited grazing and protected forest called *deni meret*. When a land is designated as *deni meret*, grazing is obviously prohibited year-round and the farmers were also prohibited from collecting wood and even branches that had fallen from woody plants like

the Acacia, etc. They were only allowed to cut and carry herbaceous plants back to home from deni meret. This deni meret system was not established by the local community association, but instituted by an outside entity as directed by the government. In this manner, the government had already established the grazing prohibition and protected forest lands in village B in Kihen since the imperial era.

As described above, the local community associations established seasonally-closed grazing land in each village voluntarily in order to secure feed for their draft oxen. Most households had enough children to help out with grazing and they stayed at the grassland and forest for several months to manage the herd.

3.1.3. The number of livestock, the livestock production and its consumption

In case 4 from Debre Birhan, the household raised about 32 cattle (12 oxen and about 20 cows and calves combined), 0 sheep and goat, 4 donkeys, 4 mules, and 0 chicken in the imperial era. In case 3, the household raised a total of 20 cattle, a total of 25 sheep and goats and 3 camels. The household from case 6 in Kihen raised 16 cattle (4 oxen, 6 cows, and 6 calves), about 150 sheep and goats, and 2 donkeys. The household from case 8 in Agulae raised about 30 cattle (10 oxen, 10 cows, and about 10 calves), 5 donkeys, and 0 sheep and goat.

Based on the testimonies given in cases 3 and 4, they drank raw milk and buttermilk and ate butter oil and curdled milk with whey every day in the imperial era^{Note 2)}. Hence, it is understood that the milk and milk products made up a large part of their nutrition. Back in the day, many of the households produced honey, because there were extensive areas of grasslands and forests nearby. In a weekly market in Agulae, the farmers' households also sold grains, butter oil, etc. The butter oil cost 1 birr per liter at the time. 1 birr could buy enough fabric to make a wardrobe for an entire family. An ox sold for 20 birrs, and a goat sold for 4 birrs.

From the information above, it shows that the households from each village each raised about 20 to 30 cattle, from which they were able to obtain resources that made them rich nutritionally and financially.

3.2. The socialist era (1975-1990)

3.2.1. The grasslands and forests that were not developed into new farms

All farmlands, including the large farmlands owned by

landlords and the small farmlands owned by individuals, were once seized by the government under socialism. The previous landlords, peasant farmers, and small-scale farmers' households were then granted new farmland usage right based on their family composition (Rahmato, 1984; Bruce *et al.*, 1994). According to the statement from case 1, one adult was allotted 2 *timad* of farmland and four children amounted to one adult in village A in Debre Birhan. For example, if a household was comprised of a husband, a wife, and four children, they were allotted a total of 6 *timad* of farmland. The household in case 1 had eight children, so they received 8 *timad*. Compared to the 15 *timad* of farmland they owned in the imperial era, this redistribution of 8 *timad* of farmland decreased the area of farmland they could use. The household from case 1 said that the lands were distributed fairly amongst the households using a lottery system. The redistributed farmlands were completely different from the farmlands they had previously. Some were as far as 7 km from the village, so the farmers did not go out to these faraway farmlands to plant crops at first. However, as the family grew, they eventually started working on the faraway farmlands. The local community association did not allocate new farmlands to the household when a son got married and started his own family, so some of the farmlands used by his parents were shared with the son and his new family.

In case 8, a husband and wife couple was allotted 10 *timad* of farmland in village C in Agulae. Here, a household comprising of a husband, a wife, and four children was allotted a total of 15 *timad* of farmland. Most households stopped working on a sloped farmland or a farmland that was too far from the village. Such abandoned farmlands eventually turned back to a grassland or a forest. It is understood that the amount of farmland and the number of households taken into account for redistribution differed by village, and the households from different villages were granted different areas of farmland.

As stated in case 1, the farmers from village A in Debre Birhan could no longer freely develop grasslands and forests into farmlands since entering the socialist era. It seems some households secretly developed farmlands anyway, but the local community association officially prohibited the development of grassland and forest into farmland. In other words, the development of grassland and forest was regulated in the socialist era. The illegal development of grasslands and forests was limited to a

few individuals, and for the most part, there was hardly any increase in the farmland area during the socialist era.

Case 6 stated that a government directive forced many of the farmers from village B in Kihen to move to southern Ethiopia. The farmlands in Kihen did not grow in size during the socialist era either. One of the main factors was related to the significant decrease in the number of households living in Kihen from the forced emigration, which made it unnecessary to develop new farmlands.

3.2.2. The changes in the grazing system

According to the statement from case 1, the use of the seasonally-closed grazing land called *hizaeti meret* became prohibited from July to middle of March in Village A in Debre Birhan. They were only allowed to take the oxen in *hizaeti meret* during the open season from mid-March to end of June and tried to sustain feed resources around the village. During this period, the oxen were often left at *hizaeti meret* with a herdsman for several months, instead of making day trips from *hizaeti meret* back to the village. They had to go down to the nearby river to obtain drinking water for the livestock in the dry season, but the livestock drank from the puddles in the rainy season. The cows grazed in the free grazing land year-round called *habar meghatsi meret*. In the socialist era, there were still extensive grasslands and forests available for grazing around the village. The farmers started making day trips with the cows to *habar meghatsi meret* throughout the year. They needed multiple herd boys to take a herd of oxen and a herd of cows out to the grasslands and forests separately. Each household typically had enough children to manage the herds in the socialist era.

Based on case 5, *hizaeti meret* in village B in Kihen were closed at the beginning of the rainy season in early July and did not open until the end of December. The farmers grazed just the oxen in the first half of January when they started running out of feed resources in the dry season. Then they grazed their cows at *hizaeti meret* in May and June. This land maintenance and grazing system had continued without any changes since the imperial era. The situation in Agulae was the same, according to case 7.

It is clear that even in the socialist era, the farmers took the oxen to the seasonally-closed grazing land for a long stay while they grazed the cows at the free grazing land daily throughout the year, and that each household had enough children to take care of the herds.

3.2.3. The changes to the number of livestock and the intake of milk products

Based on the statement from case 1, the government did not seize livestock and each household was able to keep raising their own livestock in the socialist era. In the statement from case 2 from Debre Birhan, it stated that her parents raised 5 oxen and 11 cows in 1980. They said that they drank milk and ate milk products every day. The household from case 5 from village B in Kihen raised 27 cattle (6 oxen, 9 cows, and 12 calves), about 20 sheep and goats, and 3 donkeys. The vegetation in the grassland regressed after many years of grazing, reducing the feed resources at the grassland and forest in the second half of the dry season from February to June. This also decreased the amount of milk that the cows produced, but the farmers still consumed milk products almost every day throughout the year.

There were more frequent droughts after the socialist era started, according to the statement by case 8. The droughts caused the number of livestock to decrease each year and they claimed that they lost as many as 13 cattle from the drought one year in case 8.

As described above, each household raised several dozen livestock and consumed milk, buttermilk, curdled milk, and butter oil almost every day even when they entered the socialist era. However, it is understood that the frequent droughts eventually led to the decrease in the number of livestock.

3.3. The democratic era (After 1991)

3.3.1. The expansion of farmlands and the reduction of grasslands and forests

The farmland usage rights were redistributed once more in 1990 and 1991 as the country transitioned from socialism to democracy. In case 1 in village A in Debre Birhan, the government seized the 8 *timad* of farmland that the household had been using, and allotted 9 *timad* of land (Table 1). The land was distributed fairly based on the number of households in the region, using a lottery system. The distributed farmlands were completely different than the 8 *timad* of farmland they were using in the socialist era. The 9 *timad* broke down into 7 *timad* of farmland and 2 *timad* of land for a residence and a farm attached to the residential area^{Note 3)}. In case 4, the household was allocated the same farmlands they had in the socialist era.

After democratization, the local farmers started developing more grasslands and forests in village A in

Table 1. Age of household head, keeping animal number, farmland area of the surveyed 22 households.

Case study	Village	Age of household	Animal number				Farmland area
		head (Age)	Cattle (Ox · Cow · Calf) (Head)	Goat (Head)	Donkey (Head)	Chicken (Individual)	(timad)
①	Debre Birhan	54	5 (1 · 1 · 3)	0	1	several	9
②	Debre Birhan	47	8 (2 · 1 · 5)	10	1	several	12
③	Debre Birhan	86	8 (3 · 2 · 3)	0	2	several	12
④	Debre Birhan	89	0 (0 · 0 · 0)	0	0	several	9
⑤	Kihen	52	6 (2 · 2 · 2)	0	1	several	9
⑥	Kihen	78	0 (0 · 0 · 0)	0	0	several	11
⑦	Agulae	51	4 (1 · 1 · 2)	0	1	several	7.5
⑧	Agulae	73	0 (0 · 0 · 0)	0	0	several	8
⑨	Debre Birhan	58	2 (2 · 0 · 0)	0	1	several	9
⑩	Debre Birhan	70	6 (2 · 2 · 2)	0	1	several	9
⑪	Debre Birhan	55	5 (2 · 1 · 2)	0	1	several	8
⑫	Debre Birhan	73	0 (0 · 0 · 0)	0	1	several	7
⑬	Debre Birhan	43	6 (2 · 2 · 2)	0	1	several	2
⑭	Debre Birhan	65	3 (2 · 0 · 1)	0	1	several	9
⑮	Debre Birhan	68	5 (2 · 1 · 2)	0	1	several	9
⑯	Debre Birhan	38	5 (2 · 1 · 2)	0	1	several	2
⑰	Debre Birhan	35	4 (1 · 1 · 2)	0	1	several	2
⑱	Debre Birhan	38	0 (0 · 0 · 0)	0	1	several	2
⑲	Kihen	33	0 (0 · 0 · 0)	0	0	several	5
⑳	Kihen	64	2 (0 · 1 · 1)	0	1	several	7
㉑	Kihen	43	3 (2 · 1 · 0)	0	1	several	6
㉒	Kihen	58	5 (2 · 1 · 2)	10	1	several	6

Debre Birhan in order to be able to distribute farmlands to the new generation as the population grew. Since 1991, new farmlands were being developed steadily and consequently, the grasslands and the forests had been shrinking rapidly. By 2010, they stopped developing new farmlands, because they ran out of flat grasslands and forests that could be turned into farmlands. Presently, young households are not receiving any farmland in village A in Debre Birhan. Most of the areas surrounding village A in Debre Birhan are taken up by farmlands and the small areas of grasslands and forests that remain can only be found in the steep gullies and valleys.

According to the statement from case 6, many of the farmers who were forced to move to southern Ethiopia returned to village B in Kihen in 1994. The household from case 6 was also one of the repatriates who returned from southern Ethiopia in 1994. They accepted 11 *timad* of farmland when they returned to village B in Kihen. Some repatriates also returned to village C in Agulae from southern Ethiopia in 1992, according to case 7. The natural increase in population, in addition to

the returnees from southern Ethiopia, rapidly led to a shortage of farmland that was available for distribution. The household from case 5 said that the grasslands and forests started being developed into farmlands in 2002 in village B in Kihen. Most the grasslands and forests were converted into farmlands as the development continued until 2005, drastically shrinking the areas of grasslands and forests. The newly-independent young households continued to receive about 2 *timad* of farmland for a while, but even this amount of farmland distribution was discontinued in 2013. Table 1 shows that each household used to receive a distribution of about 10 *timad* of farmland, but the younger households in their 30's only received 2 *timad* of farmland. Furthermore, they used to receive 2 *timad* for a residence and a farm attached to the residential area, but now, they only receive about 0.2 *timad*. With a land allocation of 0.2 *timad*, it was only enough for a house and a fraction of space for farming next to the house. Today, there is no more farmland distribution and the local community association only distributes land for residences.

3.3.2. The changes in the grazing system

The many years of grazing and logging also led to the vegetation regression in the grasslands and forests. In the democratic era, the government policy enlarged the lands of prohibited grazing and protected forest called *deni meret* in Debre Birhan, Kihen, and Agulae. The expansion of farmlands also reduced the areas available for grazing. Furthermore, the local community associations increased the area for the seasonally-closed grazing land called *hizaeti meret* in order to secure better feed resources for the oxen. As a result, the free grazing land where they could take their livestock to graze throughout the year drastically decreased in the democratic era. The only places where free grazing lands now remained were in small areas between farms, in gullies and valleys where it was too steep to use as a farm, or on narrow strips of land along the river.

In the socialist era, *hizaeti meret* were closed from July to mid-March in Debre Birhan, and from July to December in Kihen and Agulae. The farmers were allowed to use *hizaeti meret* for grazing outside of this timeframe. Since democratization, it became possible for the farmers to use *hizaeti meret* from September to October in Debre Birhan and Kihen. In Agulae, they were now allowed to use *hizaeti meret* from September to June. *Hizaeti meret* were opened in September, because the grasslands and forests had shrunk and they needed to secure some feed resources for the oxen. The grasslands and forests had shrunk to such an extent that they were experiencing a shortage in feed resource. They continued to take their cows to the free grazing land year-round as they had done since the socialist era.

Schools are being built in the agricultural villages since 1991. A school was built in village A in Debre Birhan in 2005 and an elementary school was built in village B in Kihen in 1996. The schools go from first grade to eighth grade (7 to 15 years old) and are divided into two sessions: Children in the first session go to school in the morning from 7:45 to 12:15 and the children in the second session go to school in the afternoon from 12:00 to 17:15. There is an additional one hour, more or less, both before and after classes from the commute. The students trade off the morning and the afternoon sessions each week. Before the construction of elementary school in village A in Debre Birhan, the school was only in Wukro. Only a limited number of children attended elementary school before the school was built in village A in Debre Birhan. After the school was built, most of the children started

attending elementary school. Furthermore, after the children completed eighth grade, they moved up to ninth grade in middle school. There is no middle school in village A in Debre Birhan, but there is one located in the suburb of Wukro. Many farmers' households sold their livestock to afford their children's stay and education in Wukro. The ninth graders are 16 years old, which is normally the proper age to start helping out with grazing, farming, collecting woods, and helping out with their parents' work.

With the new school in village A in Debre Birhan, the grazing of livestock had to be done as a day trip throughout the year. In the socialist era, there were many children at home to take care of the animals at *hizaeti meret* for an extended stay. However, when the school was built and children started attending in 2005, there were not enough children to stay and tend to the livestock at *hizaeti meret*. The shortage of children changed their grazing system from one which involved staying at *hizaeti meret* long term to one which involved taking day trips to the grasslands. There were many cases where several households combined their herds and took turns looking after the animals at the grazing lands. Some households with enough children worked independently and took day trips to the grazing lands, but most of the households collaborated with other households. Each household had more or less 5 cattle, so there were about 50 cattle in a herd when 10 households worked together. They only needed two herd boys to watch 50 cattle at the grazing lands.

The head of the house may take up the role of the herdsman if their children went off to school, but he would be too busy with farm work from June to July with plowing and sowing, and from November to December with threshing. Therefore, it was difficult for the head of the house to manage the livestock grazing during these times. It has become hard to manage the livestock as the children who used to take care of the herd started going to school. If a household only had a few animals, even the girls could take them out around the house in the afternoon when they came home from school. These households could not keep many animals, because there was not much grassland and forest they could use for grazing near the village and there were not enough feed resources left there from the frequent grazing. The girls took the small herd of animals to the grazing lands near the village, because doing so was better than not doing it at all. Grazing was traditionally a man's, specifically a

Table 2. Average nutritional intake of a 11-year-old female, AG, of a Tigrinian farmer's household from village A in Debre Birhan village in Marth of 2015.

	Energy kcal (%)	Protein g (%)	Fat g (%)	Carbohydrate g (%)	Ash g (%)
Daily food intake	2025	72	28	364	14
Self-supplied food	1986 (98)	71 (98)	27 (94)	359 (99)	8 (56)
Purchased food	39 (2)	1 (2)	2 (6)	5 (1)	6 (44)
Self-supplied food intake					
Meat	177 (9)	13 (19)	13 (45)	0 (0)	1 (4)
Milk products	206 (10)	17 (24)	4 (16)	25 (7)	4 (30)
Cereals	1549 (76)	37 (51)	9 (32)	325 (89)	3 (19)
Beans	54 (3)	4 (5)	0 (1)	9 (3)	0 (3)

Note) five days' average

herd boy's job, but with the beginning of education in the villages, they had to make changes, such as taking day trips to the grasslands, combining multiple households' herds for joint-grazing, or relying on the girls to take a small group of livestock to the grazing lands around the village.

3.3.3. The changes in the livestock number, the livestock production and its consumption

None of the 22 research households currently own more than 10 cattle (Table 1). Majority of the households only raised 1 to 2 oxen and 1 to 2 cows. Only the households from cases 2 and 22 raised goats and the other households did not raise any goats. They all typically raised a donkey for transporting goods. The households in cases 4,6,8, and 12 were too old to raise any livestock. The reason why the household of case 3 kept 8 cattle in spite of his old ages was that his children took care of his animals. Cases 18 and 19 were young households who were not in a position to own any livestock, because they lacked enough farmland and funds, and they worked in Wukro to make a living. The household in case 1 from village A in Debre Birhan raised 5 cattle (1 ox, 1 cow, and 3 calves), 1 donkey, and 0 goat. They said that the livestock was affected by the drought and there was a decreasing trend in the number of livestock in the village. The expansion of farmlands and the reduction of grasslands and forests decreased the area of grazing lands, which also contributed to the decreasing number of livestock. They did not have any goats, because they did not have enough herd boys to manage them. With only one cow, there were long periods when they were not able to milk the cow, and they were not able to be self-sufficient in milk and milk

products throughout the year.

The household from case 5 in village B in Kihen raised 6 cattle (2 oxen, 2 cows, and 2 calves), 1 donkey, and 0 goat. Table 1 shows many households in village B in Kihen only raised an ox and a cow, or 2 oxen. In these days, all the households from village B in Kihen were not able to milk their cows much and many of them were not able to be self-sufficient in milk and milk products.

Table 2 shows the average food consumed over five days by AG from village A in Debre Birhan. AG consumed an average of 2,025 kcal, 72 grams of protein, and 28 grams of fat per day. In this study, the researchers only tracked AG's nutritional intake, but the GB household claimed that all girls about 10 years old from a household raising 1 to 2 lactating cows have the same eating patterns. Over the course of the five research days, AG consumed a milk product mixture of whey and curdled milk for four days. The milk products only account for 10% of AG's caloric intake. A 11-year-old female requires 40 grams of protein per day^{Note 4)} (Kagawa, 2006). AG got enough protein since she ate an average of 72 grams of protein per day. About half of the protein in her diet came from grains and only about a quarter came from milk products. Fat should make up 20 to 25%^{Note 4)} of the total energy intake for a 11-year-old female (Kagawa, 2006), which calculates to about 43 to 65 grams per day. AG consumed an average of 28 grams of fat per day, which does not meet the target daily requirement. About half of the fat in her diet came from meat, and 20% came from milk products. It can be said that the decreased milk product consumption had brought about people's inability to meet the required fat intake. Today, milk products have become a particularly valuable food source in supplying fat. The farmers cannot consume milk products during

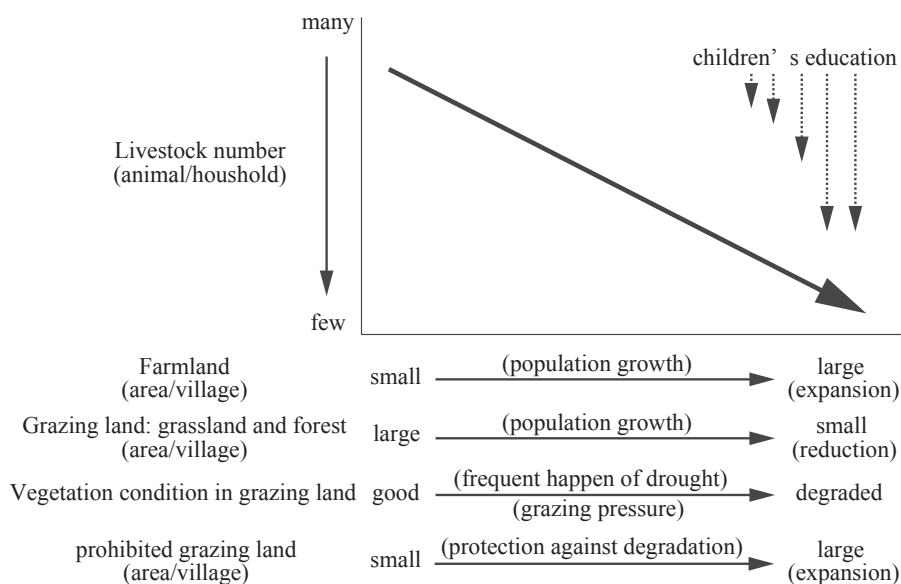


Fig. 3. The cause of decreases in number of livestock due to natural and social factors.

—————▶ trend from the imperial era to the democratic era
 - - - - -▶ effect of children's education to the decrease in number of livestock

the period when they cannot milk the cows, which further decreased the intake of protein and fat. Compared to the imperial era and socialist era when they drank raw milk and buttermilk and ate butter oil and curdled milk with whey every day, the amount and frequency of milk product consumption had largely decreased. The milk products' contribution to the farmers' nutrition has become very limited.

4. The cause of the recent decrease in the number of livestock

The researchers had been examining the farmers' reclamation of farmlands in grasslands and forests, the grazing system, the number of livestock, and the social situations relating to pastoralism and agriculture at the villages in Debre Birhan community, Kihen community, Agulae community in Kilite Awlaelo district. The number of livestock per household has decreased, slowing the farmers' production activities, such as plowing and producing raw milk, which then led to the consumption of less nutrients.

We determined that the factors that contributed to the decrease in the number of livestock were 1. expansion of farmlands and prohibited grazing lands, and reduction of grazing lands, 2. vegetation regression by grazing and drought in grasslands and forests, and 3. children's education (Fig. 3). The grasslands and forests were rapidly developed into farmlands at the research region after the democratization in 1991. As the farmlands

expanded, the grasslands and forests shrunk. The free grazing lands year-round in particular had been reduced radically and limited to the areas remaining between farms, steep gullies, valleys and narrow strips of land along the river that were not appropriate for farming. When the country transitioned from socialism to democracy, the world's heightened awareness for environmental preservation led to the expansion of lands of prohibited grazing and protected forest in the research region. The lands of prohibited grazing and protected forest were not part of the voluntary land management system by the local community association, but enforced by an external authority, central government (Hagos *et al.*, 1999). The expansion of lands of prohibited grazing and protected forest following democratization further reduced the areas available for grazing in the grasslands and forests. Many households used the shrinking free grazing lands, so the vegetation rapidly regressed from overgrazing. If the feed resource at the free grazing lands diminished, it meant that the grazing capacity also declined. The beginning of school education in the villages since democratization largely impacted the decrease in the number of livestock raised by the households. Many households stated that they could not increase the number of livestock even if they wanted to, because they did not have enough children to manage the herd. The decrease in the number of herd boys forced the farmers to work with other households and to work in shifts to graze the combined herd or use the grazing

lands closer to their houses. Utilizing a shift system with other households or grazing in nearby house made it impossible for them to raise a large herd, and they were limited to owning only a few livestock. The spread of school education has become a major factor in the decrease in the number of livestock and the farmers' withdrawal from livestock keeping (Little *et al.*, 2001; Desta and Coppock, 2004; Foggin, 2008).

The frequent droughts and increased population were the circumstances behind the decrease in the number of livestock. The growth of herbaceous plants at the free grazing lands and seasonally-closed grazing lands slowed when there was a drought, which led to a decline in feed resources. Many households attested to the fact that there were not enough feed resources at the grasslands and forests due to the frequent occurrences of drought in recent years, leading to the eventual decrease in the number of livestock. Furthermore, the growing population in recent years led to the rapid development of grasslands and forests into farmlands. The decrease in these lands available for livestock grazing was what kept the farmers from increasing the number of livestock.

In summary, the number of livestock went down due to the decrease in available herd boys and feed resources (shrinking grasslands and forests for grazing, and vegetation regression) under the environment of frequent droughts and increased population in Debre Birhan community, Kihen community, Agulae community in Kilite Awlaelo district.

5. Future trend of animal numbers

The household from case 1 said "I don't need to increase the size of my herd any more". The reasons for this statement were 1. absence of herd boys because of school, 2. shortage of grazing lands from having converted the grasslands and forests into farmlands, and 3. frequent death of livestock from the frequent occurrences of drought. They admitted that they preferred to continue to maintain the small herd in response to the current situation. The Ethiopian government has been hammering out a policy to hold back the increase in the number of livestock (Shapiro *et al.*, 2015). The policy encouraged improving breed and switching from grazing cattle to raising cattle in a barn. The government also claim that the grasslands and forests with regressed vegetation should be prohibited against grazing and protected to recover vegetation condition, and more natural grassland should be improved

to pasture by seeding, so that the farmers could cut-and-carry feed resources. In case 1, the household was content with raising a small herd of about 2 oxen and a cow. They said that they did not need to raise 10 or 20 cattle. With a small herd, the farmers could feed them hay or other farm residues and the children could take them out to grazing lands near the village after school. This trend for raising a small herd is thought to continue in the future in the Kilite Awlaelo district in Tigray.

However, with a small herd, 1. it is easy to run into a shortage of oxen should there be an accident, 2. the farmers cannot expect to receive a large sum of money from the sale of their livestock, and 3. they are more likely to experience issues, such as nutritional deficiency, etc. The decrease in the amount of feed resources and availability of herd boys will restrict the number of livestock per household and continue to be the major limiting factors in the subsistence of the Tigray farmers in the future.

Notes

1) *Timad* is a unit of farmland area used in Kilite Awlaelo district, Tigray. *Timad* is an area in which two oxen can plow in one day using a cattle-driven plow. 1 *timad* is approximately 0.25 ha.

2) Raw milk is called *tsaba*, buttermilk is called *awuso*, curdled milk mixed with whey is called *ajibo*, and butter oil is called *sihum*.

3) Farmland is called *tatharashi merit* where the farmers mainly grow grains and beans. The farmland adjacent to the residential area is called *metasha* and the farmers grow grains and beans as well as cacti and vegetables for home consumption.

4) This is a set value for when Japanese people are used as a case. The research used Japanese case for comparison, because the research was not able to use the standard nutritional value for Tigray people.

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エチオピア高原の農牧複合民における近年の家畜頭数の減少とその原因 ～ティグライ州東部ゾーンキルテ - アウラエロ郡の南部の事例から～

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要旨：本研究では、エチオピア国ティグライ州高地を対象とし、1) 近年の自然・社会環境の変化を鑑みながら、土地利用の変化、放牧パターン、家畜頭数の変化を把握し、2) 家畜頭数の減少とその要因について分析するとともに、3) 家畜頭数の減少が栄養摂取に負の影響を与えていることを明らかにすることを目的とした。帝政時代から社会主義時代を通じて、大部分の土地ははまだ家畜放牧や薪伐採が自由な自然草地・森林地であった。世帯毎にウシを十数頭から三十頭ほどを飼養し、農牧複合民は資金的にも栄養摂取的にも豊かであった。人口の増加により農耕地の不足が発生し、民主主義時代になって自然草地・森林地での農耕地開拓が進行することになり、自然草地・森林地が急速に縮小していった。また、放牧禁止・森林保護地、季節禁牧地の拡大により、一年を通じて放牧できる自然草地・森林地は更に縮小していった。そして、村落における学校教育が開始され、放牧を担当する牧童が不足するようになっていった。これらの結果から、世帯当たりの飼養家畜頭数は減少していった。家畜を数頭しか飼養できなくなったため、一年を通じて搾乳できず、乳製品を頻繁に摂取できなくなり、乳製品の栄養摂取への貢献度は限定的になっているのが現状となっている。利用可能な飼料資源量の減少と牧童の減少は、世帯当たりの家畜飼養頭数を少ないままに抑制し、今後ともティグライ州の農牧複合民の生業に対して大きな制限要因となり続けていくことであろう。

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