

A Shift from Pastoralism to Sedentary Agriculture in *Apollo* and *Felket* Areas of Eritrea: Impacts on Livelihood and Ecology

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ABSTRACT

In Eritrea, the shift to sedentary livelihood by the nomadic population has increased dramatically over the last few decades as a result of economic, political, demographic, and environmental changes. A strategic shift to more diversified livelihoods in the form of farming, petty-trade, and wage labor has been intensified due to the declining pastoral economy. This study identified environmental constraints as the main “push” factors causing many people to abandon the traditional pastoral economy, while the provision of social amenities (education, health), and pure drinking water were the “pull” factors attracting people to villages and small towns (sedentary life). The main purpose of this research paper is to provide a fresh outlook at the human and ecological circumstances that trigger the transition from pastoralism to sedentarism in *Apollo* and *Felket* areas of Eritrea. Using data gathered mainly through household questionnaire survey and focus group discussion, the paper also aims to investigate whether the changes to sedentary agriculture has led to a successful local economy. Results from this empirical research revealed that the great majority of the settled communities in the study sites get fairly adequate social services and that almost all household heads have no plan on returning to the nomadic way of life. It is anticipated the output from this study will contribute to a better understanding of traditional and changing pastoral systems in Eritrea.

Keywords: *Eritrea, pastoralism, sedentarization*

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INTRODUCTION

The literature on the traditional pastoral livelihood is rich enough to accommodate various models that explain the herders’ strategies in the face of unpredictable environment (Ellis 1993). These models are capable of providing a rational explanation to the internal dynamics of pastoralism with profound implications for development interventions. Two of the widely referenced models are the risk-averse model and high reliability theory. The risk-averse model views pastoralism as an adaptation to environmental stress caused by variability in rainfall. The herders try to avoid hazards (e.g. drought) through moving their livestock to locations of grass and water or minimize the magnitude of hazard by spreading the herd across a large geographical space. The herders therefore escape the worst effects of ecological degradation by searching for a better area. The assumption that pastoralism is a risk-averse adaptation to a highly variable environment was unchallenged for several decades (Galaty 1990). A new approach has been devised, however, as a result of the

disappointing performance of many development projects (Swallow 1989). The new model that explains the pastoralists' behavior is found in High Reliability Theory. In this model, unlike in the risk-averse approach, hazards cannot be avoided; instead they must be accepted and managed because what the risk-averse model treats as external to pastoralism the High Reliability Theory considers internal.

The change from pastoralism to sedentary lifestyle has led to opposing views on whether pastoralists should be sedentarized or not. Proponents of resettlement programmes argue that pastoralists should abandon nomadic way of life both in response to 'pushes' away from the pastoral economy and to 'pulls' of urban or agricultural life. For example, in a more arid and sparsely populated southern Ethiopia, many pastoral families have settled in response to drought and violence of cattle raiding (Ellis and Swift 1988). Similarly, Rendille pastoralists of Kenya shifted to sedentary life due to increased marketing benefits particularly to women selling agricultural products and easy access to social services including education to children (Salzman 1982; Smith 1992). In contrast, there are study findings that refer to the negative consequences of sedentarization some of which, point to the problems of impoverishment and destitution for pastoralists who settle (Hogg 1986; Little 1985). There are also reports on poor nutrition and higher rates of certain infectious diseases despite better access of settled population to formal education and health care (Fratkin et al 1999). Moreover, the study on the effect of settlement on children's nutrition and health revealed large differences in the growth pattern and morbidity of nomadic versus settlers' children. In particular, age-specific height and weight measurements for the pastoral community are significantly higher than same aged measurements of children from the settled villages. Furthermore, women and especially pregnant women showed higher levels of malnutrition in the settled communities.

In Eritrea, the shift to sedentary livelihood by the nomadic population has increased dramatically over the last few decades due to human and natural circumstances. Many formerly pastoral families have settled in or near towns and pursue alternate economic strategies, including crop cultivation, agro-pastoralism, and urban wage labor. Prolonged droughts, population growth, and expanding commercial agriculture have all restricted the ability of pastoralists to keep moving. In 2003, the Pastoral Environment Network in Horn of Africa (PENHA) conducted a baseline survey in Eritrea with the aim of identifying development opportunities for the pastoral communities. The study focussed on the provision of education and health services to the nomadic children. It also examined development intervention such as the supply of pure drinking water to the pastoral communities and how this had impacted livelihood patterns. In 2006, the Ministry of Agriculture (MoA), initiated a similar survey in the Western Lowlands of Eritrea with the aim of assessing the problem of ecological degradation resulting from pastoral sedentarization. The attempt was to examine how settled communities might have caused land degradation as a result of high population densities particularly at those sites where water points are located. The preliminary findings from these surveys clearly showed the importance of conducting extensive research on the key impacts of sedentary life on human welfare and the natural environment.

Objectives of the study: The main goal of this study is to investigate whether sedentary lifestyle has been effective as a strategic shift to a better and more diversified livelihood system. The study specifically addresses the following objectives:

First, it aims to examine, from the perspective of settled communities, the extent to which the provision of social amenities (education, health) and pure drinking water impacted livelihood systems.

Second, it aims to provide baseline information on selected parameters such as rainfed and irrigated farming, grazing land, livestock possession, income levels, female headed households, and changing ecology.

Third, it presents comparative perspectives whether or not agricultural economy gave settlers greater economic autonomy than their pastoral counterparts.

Fourth, it presents an addition to the scant picture of sedentary agro-pastoral communities available in Eritrea that can be used for academic institutions, government organizations and development partners.

Finally, the project forwards issues for recommendation if the present process of sedentarization could be taken as a model of improved livelihood for pastoralists in Eritrea.

Methodology of the study: The methodology used for this study included the following.

a) A structured household questionnaire that consisted both open-ended and close-ended questions was prepared and administered with a sample size of 120 households for both study sites. The survey covered major themes including: household demography, labor supply, dietary composition, farm resources, livestock marketing, and off-farm income.

b) Participatory Rural Appraisal (PRA) and Key Informant Discussions (KID) were conducted to extract data on resource mapping; problem identification and ranking; development intervention, the changing roles of women and community perception.

c) A series of discussions on specific topics including rain-fed and irrigated agriculture, livestock types and size, forage and water availability, human and livestock diseases, and policy issues were conducted with local officials, employees of the Ministry of Agriculture (MoA), and employees of the Ministry of Health (MoH).

d) Documentary evidences (secondary data) on specific topics such as rangeland resources and management techniques, herd dynamics, and community organization were obtained from the Ministry of Agriculture branch offices in *Afaebet* sub-zone and *Nakfa* sub-zone.

e) The preparation of the study report was dealt with the organization of field notes, database formation and interpretation of research results. Final copies of the research were disseminated through the study villages, academic institutions and through stakeholders and partners that were involved in the study.

The Research Area: *Apollo* and *Felket* are villages selected for the present study located in the northern part of Eritrea. The selection of these villages is based on the condition where the influence of sedentary life can be evidently observed on the livelihood patterns of the target groups. The study areas are historically inhabited by *Tigre* nomadic pastoralists who keep mixed herds of camels, cattle, goats and sheep. *Tigre* people are found scattered in various parts of Eritrea today featuring similar demographic and social networks. Farming is the mainstay of livelihood for the study communities, though livestock economy is still an important source of revenue for many households. The traditional mode of production is highly constrained by multiple factors most notably, by the erratic nature of rainfall and by the declining rangeland productivity. With the transition to sedentary lifestyle, the local residents have started diversifying their economic bases through practicing horticulture and small-scale businesses. Government support and remittance from relatives living abroad are additional sources of revenues for the households.

Geographically, the study sites are characterized by arid lowland and semi-desert agro-ecological zones (AEZs) possessing a uniform set of constraints and potentials for livestock and agricultural development. High temperatures and irregularity in rainfall characterize the climatic conditions of the study areas implying factors of unpredictability for plant growth. The areas have suffered from an intense degree of deforestation as they are scarcely vegetated with the exception of thick vegetation along the riverbanks. The study areas have topography ranging from flat to extremely steep terrain. The steeper slopes are devoid of soil or are covered by shallow and rocky soils, while the gentler slopes and flat areas have relatively deeper and fertile soil due to silt accumulation from the nearby hills. The presence of barren slopes, and exposed grass and tree roots indicate the prevalence of severe land degradation and hence the need for reclamation measures.

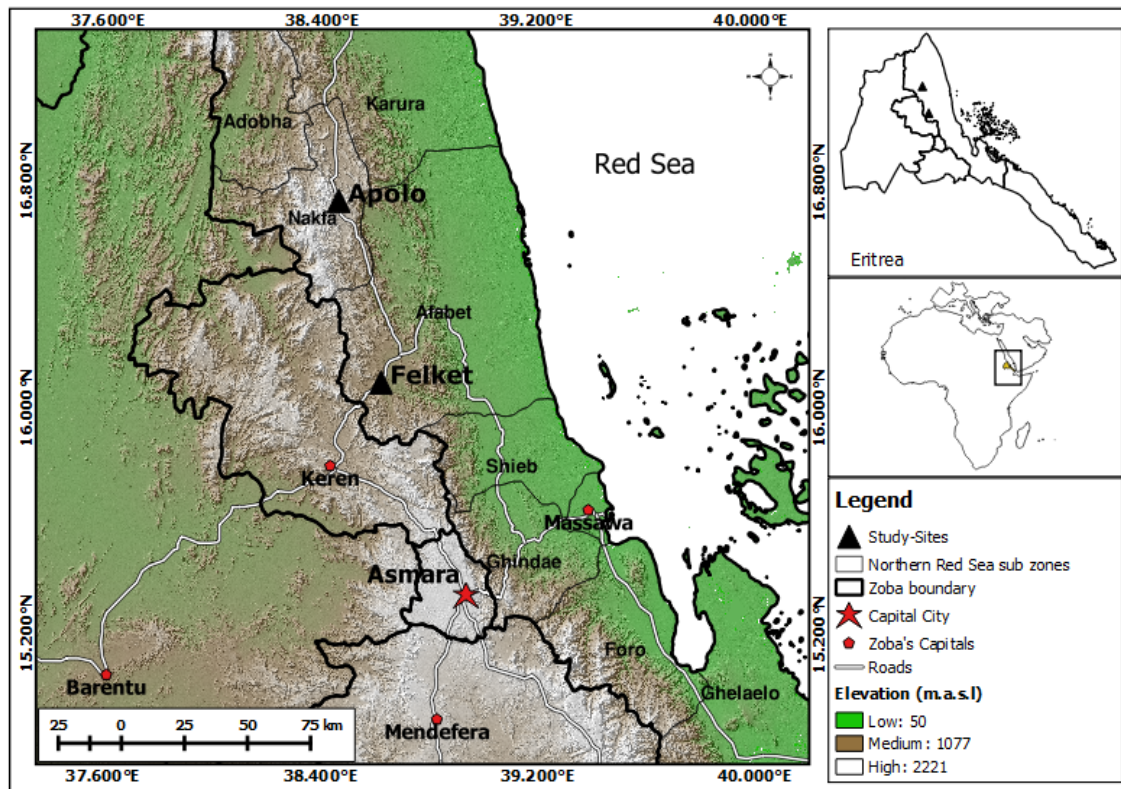


Figure 1. Location map of the study sites

FINDINGS AND DISCUSSION

DEMOGRAPHY AND HUMAN WELFARE

The result of the questionnaire surveys showed that the size for each household in the study villages varies between one member and 12 members. Fairly large proportions of the residents (60 percent) are below age 19. The sex ratio, which is the proportion of males to females, was calculated to be 114 percent and 93 percent for *Apollo* and *Felket*, respectively. The actual sex ratio for *Felket* could be greater than the calculated value as some of the young men were absent during the time of the fieldwork due to periodic migration to the mining places. The average dependency ratio for both study sites (i.e. the sum of the number of persons 0-14 years old plus number of persons 65 years and older divided by the number of persons who are 15-64 years old multiplied by 100) was calculated to be 109 percent.

Table 1A

Age and sex structure of the sampled population in *Apollo* study area

Age Group	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
0 - 4	11	8.9	9	8.3	20	8.6
5 - 9	16	12.9	19	17.6	35	15.1
10 - 14	32	25.8	22	20.4	54	23.3
15 - 19	14	11.4	13	12.0	27	11.5
20 - 24	9	7.4	5	2.8	14	5.2
25 - 29	4	3.2	4	3.7	8	3.4
30 - 34	2	1.6	1	0.9	3	1.3
35 - 39	2	1.6	3	2.8	5	2.2
40 - 44	1	0.8	11	10.2	12	5.2
45 - 49	5	4.0	9	8.3	14	6.1
50 - 54	6	4.8	6	5.6	12	5.2
55 - 59	6	4.8	2	1.8	8	3.4
60 - 64	4	3.2	2	1.8	6	2.6
65 - 69	2	1.6	1	0.9	3	1.3
70 - 74	3	2.4	2	1.8	5	2.2
75 +	7	5.6	1	0.9	8	3.4
	124		110		234	100

Source: Household questionnaire survey, 2019

Table 1B

Age and sex structure of the sampled population in *Felket* study area

Age Group	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
0 - 4	18	11.7	20	13.0	38	12.6
5 - 9	15	9.8	32	20.9	47	15.7
10 - 14	25	18.9	26	17.1	51	17.0
15 - 19	33	22.8	15	9.8	48	16.0
20 - 24	10	6.5	5	3.3	15	5.0
25 - 29	5	3.3	4	2.6	9	3.0
30 - 34	1	0.6	4	2.6	5	1.6
35 - 39	0	0.0	7	4.6	7	2.3
40 - 44	2	1.3	15	9.8	17	5.6
45 - 49	2	1.3	7	4.6	10	3.0
50 - 54	6	4.0	6	3.9	12	4.0
55 - 59	7	4.6	4	2.6	11	3.6
60 - 64	5	3.3	7	4.6	12	4.0
65 - 69	9	5.9	1	0.6	10	3.4
70 - 74	7	4.7	0	0.0	7	2.3
75 +	2	1.3	0	0.0	2	0.7
	147	100.00	153	100.00	301	100.0

Source: Household questionnaire survey, 2019

Table 1A and Table 1B show population distributions of the sampled households by age and sex. A large concentration of people in the study sites is found between the age groups 0-4 and 20-24, which account for 66 percent and 64 percent of the people in the *Apollo* and *Felket* sites, respectively. This indicates that the population in the study areas is basically young, which is also a typical demographic characteristic of populations in the developing countries. No remarkable differences in the proportions of males to females are noticed for both sites in these age-groups. On the other hand, the number of females in the age-groups 30-34 to 50-54 is greater than males in the same groups. In contrast, males out-number females for the age-groups 55-59 to 75+ in both sites. In the absence of documented evidence on migration, mortality, and other vital statistics, the research team found it difficult to adequately examine the disproportionate distributions of number of males and females in the above age groups. But two facts stand out clearly from the discussion with PRA participants. First, the community practice temporal migration that commonly involves young males who move periodically to the nearby mining sites. Second, the uneven distribution of population could be attributed to reason like errors in age reporting on the side of the respondents.

Human Welfare: The depletion of grazing resources i.e., scarcity of water and forage resources, had resulted in a considerable reduction of livestock size across the areas surveyed. This has negatively impacted livestock productivity and hence the welfare of the local people. Human factors, including the long war for independence (1961-1991) and the recent conflict with the neighboring Ethiopia had also negative consequences on the settled communities and their economies. In this section, human welfare is assessed in terms of housing types, eating habits and community health before and after the transition to sedentary life.

Type of Housing: Housing is a very important component of the cultural fabric of the residents in the study areas. The changes that can be seen in the traditional dwellings are part of the processes that the pastoralists have gone through the transition to a sedentary lifestyle. Three phases of dwellings were recognized in terms of structure and material content. The earliest phase, called *ablow*, is a typical house for the nomadic population. It is part of the temporary campsite and nothing permanent is built. This type of house is designed in a simple way where holes are dug with thin poles tied together to the ground and covered with branches and leaves that serve as shelter. Women usually play an active role in the construction of *ablow*. The second phase of housing structure is locally known as the *maaden*. It is rectangular in shape and is made up of acacia bark and cornstalk with poles erected at regular intervals to keep the structure upright. The local people regard this type of housing as a permanent residential building and as a result none of its parts is removed during migration, so that it can serve again when a household returns. The third phase in the morphology of settlement is called the *merebait*. This is a modern housing structure made of cement blocks, lumber, and corrugated sheet iron. This phase has emerged recently, initiated by a number of factors including increase in the household income and a gradual shift from nomadic pastoralism to market-oriented diversified economy. During the time of fieldwork, 75 percent of the residents in the study areas lived in modern housing structure.

Type of Diet: Eating habits for the sampled households were examined on the basis of the type and frequency of food consumed. Cereals, pulses, milk, meat and vegetables were the main dietary compositions that were investigated for the community under survey. In the past, the diet for the pastoral groups was significantly dominated by milk and meat. This is hardly surprising since pastoralists had been with their animals all the time, while sedentary communities often are separated from their herds. In times of drought, the overall food consumption pattern shifts from milk to cereals, although a few well- to-do households continue to consume milk and meat. Nevertheless, there had been no significant difference in terms of food intake between the rich and the poor during food crisis period due to the ‘moral economy’ of food sharing where rich households share milk and meat with poorer relatives. The transition to sedentary form of livelihood is characterized with a marked shift from milk and meat to cereals and pulses. During the time of the fieldwork, the majority of the household heads noted that they rarely consume milk and meat products, whereas animals are slaughtered for religious occasions and social obligations. A large proportion of the interviewed household heads (83 percent) reported that cereal grains and pulses are the main food items in their area. Vegetable consumption was least affected by the changes

from pastoralism to sedentary agriculture. In *Felket*, for example, the proportion of households who frequently consumed vegetables during pastoral and sedentary was 67 percent and 62 percent, respectively. The table below presents the number of the respondents who reported on the frequency of consuming specific types of food (frequently, sometimes, or never).

Table 2A

Frequency of food consumption by number of households in *Apollo* Study Site (N = 60)

Food Type	Pastoral			Sedentary		
	Frequently	Sometimes	Never	Frequently	Sometimes	Never
Cereals	53	7	0	60	0	0
Pulses	0	18	42	12	32	16
Milk	60	0	0	5	21	34
Meat	60	0	0	3	22	35
Vegetables	12	5	43	18	5	37

Source: Household questionnaire survey, 2019

Table 2B

Frequency of food consumption by number of households in *Felket* Study Site (N = 60)

Food Type	Pastoral			Sedentary		
	Frequently	Sometimes	Never	Frequently	Sometimes	Never
Cereals	58	2	0	60	0	0
Pulses	12	15	33	40	12	8
Milk	60	0	0	3	39	18
Meat	60	0	0	10	40	10
Vegetables	40	6	14	38	14	8

Source: Household questionnaire survey, 2019

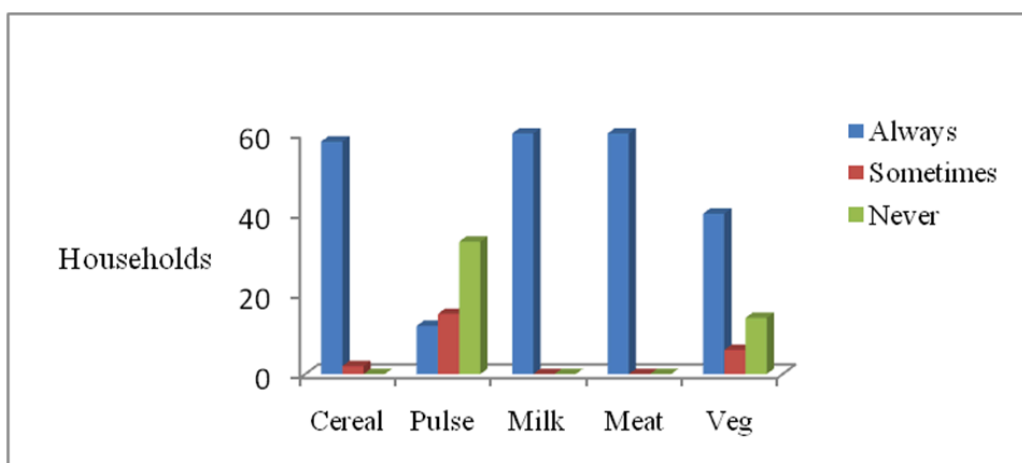


Figure 2A. Dietary variety of pastoral households in *Felket* study site

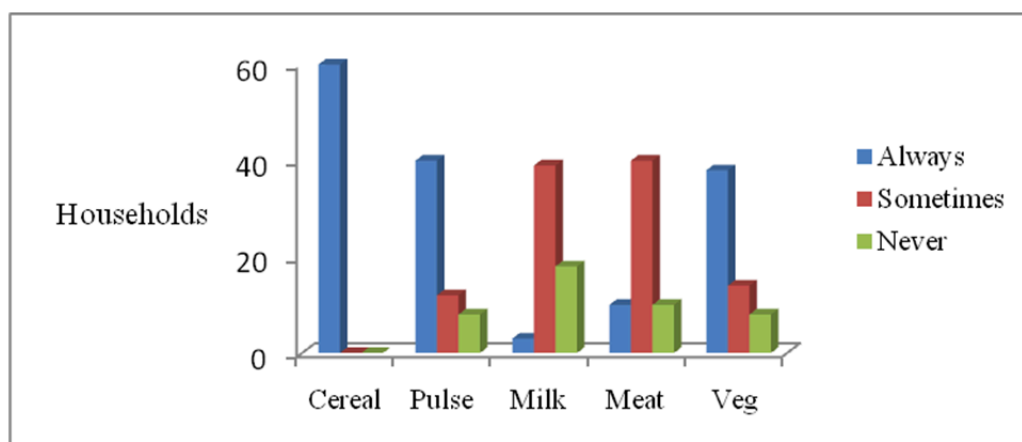


Figure 2B. Dietary variety of sedentary households in *Felket* study site

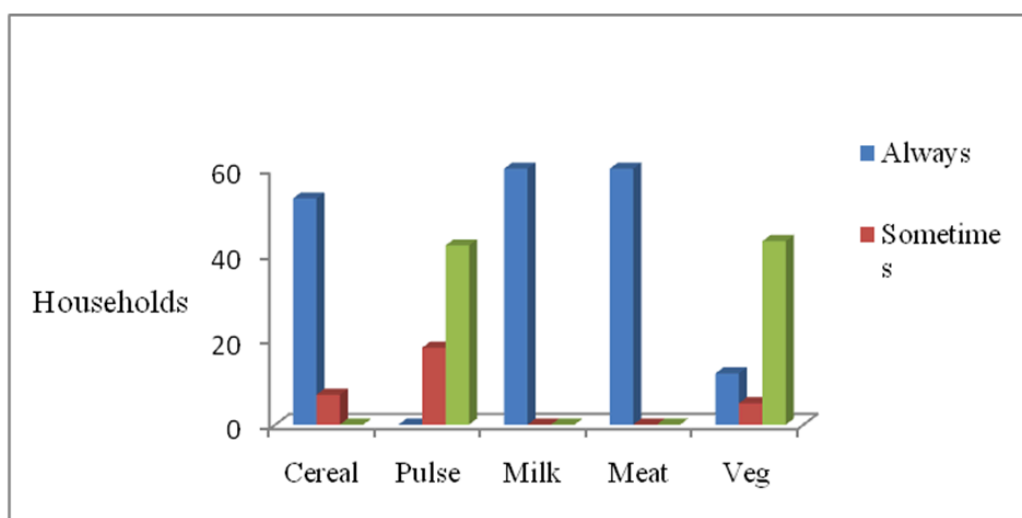


Figure 2C. Dietary variety of pastoral households in *Apollo* study site

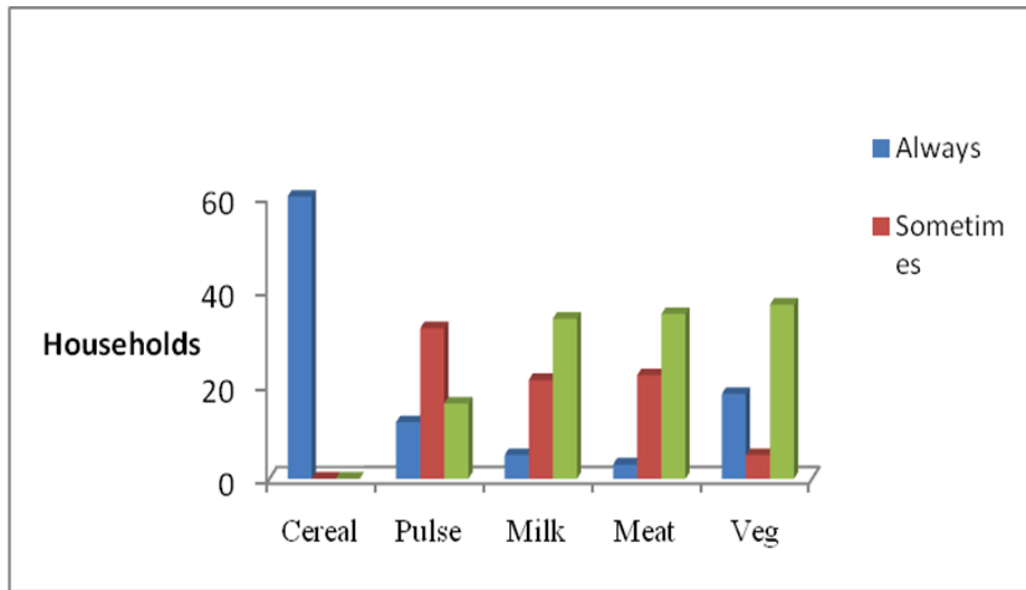


Figure 2D. Dietary variety of sedentary households in *Apollo* study site

Community Health: The most prevalent human diseases surveyed included pneumonia, tonsillitis, and urinary tract infection (UTI). Urinary tract infection was observed predominantly among the older age groups, while boils and tonsillitis affected mostly children aged five years and below. During the onset of rain, the most prevalent parasitic disease is malaria, which is an acute health problem for all age groups in the study areas. Malaria is intensified during wet season, while other incidences of diseases are most prevalent in times of extremely high temperatures. Maternal mortality and prevalence rate for sexually transmitted diseases (STD) were found to be minimal. During the time of the fieldwork, only one case of maternal death from anemia and severe bleeding was reported. Prevalence of stunting among children is also low, though no anthropometry measurements have been carried out. Several mothers reported that they have better access to outreach services to receive lessons related to food safety and hygiene through the community platforms.

Information from *Afaebet* hospital revealed that nomadic groups in the past had higher rates of tuberculosis, syphilis, and trachoma than settled agricultural populations. On the other hand, the latter group suffered higher rates of parasitic infections, malaria and anemia, particularly among those people living close to rivers. Infant and child mortality rates are lower for settled communities than for the pastoral population because of increased awareness and access to modern medical services. Key village informants reported that age-specific weight measurements for children of settled households were significantly higher than for the same aged children from the pastoral households. Children gain more weight today than in the past as a result of better hygiene and protection from infectious diseases. At present, preventative strategies, such as vaccination-immunization are most available to people living closer to health centers. Nevertheless, many households still practice ethno-therapeutic methods made of herbs and roots to treat various types of illnesses. Despite the

positive results achieved in the health sector, much remain to be done, to further improve the health status of the population.

INSTITUTIONS AND SOCIAL ORGANIZATIONS

Local institutions play important roles by providing support to the residents in the study villages, though they operate under limited resources. The role of such institutions among the local communities can be seen in all spheres of life notably in marriage, resource sharing and conflict resolution. A Participatory Rural Appraisal (PRA) approach was used to identify their relative significance and the roles they play in various aspects of social life.

Marriage: Marriage has enormous cultural implication reflecting a significant process of socialization. It is an important variable affecting fertility behavior as the study groups do not use contraceptives. There are strong inclinations among both men and women for having as many children as possible, with no preference of one sex for another. A larger family is perceived as an indication of physical strength as well as social security during old age. Discussion with key informants revealed that during the nomadic way of life, marriage was highly endogamous where a man is married to a woman of his own social group. Travelling over long distance to conduct marriage ceremonies with members of different ethnic groups was perceived as difficult and unusual. With gradual transition to sedentary life, however, marriage outside ones' social group, i.e. exogamous, became more apparent. A dispute sometimes arises between a husband and his wife where both sides openly present their case in front of a traditional arbitration court involving elderly people and religious leaders. The decision from the traditional court is believed to be rational and fairly balanced and, as a result, both the husband and his wife are expected to accept the verdict. Under rare circumstance, arbitration takes place outside the village, which is usually discouraging particularly for women as the journey to another place entails costs in transportation and lodging. Discussion with community elders revealed that divorce occurs more frequently among settled communities than it did among the pastoral people. The two main causes of marriage breakdown were found to be household economic crisis and desertion, the latter more frequently on the husband's side. Rising incidences of divorce rate and the resulting number of female-headed households have some social and economic implications.

Deeply rooted patriarchal and religious restrictions in the study areas have made women to have a highly limited access to factors of production. They do not have, for example, control over animals, though they exercise some rights over goats and cattle allocated to them by their husbands or by their parents during marriage. In addition, they have almost no authority regarding the sale or slaughter of large stock animals, which are exclusively men's roles. As settled life became more important, women's roles changed significantly and their participation in the community affairs help them acquire better social position. This has a clear implication for local and national development. In the past, when labor shortages were virtually absent, women's duties were strictly limited to household tasks (e.g., child rearing, food processing, and water fetching), while men were engaged wholly in herding. Nowadays, women have started assuming a much broader social and economic responsibility within their community. The factors that led to improvement in the women's

status include the services made available to them (water supply and health care) and the financial aid they receive from the government.

The survey of the settled communities showed a marked gender differentiation in the primary responsibilities of decision-making. As part of the established tradition, the women do not own control over animals, but still they exercise rights over goats and cattle allocated to them by their husbands or by their parents during marriage. Women have a crucial role to play in the management of milk and meat from all animals. On the other hand, they have little or no authority regarding the sale or slaughter of large stock or grazing and mobility decisions, which are exclusively men's roles. They seem, of course, to participate in decisions concerning sales and slaughter of goats and sheep, which happen more frequently than for cattle and camels.

Formal Organizations: In the study areas, formal organizations are those institutions that provide services managed by respective government agencies, and supported by facilities and administrative network. Pastoralists who are in a transition to a settled life live close to one another usually having some interests in common. For example, they look for the provision of social services and also seek access to roads as well as a fair share in government development programs. Two of the formal organizations, school and health, are briefly discussed below.

A certain level of literacy seems to be required for a society to move away from subsistence economy. In view of this, the Government of the State of Eritrea is currently moving ahead with a program aimed at expanding school enrollment of children in the pastoral regions of the country. It has launched a program that enhanced expansion of education by setting up low-cost boarding schools. As a result, the number of primary schools has substantially increased since sedentarization. In the past, mobility, harsh climate, and remoteness from the main development centers had always stood as constraints to the provision of modern education to the nomadic population. Besides the ecological hindrances, parents were reluctant to educate their children beyond primary school because of the cultural conservatism of the nomads' way of life. In the past, rich herders gave no value to educating their children in school; instead they encouraged them to get engaged in animal herding. Children from poor families, on the other hand, attended school. An elderly from *Felket* had to say the following about those who went to school during his time.

'Children from poor families, who attended school in the past, are now our leaders'.

An attempt was made to provide education to the nomadic children through mobile schools, but this form of education could not be made easier as the pastoral populations were widely dispersed and most often followed unpredictable migration patterns. Moreover, the schools lacked the necessary infrastructure and educational facilities, and as a result, the number of dropout students was high. With the shift to sedentary life, a more systematic approach was devised to educate children through boarding schools. Such schools provided a better learning environment for many students. Parents have to pay nothing for their children's

education except a small fee for registration, sport and youth association. Females' school enrollment is encouraging, but most often they are restricted to grade eight due to the long distance they have to travel to secondary school. During the time of the fieldwork, 95 percent of the households in *Felket* study site send their children to schools.

Progress has been made over the last few years particularly in primary school student enrollment because gender inequalities in education became almost non-existent. A good example is *Felket* elementary school where females account for 41percent of total student population during the 2018/19 academic year. Once students complete grade eight, they move to *Tsabra* secondary school in *Nakfa*. *Tsabra* secondary school is a government-run boarding school aimed at helping children from pastoral community complete secondary school and even pursue through higher education. In spite of the progress made in the education sector, the proportion of female enrolment progressively decreases as the level of education increases. Such trend in enrollment can be explained by culture-specific conditions such as parental decisions concerning female education. There is sufficient awareness among parents regarding the importance of acquiring a minimum level of education. They are increasingly showing interest in the literacy program and, as a result, a considerable number of the community members have attained basic skills in reading and writing. Such improvement is the result of effective development interventions, and expanding social services. Besides, mainstream media including radio and television play an important role in cultivating awareness among the local communities, hitherto unknown to the pastoralists.

Substantial improvement in the health services has been achieved over the last few years in both study sites due to increased number of health personnel, and improved services. Most of the health facilities are equipped with water supply systems and proper toilet facilities. In addition, medicines are kept fresh and safe with the use of solar refrigerators. A couple of rooms are also available that serve as store, administrative offices and waiting delivery. Overall, the health establishments are well maintained, though shortage in personnel remains a constraint in serving the health needs of over 95,000 people in the region.

Table 3A

Human and Health Facilities in *Afaebet* sub zone during different periods of time

Health Facility	Number		Health Personnel	Number	
	Pastoral	Sedentary		Pastoral	Sedentary
Hospital	0	1	Medical doctors	0	3
Health centers	0	1	Nurses	1	5
Health stations	0	2	Midwifery	1	6
Clinics	1	1	Lab technicians	2	8
Health posts	0	1	Health agents	4	41

Source: *Afaebet* sub zone health center, 2019

Table 3B

Human and Health Facilities in *Nakfa* sub zone during different periods of time

Health Facility	Number		Health Personnel	Number	
	Pastoral	Sedentary		Pastoral	Sedentary
Hospital	0	1	Medical doctors	0	3
Health centers	0	1	Nurses	0	5
Health stations	0	2	Midwifery	2	6
Clinics	0	1	Lab technicians	2	8
Health posts	1	1	Health agents	6	41

Source: *Nakfa* sub zone health center, 2019

LIVESTOCK ECONOMY IN PERSPECTIVE

Livestock occupy a place of significant importance in the economic and social lives of sedentary communities in the study areas. They serve as a source of food in the form of meat and milk. They also acquire cultural significance as important indicators of a person's social status. Further, livestock play a crucial role in agriculture and as a means of transport for the households. Owning cattle has important wealth ramification as the more cattle a household owns a greater chance for it to own other animal types as well. A camel is a valuable asset as it carries family members, cereals, and bulky household materials. Small ruminants such as sheep and goats are highly regarded as potential sources of food and cash income because of their high reproductive rates. Donkeys, which are much cheaper than large stock animals, play crucial day-to-day roles in the livelihood of the settled communities by carrying water and straw.

The total herd size for the study sites was estimated on the basis of data from the household questionnaire survey. The mean livestock holding per household was converted into Tropical Livestock Units (TLU)¹ using Food and Agriculture Organization (FAO)

¹ TLU = a standard zebu bovine of 250 kg live weight

conversion rates. In addition, a “progeny history” approach (Grandin 1983) was applied to reconstruct a livestock-wealth history, which allowed the researcher to compare wealth possession of the sampled households before and after the adoption of sedentary life. Based on the computed values of TLU per household, the livestock population during different periods (i.e. before and after sedentarization) in time is presented for each study site.

Table 4

Livestock Possession of Sampled Households in TLU (Pastoral: Livestock at the time when households were pastoralists; Sedentary: Livestock after sedentarization)

Animal Type	<i>Apollo</i>			<i>Felket</i>		
	Pastoral	Sedentary	% change	Pastoral	Sedentary	% change
Camel	132	22	83	210	29	82
Cattle	462	20	95	220	26	88
Sheep	85	4	95	38	5	97
Goat	260	15	94	165	32	92
Donkey	53	27	49	36	26	27
Total	992	88	91	669	118	82

Source: Household questionnaire survey, 2019

TLU conversion factors: Camel = 1.6; Cattle = 1.12; Goat = 0.07; Sheep = 0.0892; Donkey = 0.9

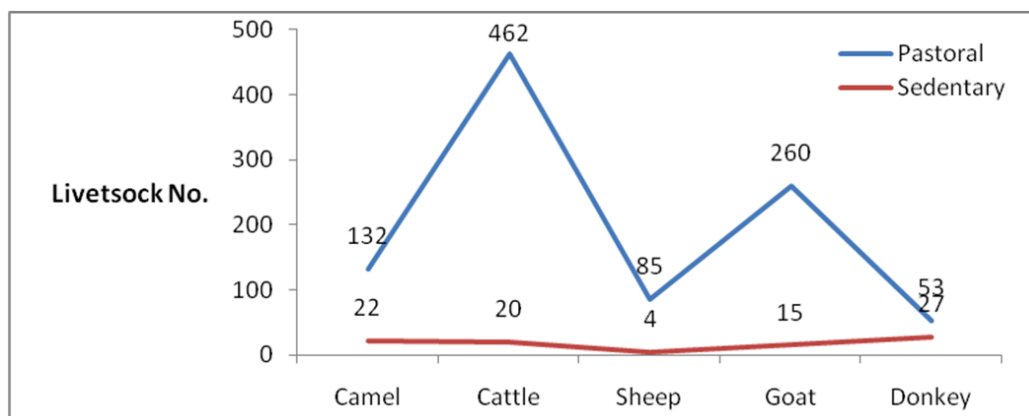


Figure 3A. A synoptic view of livestock possession for sampled households in *Apollo*

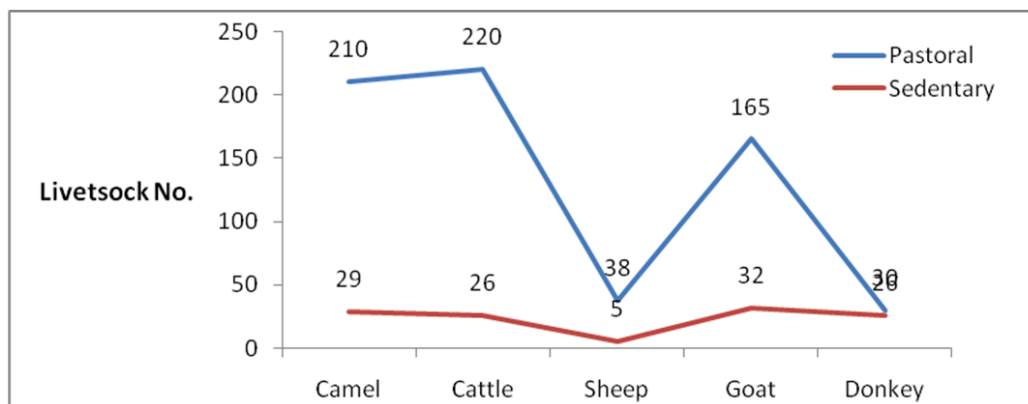


Figure 3B. A synoptic view of livestock possession for sampled households in *Felket*

Herd Dynamics: Herd dynamics is the result of a specific event in births, sales, purchases, slaughter, and mortality of livestock over time (ILRI 2000). The number of animals possessed by the sampled households during the different modes of production was recorded and analyzed to understand the changes in the livestock economy. The local people aim to own more cattle and camels than the other species since marketing of these animals can provide a large amount of cash in times of crisis. In addition, those owning cattle and camels tend to own the full range of livestock (including goats, sheep, and donkeys), in contrast to those possessing primarily small ruminants. The result of the household survey showed that the overall livestock possession has been reduced by 91 percent and 82 percent for *Apollo* and *Felket* study sites, respectively. This finding may have to be regarded with some reservation including data quality about the exact number of animals each household possesses, which is a touchy issue. Nevertheless, the result is a useful indicator of the changing livestock holdings of households before and after sedentarization.

A common irregularity in the study areas is that the livestock number grows in time of favorable water and pasture conditions, but during crises period, a sudden decline is observed through mortality and sales. After the crisis period is over, the size of livestock possessions for the households begins to increase, and the cycle repeats itself. This is referred to as the “boom and bust” cycles in animal production. All types of animals were vulnerable to the stressful conditions of drought and disease, but clear differences were observed between the various species with respect to survival and recovery after a disaster is over. Such differences reflect both the managing capability of the herders and the varying degree of resistance by animals. In general, small ruminants suffered higher mortality rates than cattle and camels, and within small stock, sheep experienced higher reduction rate. Camels are better adapted to changing environmental conditions than cattle and sheep. They reach the branches of acacia tree to eat leaves when vegetation becomes scarce, giving them an adaptive advantage over the other livestock. On the other hand; the strength of small ruminants lies in their ability to recover rapidly following a drought period. They can survive feeding over scrub vegetation around homesteads, whereas cattle and camels must be taken far away from the village. Based on data generated, a statistical assessment of the

herd diversification was carried out using the Simpson Index (SI)². Indices of 0.27 and 0.26 were obtained for pastoral and sedentary communities, respectively. This suggests that, in either case, there exists no single species that tend to dominate the herd composition.

Migratory routes: An important aspect of the study is to closely see how the migratory routes of the local people changed with the transition to sedentary life. Result showed that the communities follow well defined routes to the grazing reserves and watering points, and movements are almost entirely carried on within the northern part of the country itself. Movement over large geographic area is rare because conditions in ecology, temperature and rainfall remain almost the same everywhere. Small ruminants are kept around the homestead for most part of the year using forage from the surrounding farmland, while large stock animals are tracked into distant places. Members of a household, who move along with their livestock, tend to stay in temporary settlements for few days and continue their journey until they reach the point of destination. Duration of the seasonal movement varies from one day to several months depending on the expected time and distance for the journey. The high movement seasons are between the months of April and October when there is very limited grass for grazing in the local areas. Movement is not usually easy as pastures are well protected under closures. In spite of the uneasiness, the local people manage to use range resources for their livestock and earn income from selling wood. Information on the exact number of the mobile communities disaggregated by age and gender is scant, but heads of households tend to move more frequently along with their livestock.

One of the consequences of the transition to the new lifestyle is the change in the length of time required to take animals to water sources. In the past, four hours, on the average, was required to take animals to the nearest source of water. During the author's fieldwork in 2019, this has lowered to 30 minutes i.e. an 85 percent reduction from what it had been. The reduction in time implies the availability of extra time for labor in agriculture. It also means allowing children to spend more time for learning. As already discussed, no serious disputes exist among the villagers with regard to the use of range resources and minor conflicts arising infrequently are tackled through the traditional power network.

Rangeland Ecology: A rangeland is a dominant form of land use system and an important source of income for the local people in the study areas. In the past, when human and livestock populations were dispersed over a large geographic space, the pressure on the grazing resources remained insignificant. But circumstances changed drastically with intense population pressure and expansion of settlements. In addition, the environment was adversely influenced by the natural processes of climate change. The transition to sedentarism asserts that water points, villages, and development interventions reduce mobility, while it enhances concentration of people and livestock over a small territory. Such an intense use of natural resources diminishes rangeland productivity and adversely affects feed quality. It is difficult to quantify the extent of range degradation in *Apollo* and

² Simpson Index = [(Cattle TLU²) + (Goat/sheep TLU²) + (Donkey TLU²)]/(Total TLU)²

Felket areas; nevertheless an indication can be made about the proximate causes, which mainly consists of anthropogenic factors such as agricultural expansion, increased firewood consumption and heavy livestock grazing. A methodological approach called Mean Species Abundance (MSA) was used to describe the effect of overgrazing by comparing composition of plant species from the present grazing ground with those of the adjacent natural systems such as closures.

An attempt was made to determine the carrying capacity of the rangeland in the study areas expressed as a stocking rate in hectares per Tropical Livestock Unit (ha/TLU). Given the 6.25 kg/TLU/day feed requirement of livestock for sub-Saharan Africa (Janke 1982), two basic assumptions were considered. First, not all forage supply is used as feed for livestock because of the effects of three correction factors: grazing inefficiency, losses due to trampling, and residue left after the harvestable portion of forage. Second, annual rainfall is assumed to be a reasonable indicator and a critical factor of forage production. For ease of computation, the three correction factors in the first assumption were represented by a single multiplier using the 30 percent utilization rate of edible forage by Cossins and Upton (1987). Based on the above assumptions, the mean carrying capacity for the study areas were computed to be 5.57 ha/TLU. This finding goes in line with the work by De Leeuw and Tothill (1990) for rangelands with similar rainfall in the African Sahel. It is important to note that the concept of carrying capacity was originally developed for commercial ranches based on the management of single livestock type within an enclosed area. The above computation, thus, should be used with caution as it may not be strictly applied on the communal rangelands with diversified animal species like the present study areas.

THE TRANSITION TO SEDENTARY FORM OF LIVELIHOOD

The Farming Alternative: Subsistence mixed-farming is a dominant system of production and way of life for 70 percent of the households in the study sites. It provides protection against food insecurity by meeting households' demand for food. Agriculture is mainly rain-fed, but spate irrigation is also used where rainfall from the highlands provides seasons of flood. The main crops cultivated are sorghum, maize, barley, wheat and millet. Crop output is low and highly susceptible to variations in rainfall. The farmers, therefore, grow crops mainly to meet their subsistence needs and, as a result, marketable produce is virtually absent. According to experts from *Afaebet* Ministry of Agriculture branch office, yield per hectare averages four quintals per hectare using the traditional methods, while it reaches 10 to 20 quintals per hectare with irrigation. Infertile soils and unpredictable rainfall patterns are the main causes for low productivity. Irrigated farming, though in a small scale, plays key role in ensuring food security to the expanding populations of the study region. It raises crop yield, while at the same time it allows for multiple cropping where only a single crop could be grown otherwise. An important aspect of production in the study areas is the interdependence that exists between crop production and livestock rearing. Farm animals feed on crop residue, while at the same time their wastes are ploughed back into the soil thus maintaining nutrient recycling and keeping the production system sustainable. The following section analyses the relative importance of land, labor and draught animals as household level drivers of agricultural output in *Apollo* and *Felket* villages.

Farm Size: In the past, land had been under exclusive control of a wealthy ethnic group called *Bete Asgede*. Farmers who do not possess farmland had to work on the fields controlled by these rich people where they were compensated with a certain amount of crop. The 1994 Land Proclamation of Eritrea, however, allowed land to be granted equally to any villager who is at least 18 years old. Female headed households are also entitled to farmland under such a village land tenure system. Under a traditional farming system, like in the present study area, crop production is highly influenced by the amount and quality of the arable land farmers have at their disposal. A large farm holding means a relative increase in the amount of production. In the past, there was plenty of cultivable land in the study areas mainly because of low population pressure on land resources. It was possible for farmers to abandon their fields after two or three seasons and move on to fresh fertile land. The old fields then have a chance to recover during a fallow period. But as population pressure grows, land became scarce and the land holding size for each household was reduced substantially. In addition, a large track of land has been converted into barren through land degradation, which further restricted the size of farm land to community members.

Ownership of draught animal: There are several advantages with the use of oxen and camels as draught animals. Oxen and camels are cost-effective means of power for small-scale farming like in the present study areas. They are affordable and environmentally friendly, and their manure is an effective way of supplying crops with essential nutrients and improving soil fertility. The households in the study villages heavily rely on oxen and camels for tilling their farmlands and for threshing crops. Possession of a pair of draught animals is, therefore, a very important determinant of household's income from agricultural activities. A household that does not possess an ox looks for a rental arrangement with someone who owns a pair of oxen, which are primarily based on the proportion of input made by the land owner and share cropper. Similarly, two households enter into a collaborative agreement where they bring their farm implements together; an arrangement locally known as *lifin*.

Supply of Labor Force: Household labor, which usually comprises the head of household, his wife, and children, forms the most important part of the labor force in the study area. Practically all the members of the community except aged and young children are active participants in production activities. The share of labor among members follows a well-established pattern. Men generally perform activities involving farming, herding of large stock animals, livestock marketing, and community decisions, while activities related to household economy such as fetching water, firewood collection, food preparation and processing, handicrafts, marketing, and child caring are performed by women. Nowadays, a shift of labor has resulted as women are taking a wider labor share in order to maintain food production. They are increasingly involved in animal herding, traditionally reserved for males. This is particularly the case for those households where male members of the family are away from the village for various reasons. These conditions have motivated women to assume a wider responsibility by playing roles in decision-making in the community affairs.

Under normal situations, family members do all the farm works themselves for the simple reason that farm holding is small and even if a household head wants to hire labor it is scarce and he may not afford the payment which is made in cash. To a lesser extent, hired labor is practiced, particularly for herding small stock animals. Most frequently, children are the ones hired to perform this activity, and they are paid in kind, based on the agreement reached beforehand. Across the areas surveyed, collective labor, which is a traditional sharing system, is sometimes used to supplement the household labor force. In collective labor, a group of persons, consisting of neighbors and close relatives, come together to assist a particular household. The main purpose of collective labor is to help alleviate the work burden of a person during the peak farm season and in house construction.

As reported by the village informants, subsistence agriculture in the area faces human and environmental constraints. Rainfall is the major limiting factor because of its erratic and unpredictable nature. In addition, the nutrients removed by the crops during harvesting are not returned to the soil as crop residue constitute important forage for the animals, while dung is most often used as a source of fuel. Some of the villagers were also commenting on the problems of erosion and land quality that caused low crop output. Moreover, lack of draught animals and shortage in household labor were mentioned as reasons for poor harvests. All these factors have markedly affected the production base of the area, with an overall decline in household consumption levels. Food bought with the money earned through selling livestock and through off-farm activities (wage labor and remittances) were used to make up for the food shortage. Moreover, most households reported that they received food supplies from the government in time of climatically stressful periods.

The residents in the study areas often reflect common social and economic characteristics. Nevertheless, there are important differences within them which tend to put a considerable impact on the pattern of their livelihoods. The main dimensions of these differences depend, to a large extent, on the number of livestock possessed and on the degree of off-farm activities. Farming is the basis of livelihood for the majority of the villagers, though the annual harvest is mainly intended for household consumption. People with land near irrigation channels enjoy greater access to water than others. But only a few villagers have access to irrigation, who were able to grow vegetables to sell in the nearby towns. In times of food crises, the poor survive by borrowing or asking for assistance from neighbors, relatives or friends. In addition, most men migrate in search of wage labor during the non-farming seasons. Further, several households, especially those of the elderly, depend heavily on children residing in the capital city or other towns in the country, or abroad, for financial support. The study showed that female-headed households are usually vulnerable as they are disadvantaged in terms of possession of assets (e.g. labor, capital). Their meager income, therefore, usually forces them to adopt coping mechanisms appropriate to their own economic and gender characteristics. As a result, they are mostly engaged in the production of poultry and small stock animals.

CONCLUSION

In Eritrea, pastoralism is increasingly becoming difficult since recent times due, mainly, to deteriorating rangeland. The depletion of grazing resources (i.e., scarcity of water and forage resources) had negatively impacted livestock productivity and hence the welfare and livelihoods of the pastoralists. Prolonged droughts, population growth, and expanding commercial agriculture have also restricted pastoral mobility, while allowing agriculture to become a necessary subsistence strategy. Further, the Government of the State of Eritrea is pursuing a policy that favors settlement through the provision of social services and irrigation schemes. All these have led to changes in resource utilization and living conditions for the formerly pastoral communities. The researcher has put the following conclusive remarks as essential feedback for decision making processes on matters related to improved livelihoods in the study villages.

a) The shift to sedentary lifestyle by the Eritrean nomadic populations has brought a gradual transformation from a complete dependence on the livestock economy to subsistence-based mixed farming. The traditional migratory pattern has also changed significantly as livestock for most part of the year are kept around the homestead using forage from the nearby farmland.

b) Labor has been significantly restructured as the household members now spend less time going to areas of water and pasture, while the main work force of the family stayed at the village to do some other work. Such emerging trend toward short range herding system could have some negative effects particularly on the vegetation and soils around permanent wells and boreholes. According to local sources, the consequences of these effects have been felt through overgrazing and the gradual decline in herd productivity.

c) The settled communities pursue strategies to mitigate the effects of environmental crisis using community strategies. In addition, the persistence of well-established territorial alliances between the various social groups of the country helps reduce conflicts over resource-uses. Unlike most other pastoral/sedentary groups in East Africa (e.g., *Turkana*, *Rendille*, *Masaai*, and *Borana*) and West Africa (e.g., *Fulani* and *Fulbe*), cattle raiding and ethnic strife are not common among herders in Eritrea.

d) The great majority of the respondents in *Apollo* and *Felket* study sites mentioned fairly adequate social services including education, health, and water supply, which are seen as the main advantages of the new way of life. The result showed that 94 percent of all the sampled households mentioned services with pastoral sedentarization to be in general satisfactory. They also felt that they had better housing, and a more convenient daily life. Almost all household heads responded that they have no plan on returning to nomadic way of life.

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SOMMARIO

In Eritrea, il passaggio al sostentamento sedentario da parte della popolazione nomade è aumentato drammaticamente negli ultimi decenni a seguito di cambiamenti economici, politici, demografici e ambientali. Un passaggio strategico a mezzi di sussistenza più diversificati sotto forma di agricoltura, piccolo commercio e lavoro salariato è stato intensificato a causa del declino dell'economia pastorale. Questo studio ha identificato i vincoli ambientali come i principali fattori di "spinta" che portano molte persone ad abbandonare la tradizionale economia pastorale, mentre la fornitura di servizi sociali (istruzione, salute) e acqua potabile pura sono stati i fattori di "trazione" che attraggono le persone nei villaggi e nelle piccole città (vita sedentaria). Lo scopo principale di questo studio è fornire una nuova visione delle circostanze umane ed ecologiche che innescano la transizione dalla pastorizia al sedentarismo nelle aree di *Apollo* e *Felket* in Eritrea. Utilizzando i dati raccolti principalmente attraverso il questionario sulle famiglie e la discussione dei focus group, il documento mira anche a studiare se i cambiamenti nell'agricoltura sedentaria hanno portato a un'economia locale di successo. I risultati di questa ricerca empirica hanno rivelato che la grande maggioranza delle comunità stabilite nei siti di studio ottengono servizi sociali abbastanza adeguati e che quasi tutti i capifamiglia non hanno in programma di ritornare al modo di vivere nomade. Si prevede che l'output di questo studio contribuirà a una migliore comprensione dei sistemi pastorali tradizionali e in evoluzione in Eritrea.