

RENEWING HERDS THROUGH LIVESTOCK TRADES: CHANGES IN CATTLE KEEPING UNDER POPULATION PRESSURE IN THE MBOZI PLATEAU, TANZANIA

Kana YAMAMOTO

Graduate School of Asian and African Area Studies, Kyoto University

ABSTRACT In the semi-arid areas of Africa and surrounding areas, livestock have brought various benefits to agricultural people. However, population growth has caused land use competition between crop fields and livestock pastures. This paper argues how this competition was mitigated by the Nyiha farmers in the Mbozi Plateau, Tanzania. By the end of the 1970s crop fields covered almost all the area, except seasonal wetlands, and farmers' cattle herd size shrank. The cultural significance that the cattle carried for social interactions diminished, such as for bridewealth, but cattle for draft power remains essential in agriculture. Gradually the farmers shifted to raising smaller herds in which bulls and oxen comprised the majority, which in turn brought difficulty for renewing the herds. However, transactions with cattle traders provided a solution: the farmers could obtain young cattle from traders in exchange for old bulls and oxen to be consumed as meat. This way, the farmers have sustained their agricultural system that depends largely on cattle draft power under the dense population pressure.

Key Words: Population pressure; Ox-drawn plow; Livestock trader; Barter transaction.

INTRODUCTION

In the semi-arid areas of Africa and surrounding areas, many agricultural people keep livestock. Livestock provide milk and the social and cultural means of wealth accumulation. Livestock also serve as funds to invest in agriculture. For example, farmers with large herds of livestock can buy tractors with the money gained by selling their livestock, and thus expand their agricultural production (Tsuruta, 2011). Furthermore, integrating livestock power and manure into cultivation can realize high productivity.

Faced with the increasing demand for cash income, many farmers began using animal draft power to expand production, and have increasingly integrated livestock keeping with crop cultivation (Francis, 1988; Tiffen, 2004; Tsuruta, 2011). On the other hand, the expansion of agricultural fields lead to land allocation competition between crops and livestock. Generally, the competition limits the number of livestock that farmers can keep (Goldman, 1993; Spear, 1996; Tiffen et al., 1993). To mitigate the competition, farmers eventually have come to keep only one or two head of livestock for savings or for milk, and there is often a shift from larger to smaller animals (Ford, 1993; Bernard, 1993; Mortimore, 1993). Moreover, livestock may become peripheral to the agricultural system.

In the Mbozi Plateau, Tanzania's top production area for coffee, the Nyiha farmers have historically raised cattle, the short-horned zebu (Knight, 1974).

Population growth coupled with social and economic changes decreased the herd size of cattle, where priority was placed on keeping mature bulls and oxen as draft power, important in the Nyiha agricultural system. This change also meant that farmers tended to have few or no female cattle, and less opportunity for reproduction within their own herds. Given the situation, local livestock traders facilitated the ability of farmers to maintain the desired mature male cattle of prime age as draft power, and therefore the interdependence between Nyiha agriculture and livestock has been kept intact despite an increasing population pressure on land allocation. In this paper, the author describes how cattle keeping in the plateau has changed, and point out the significance of livestock traders for this change.

THE RESEARCH AREA AND DATA COLLECTION METHODS

The field research was conducted in Itepula Village, located in the center of the Mbozi Plateau, a part of the highlands between Lake Tanganyika and Lake Nyasa (Fig. 1). The southeastern part of the plateau is a mountainous region with an elevation of over 1,800 m, while the rest of the area comprises gradually rolling hills with an elevation ranging from 1,400 to 1,600 m. The average annual temperature is 19°C. Rainfall is highly seasonal, with an average of 1,300 mm concentrated from November to May. The Nyiha have lived in the area for over 200 years. Owing to an abundant rainfall without annual fluctuations, a cool climate, and fertile soil with good drainage, a German missionary introduced coffee

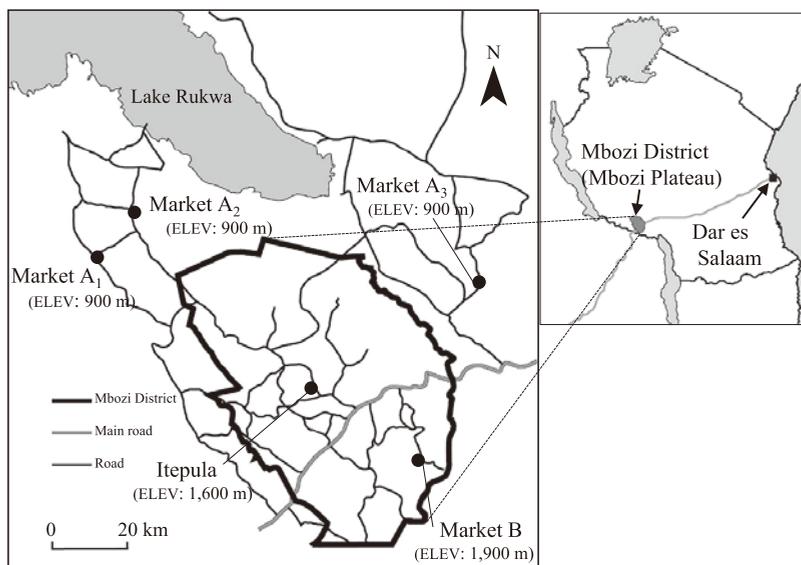


Fig. 1. The location of research area and livestock markets. The roads outside the district shown in the map are limited to the main routes accessing the markets.

cultivation to the Mbozi Plateau at the beginning of the twentieth century, which has flourished and brought economic development. Because the Nyiha enjoyed ample income from coffee production, it kept young men from emigrating and attracted the Nyakyusa and the Ndali, who lived in the adjacent areas. Thus, the population of the plateau increased 50-fold in a century, and the population density of the Mbozi District, corresponding roughly to the plateau, is now 106 people/km². Itepula Village has 746 households and 3,628 people, and the population density is 139 people/km², which is higher than the district average, because of the easy access to the main road and the suitability for coffee production. The plateau was historically covered with open *miombo* woodland, but much of it has been cleared and turned into homesteads and agricultural fields.

In addition to coffee, each household cultivates maize, common beans, and groundnuts as food and minor cash income sources. All crops are cultivated in permanent fields and there is little fallow or unexplored land left around the homesteads. Traditionally, grasslands were left uncultivated among seasonal wetlands in hollows scattered in the rolling hills. As these wetlands flood only in the rainy season, the Nyiha have used the wetlands for cattle grazing in not only the dry season but also the rainy season, avoiding the deep water at the center.

In the Mbozi Plateau, ox-drawn plows have been in use since the founding of the Mbozi Mission by the German missionary mentioned above. However, plowing has become popular only since 1950 (Knight, 1974). In the 1970s, the government promoted mechanized cultivation with tractors. However, with the high price of fuel more recently, tractors have become impractical and have not yet replaced cattle.

In the following sections, the author uses a variety of data to describe changes in cattle keeping under increasing population pressure. The main data was collected from 127 households between December 2007 and October 2009 in M Sub-Village, one of the six sub-villages in Itepula Village. Out of these 127 households, 34 kept cattle, and the author collected information about the size and composition of the cattle herds, and recorded how cattle were obtained and parted with. The author asked a livestock trader who frequented the study site to record his trades in 2008 and 2009. To examine the long-term changes in herd size, the author interviewed 13 households of seven different family lineages, who could remember the size of their cattle herds in the 1960s and 1970s. In addition, in 2005, the author randomly selected and interviewed 21 heads of households out of 127 for the age structure of the households, to examine the changes in land use and dependency on plowing. And in 2009, 12 households out of these 21 were available for the author to record the historical changes in their bride-wealth practices.

EXPANSION OF AGRICULTURAL LANDS

In the Mbozi Plateau, agricultural fields have expanded as the population grew. Slash-and-burn cultivation was formerly practiced in the *miombo* woodlands, yet the fallow period became shorter and shorter because of the population increase

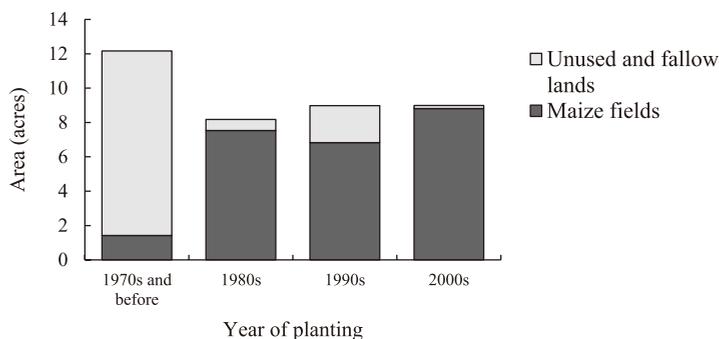


Fig. 2. Land uses in Itepula before coffee trees were planted.

Source: Field survey by Yamamoto in 2005.

Coffee farms belonging to 21 households, by previous land use and the decade in which they were planted. Some households planted several plots with coffee trees in different decades.

Table 1. Herd sizes in the 1960s and 1970s, and 2007

Herd size	1960s and 1970s		2007	
	No. household	%	No. household	%
1–4	2	15	23	68
5–9	3	23	8	24
10–14	2	15	2	6
15–19	4	31	1	3
20–	2	15	0	0
<10	5	39	31	91
≥10	8	61	3	9
Total	13	100	34	100

Source: Field survey by Yamamoto in 2007 and 2008.

Data include those from two elderly men who described the cattle they had owned when they became independent of their parents and from nine younger men who described the cattle their father had owned when they worked as herd boys. Two men among the latter group provided data for two different periods.

in the 1960s (Knight, 1974). By the 1980s, woodlands had become scarce, and slash-and-burn cultivation was seldom practiced (Bantje, 1986). The National Maize Project (1975–1982) by the Tanzania government introduced the new technique of permanent maize cultivation with chemical fertilizers, which was immediately adopted by local people. This vastly raised the yield, and the need for agricultural land was alleviated temporarily. However, continuous population pressure and the expansion of coffee cultivation caused the further decline in fallow and uncultivated bush land. As shown in Fig. 2, where the farmers cleared fallow or bush land to plant coffee until the 1970s, in the 1980s and later they began to transform maize fields into coffee farms. This was because crop fields had covered almost all the available land by the end of the 1970s.

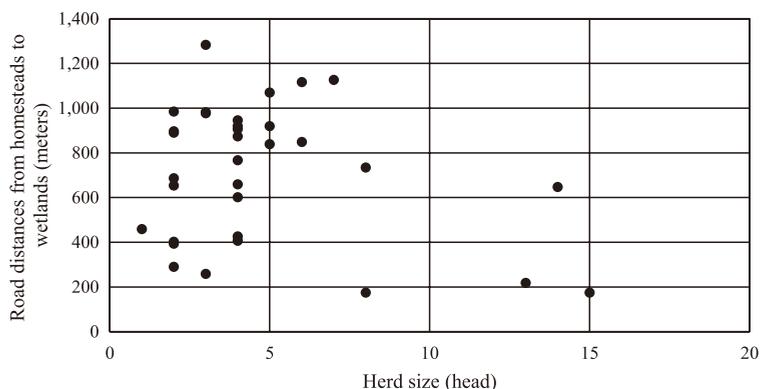


Fig. 3. Correlation between road distance from homesteads to wetlands and herd size.

Source: Field survey by Yamamoto in 2007.

Data collected from 33 households, where 34 households out of 127 owned cattle, but the location of one household was unknown.

In parallel with the above development, cattle herd size kept shrinking. About 60% (8 out of 13) heads of households told me that they had owned ten or more cattle in the 1960s and 1970s (Table 1). In 2007, however, only 9 percent (3 out of 34 households) owned ten or more, and more than half of the owners kept less than five. This change appears to have been related with the expansion of permanent crop fields in uplands. Fallow and bush land used to provide cattle with grazing ground, yet permanent crop fields took over. In addition, the expansion of crop fields impeded access of large cattle herds to the wetland, the communal grazing ground, due to fear of crop damage. In fact, three homesteads with ten or more cattle were located somewhat near the wetland (Fig. 3), and one of the three located relatively farthest from the wetland fenced off the pathway with shrubs, to keep cattle away from near-by crop fields.

CHANGES IN THE ROLE OF CATTLE

The decrease in herd size coincided with changes in the role of cattle. Cattle were the cultural symbol of wealth until the 1970s. As a large herd brought social prestige, the Nyiha did not like to part with cattle until the 1970s. People gave up only exhausted oxen or sterile cows. Recently, however, cars and fine homesteads have come to symbolize wealth instead of cattle. Tsuruta (2011) argued, based on his research about the Iraqw and the Gogo agro-pastoralists in Tanzania, that the monetary economy spread throughout the colonial period and the era of *Ujamaa* Tanzanian socialism (1967–1985), and money gradually replaced the role of livestock as wealth. The same change has occurred in the Mbozi Plateau.

As other areas in Tanzania, the Nyiha in the Mbozi Plateau customarily obligated the groom's family to bring cattle as bridewealth to the bride's family, regardless of whether the groom owned cattle.⁽¹⁾ However, it is merely a formality today. In the 1950s and 1960s, the grooms were requested six to eight head

of cattle and they obliged with as many (Fig. 4). Since the 1970s, however, the groom brought less cattle than requested, although the number claimed stayed much the same. In the 1990s, some grooms brought no cattle to the bride's family. Before the 1960s, a groom could not marry unless he obliged with all the cattle demanded by a bride's family, but a groom is now allowed to marry with only one or two. A groom's family not able to fulfill all the bridewealth was used to be regarded as "in debt" to the bride's family, yet now the sense of debt is nominal and the payment is rarely completed. Thus, the people could reduce their cattle.

Currently, cattle provide draft power essential for Nhiya agriculture. It takes two weeks to cultivate one acre (4,047 m²) by hoe, but the same area can be plowed by cattle in two to four days. Hence, almost all households plow their fields with cattle for maize production (Table 2), although only 21 households out of the total 127 households of M Sub-Village had a pair of mature male cattle. As described above, 34 households had cattle, but 13 households did not own a pair of male cattle. These and other households with no available male cattle

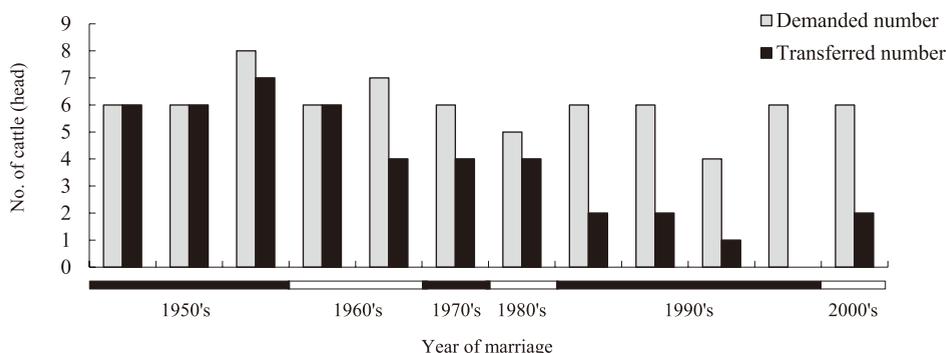


Fig. 4. Number of cattle which each groom's family was claimed by bride's family and the number actually transferred.

Note: Transferred head after marriage were included.

Table 2. Means of cultivation by households

Means of cultivation	No. households	%
Plow	17	81
Without payment	10	48
With payment	7	33
Hoe	4	19
Total	21	100

Source: Field survey by Yamamoto in 2005.

"Without payment" means that households own their own cattle for plowing or borrow them from relatives or friends. "With Payment" means that households hire or request their neighbors to do piecework plowing.

borrow or hire them, or request their neighbors to do piecework plowing for them.

DIFFICULTY IN RENEWING CATTLE HERDS THROUGH BREEDING

Since the main role of cattle changed from symbolic wealth to draft power, the farmers no longer attempted to increase the number of cattle. In addition, and more importantly, they shifted to raising smaller herds with bulls and oxen comprising the majority. As shown in Table 3, as herd size became smaller, the ratio of mature male cattle to the total number increased. This is because only oxen or bulls⁽²⁾ can draw a plow, never cows.

This shift made it difficult for the herds to renew themselves. Some households even had only male cattle. It seemed also difficult to maintain herd size at the village level. The number of mature male cattle in the surveyed 34 households was 61 in 2007 (Table 3). Because mature male cattle could plow for six years (from age four to ten), it can be roughly calculated that ten of male draft animals retire every year, and optimally, the same number need to be brought in for draft power. During the approximately two years of the survey period (December 2007 to October 2009), 33 calves were born, of which 14 were male. If one assumes that only 7 male calves are born every year, the number of male cattle would continuously decrease without some additional way to complement the decline.

In fact, the farmers appear to have abandoned breeding. The number of mature female cattle in the 34 households was 48 in 2007 (Table 3). As cows breed every 1–2 years according to local farmers⁽³⁾ and assuming an 18-month calving interval, 32 male calves would be born every two years, which is enough to maintain the total number. However, in the reality described above, only 14 were born in the two years of study. This is because the farmers often sell cattle. During the study period, about 40% of the total cattle in the village was parted with,

Table 3. Composition of herds and herd size

	a) Households with ≥10 head (n = 3)			b) Households with ≥5 and <10 head (n = 8)			c) Households with <5 head (n = 23)			All households with cattle (n = 34)		
	Average Head	head per owner	%	Average Head	head per owner	%	Average Head	head per owner	%	Average Head	head per owner	%
Male (Mature)	11	3.3	26	17	2.1	34	33	1.4	50	61	1.8	39
Male (Calf)	7	2.7	17	9	1.1	18	5	0.3	8	21	0.6	13
Female (Mature)	13	4.3	31	16	2.0	32	19	0.8	29	48	1.4	30
Female (Calf)	11	3.7	26	8	1.0	16	9	0.4	14	28	0.8	18
Total	42	14.0	100	50	6.3	100	66	2.9	100	158	4.6	100

Source: Field survey by Yamamoto in 2007.

Table 4. Number and transaction of cattle parted with between 2007 and 2009

	Head	%
Total number in 2007	158	100
No. of cattle parted with	67	42
Sale	31	20
Entrustment	13	8
Exchange	8	5
Death	8	5
Stolen	2	1
Gift	1	1
Bridewealth	1	1
Others	3	2

Source: Field survey by Yamamoto in 2007 and 2009.

Note: Data collected from the 34 households in Table 1.

and half were sold (Table 4). Although the number of mature cows slightly decreased from 48 to 41 between December 2007 and October 2009, only 28 same individuals remained in the herd. In other words, 20 mature cows were parted with and 13 were either purchased or had reached maturity in the herd.

CATTLE RENEWAL THROUGH REGIONAL LIVESTOCK TRADERS

Farmers with smaller herds, in fact the majority of the surveyed 34 households, depend on a variety of ways to obtain new cattle, including breeding (29 out of 61 new cattle in the study site between December 2007 and October 2009), purchase (13), barter transaction (10), bridewealth (6), trust (2), and gift (1), while those who owned ten or more gained cattle mostly through breeding (Table 5).

Among these options, purchase and barter transactions are the major complementary ways to breeding. As described above, few farmers intend to enlarge herd size today, and they do not hesitate to sell cattle if they need to pay for large expenses. They will fill the vacancy later when they have enough money. For example, Mr. A sold two oxen and a cow for school fees, and bought a male calf and a female calf during the study period. Although such frequent replacements of cattle seem to diminish the potential for reproduction, it also results in herd renewal even when farmers do not intend this.

However, it is often difficult to exchange and replace enough cattle within the village, because most farmers keep minimum herds. Therefore, they must find cattle for sale outside the village (Table 6). Some neighboring villages with a relatively low population density have more cattle than the study site. Some farmers found cattle at remote villages, more than 20 km away. Others bought cattle from livestock traders. Even traders may not always find cattle in the surrounding villages, but they can at the livestock market.

The traders are farmers who live in the study site or in nearby villages, and

Table 5. Means of obtaining cattle by herd size (December 2007 to October 2009)

	a) Households with ≥10 head (n = 3)		b) Households with ≥5 and <10 head (n = 8)		c) Households with <5 head (n = 23)		All households with cattle (n = 34)	
	Head	%	Head	%	Head	%	Head	%
Birth	8	80	5	50	17	40	30	48
Purchase	1	10	2	20	10	24	13	21
Exchange	1	10	3	30	6	14	10	16
Bridewealth	0	0	0	0	6	14	6	10
Trust	0	0	0	0	2	5	2	3
Gift	0	0	0	0	1	2	1	2
Total	10	100	10	100	42	100	62	100

Source: Field survey by Yamamoto in 2007 and 2009.

Although 33 calves were born during the survey period, three calves were sold or entrusted to others soon after birth and eventually 30 calves joined the herds.

Table 6. Locations of villages in which farmers purchased cattle

Location	No. of cases
Itepula (-2.0 km)	7
Neighboring villages (2.0–5.0 km)	9
5.1–10.0 km	11
10.1–20.0 km	2
20.1 km–	10
Through livestock traders	8
Total	47

Source: Field survey by Yamamoto in 2007 and 2009.

Between 2007 and 2009, 13 were purchased. Cattle purchased before 2007 are also included.

also work as butchers and sell meat in these villages.⁽⁴⁾ There are two market options for traders to get cattle elsewhere. One is the livestock markets A₁, A₂, and A₃ around the lakeside of Rukwa, about 70 km away from the study site; the other is Market B in the southern part of the Mbozi Plateau, 40 km away from the study site (Fig. 1).

The former option, livestock markets A₁, A₂, and A₃ are located in the lower area (900 m above the sea level), each is held once a month, do not contribute in herd renewal to the farmers in the study site, because no young cattle is bought from these markets. Pastoralists in surrounding areas sell cattle at lower prices in these markets. However, people believe that the cattle are not adaptable to the high altitude of the plateau (1,600 m above the sea level), and that eventually weaken and die. Therefore, traders buy adult cattle for beef there, but never buy young cattle.

The other option Market B, on the other hand, is important for renewing cattle in the study site. It is in the mountainous area (1,900 m above the sea level), and held once a week, every Thursday. Traders buy young cattle there, and exchange them for exhausted cattle in the study site and neighboring villages. The price of cattle at Market B is higher than in the lowland area, but the environmental conditions of market B and the study area are similar and young cattle from Market B grow without problems in the study site. Many young male cattle are for sale in Market B because cattle there are not used so much for plowing. Coffee yield is low in this area with steep slopes and poor soil, and livestock rearing provides important cash income to the people. Market B was founded in the early 1990s, but from even before, the mountainous area had supplied young cattle. As early as the 1970s, livestock traders seemed to have bought young cattle from the area surrounding the present Market B, and brought them to the study site.

SIGNIFICANCE OF BARTER TRANSACTIONS FOR FARMERS

Purchase is an important way to obtain cattle from elsewhere, but remarkably, barter transactions are also a significant option for the farmers to renew their cattle herds. This is due to the fact that only traders buy exhausted cattle. Although cattle are now rarely slaughtered for ceremonies, traders never refuse to buy exhausted cattle, because they are also butchers and slaughter at least one head of cattle per week to sell meat. Barter transactions are convenient for the farmers who want to sell exhausted cattle to replace it with young cattle at the same time. Mr. L is a typical livestock trader in this area, who started cattle trading in 2004, after trading in pigs. During December 2008 to October 2009, he obtained 56 head of cattle for meat, among which he bartered nine (16%).⁽⁵⁾ According to him, a typical barter is two head of young male cattle for an old male for meat. Sometimes, he bartered a young male and a young female for an ox, or two male calves for a cow.

Barter transactions are also important for farmers wishing to keep the herd size at minimum. As described above, farmers try to keep their herds small, just enough to plow their fields. When the farmers need to renew their cattle, traders can provide cattle immediately through procurement from the remote market, where young cattle are sold every week. It is advantageous for farmers because with mature cattle readily available for plowing, they do not have to wait for calves to grow to substitute the currently mature cattle. When a calf is born, it can be sold if necessary. Of course, traders gain profit from the barter transactions with farmers. For the farmers, there is a risk that the traders may rig the value of young cattle they provide. However, there are several livestock traders in the study area, and farmers can reject the traders who make unfairly large profits. Moreover, traders are also local residents, and are motivated to be trusted by the farmers. Barter transactions thus significantly facilitate the farmers to renew and maintain their small cattle herds.

CONCLUSION

Cattle-keeping practices have changed greatly on the Mbozi Plateau over the past several decades. What can be learned from this region with respect to combining agriculture and livestock keeping under increasing land shortage?

In rural areas, when competition for land between crops and livestock becomes severe, livestock populations eventually tend to decline, despite the introduction of intensive feeding methods, such as gathering or cultivating fodder and restricting livestock to stalls (Templeton & Scherr, 1999). Such a decline usually affects relationship between agriculture and livestock keeping. McIntire et al. (1992), who examined how to integrate agriculture and livestock keeping in Sub-Saharan Africa, pointed out that farmers have shown many responses to the land competition associated with animal traction, and that these encompassed mechanizing with engines, using cows for traction, plowing with fewer animals in the team, etc. In the Mbozi Plateau, however, such changes have not occurred, and the Nyiha have sustained their agricultural system by selectively keeping mature male cattle. Although this may be also attributed to the fact that the Nyiha do not have a strong attachment to milk, more importantly, the farmers could sustain and renew their small herds with little but sufficient mature male draft power through barter transactions, from as early as in the 1970s when land competition came about. The Nyiha people in the Mbozi Plateau has kept their livelihood by expanding on social divisions of labor across broader areas than before.

NOTES

- (1) In many Tanzanian societies, the groom's family pays bridewealth to the bride's family. In Nyiha society, goats, blankets, sheets, and hoes are transferred in addition to cattle.
- (2) Although oxen are thought to be more suitable as farm work animals, bulls also can draw a plow. Many cattle are castrated before they become five years old, but a few mature male cattle are kept without castration.
- (3) Mukasa-Mugerwa (1989) estimated the calving interval in zebu cattle to range from 12.2 to 26.6 months, based on his research and other literature, while Rege et al. (2001) reported 13.9 to 18.5 months for four districts in southern Kenya.
- (4) People in this area consume beef especially in the dry season when they have income from coffee. Many people likely eat beef at least once a week. As early as in the 1960s, there were butchers not only in towns but also rural areas, including the study area, in the Mbozi Plateau (Knight, 1974).
- (5) The number of cattle which Mr. L bought or obtained through barter transactions during the research period included that of cattle which had been kept in other villages.

REFERENCES

- Bantje, H. 1986. *Household Differentiation and Productivity: A Study of Smallholder Agriculture in Mbozi District*. Institute of Resource Assessment, University of Dar es Salaam, Dar es Salaam.
- Bernard, F.E. 1993. Increasing variability in agricultural production: Meru District Kenya, in

- the twentieth century. In (B.L. Turner II, G. Hyden & R.W. Kates, eds.) *Population Growth and Agricultural Change in Africa*. pp. 80–113. University Press of Florida, Gainesville.
- Ford, R. 1993. Marginal coping in extreme land pressures: Ruhengeri, Rwanda. In (B.L. Turner II, G. Hyden & R.W. Kates, eds.) pp. 145–186. *Population Growth and Agricultural Change in Africa*. University Press of Florida, Gainesville.
- Francis, P.A. 1988. Ox draught power and agricultural transformation in northern Zambia. *Agricultural Systems*, 2: 35–49.
- Goldman, A. 1993. Population growth and agricultural change in Imo State, Southeastern Nigeria. In (B.L. Turner II, G. Hyden & R.W. Kates, eds.) *Population Growth and Agricultural Change in Africa*. pp. 250–301. University Press of Florida, Gainesville.
- Knight, C.G. 1974. *Ecology and Change*. Academic Press, New York.
- McIntire, J., D. Bourzat & P. Pingali 1992. *Crop—Livestock Interaction in Sub-Saharan Africa*. The World Bank, Washington, D.C.
- Mortimore, M. 1993. The intensification of peri-urban agriculture: The Kano close-settled zone 1964–1986. In (B.L. Turner II, G. Hyden & R.W. Kates, eds.) *Population Growth and Agricultural Change in Africa*. pp. 358–400. University Press of Florida, Gainesville.
- Mukasa-Mugerwa, E. 1989. *A Review of Reproductive Performance of Female Bos indicus (Zebu) Cattle*. International Livestock Centre for Africa, Addis Ababa.
- Rege J.E.O., A. Kachi, M. Okomo-Adhiambo, J. Mwacharo & O. Hanotte 2001. *Zebu Cattle of Kenya: Uses, Performance, Farmer Preferences, Measures of Genetic Diversity and Options for Improved Use. Animal Genetic Resources Research 1*. International Livestock Research Institute, Nairobi.
- Spear, T. 1996. Struggles for land: the political and moral economies of land on Mount Meru. In (G. Maddox, J.L. Gibling & I.N. Kimambo, eds.) *Custodians of the Land: Ecology & Culture in the History of Tanzania*. pp. 213–240. James Curry, London.
- Templeton S. & S.J Scherr 1999. Effects of demographic and related microeconomic change on land quality in hills and mountains of developing countries. *World Development*, 27(6): 903–918.
- Tiffen, M. 2004. Population pressure, migration and urbanization: Impacts on crop-livestock systems development in West Africa. In (T.O. Williams, S. Tarawali, P. Hiernaux & S. Fernandez-Rivera, eds.) *Sustainable Crop—Livestock Production for Improved Livelihoods and Natural Resource Management in West Africa: Proceedings of an International Conference Held at the International Institute of Tropical Agriculture Ibadan, Nigeria, 19–22 November 2001*, pp. 3–27. International Livestock Research Institute, Nairobi and Technical Centre for Agricultural and Rural Cooperation, Wageningen.
- Tiffen, M., M. Mortimore & A.C. Ackello-Ogutu 1993. *From Agro-Pastoralism to Mixed Farming: The Evolution of Farming Systems in Machakos, Kenya, 1930–1990*. Agricultural Administration Unit, Overseas Development Institute, London.
- Tsuruta, T. 2011. Agriculture-pastoralism complex in semi-arid areas in East Africa: A case of Eastern Rift Valley in North-central Tanzania. (In Japanese with English abstract). *Memoirs of the Faculty of Agriculture of Kinki University*, 44: 97–114.

————— Accepted January 30, 2017

Author's Name and Address: Kana YAMAMOTO, *Graduate School of Asian and African Area Studies, Kyoto University, Honmachi, Yoshida, Sakyo-ku, Kyoto 606-8501, JAPAN.*
E-mail: y-kana [at] jambo.africa.kyoto-u.ac.jp