The Ecology of Nomadic Habitats in Far North Cameroon

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ABSTRACT

This research study on 'The ecology of Nomadic Habitats' in the Far North Region of Cameroon had as principal objective to investigate the environmental dynamics underlying the mobility of pastoralists in a non-equilibrium landscape as well as the choice of their habitat location. Data was obtained through the collaring of two Zebu cattle with Global Positioning Systems (GPS) in two herds at different locations particularly to determine the migratory trajectories of the nomads. The collar data were complemented by Participatory Rural Appraisal workshops and field interviews. The findings of the research showed that the presence or absence of water, pastures, and diseases impact pastoral mobility and choice of habitat location. The periodic scarcity of water imposed limits to vegetation growth, compelled some herders to resort to waterholes, while others opted for distant migration in search of water and pasture. It was evidenced that pasture degradation emanated from diverse activities of man, including overgrazing, trampling, firewood harvesting, slash-and-burn agriculture, bush fires, thorn bush invasion, and adverse climatic circumstances. Wide-ranging response strategies involving migration, market integration, herd diversification, feed supplementation, sales and slaughter, and social organization were put in place by the herders to curb the ecological threats. Generally, mobility and choice of habitat of the herders was above all motivated by the search for water and pastures for livestock, escape from inter-occupational conflicts, and avoidance of household and livestock illnesses. It was equally observed that the use of indigenous knowledge in rangeland and cattle management, exemplified in the ecological analyses, illustrates how pastoralists have over time adjusted to difficult circumstances.Conclusively, traditional pastoralism in Far North Cameroon is witnessing increasing perturbations, including ecological and climatic adversities, dwindling space due to population growth, expansion of dry-land farming and irrigation agriculture, lack of competitiveness, inadequate policy support, and agro-pastoral conflicts that exacerbated migrations.

Keywords: Zebu cattle, pastoral mobility, ecological threats, migration, traditional pastoralism, dwindling space, response strategies

INTRODUCTION

This study focuses on the underlying ecological causes of the dynamic oscillation of pastoralists from one ecological zone to another and the strategic responses of the pastoralists to environmental pressures. The link between the herders and the environment in the region is very strong as they predominantly depend on primary production and are in the main striving to get out of the cycle of poverty.

ISSN: 2223-9944, e ISSN: 2223-9553

The deployment of the Global Positioning System (GPS) collars (Telonics Ltd., Arizona, US) on nomadic cattle was carried out on two Zebu cattle in two herds at different locations for over a year to determine the ecology of nomadic mobility and nomadic responses to environmental pressures. The data were downloaded in a prototype robot with a GIS software and demonstrated to the communities concerned to facilitate the interpretation results.

The results showed that the influences of pasture and water availability as well as disease incidence on man and livestock linked to seasonal cycles play a large role in determining pastoral activities. In the dry season when water and pastures are most scarce, nomadic camps drift towards the transhumance Waza-Logone floodplain. In particular, concerning access to pastures, the number of nomadic camps oscillates as the quantity of available water and pastures fluctuates. Abundant palatable pastures were observed to be a source of attraction for the installation of nomadic camps.The fluctuations of water and pastures and the occurrence of diseases are thus the major ecological determinants of the forward and backward movements carried out by the traditional pastoralists. The concern of the men for pasture and water availability, the occurrence of diseases, the availability of fuel wood, and building materials, and the escape of their women along the way were largely significant. The women worried much about milk trade, indicating places of greater milk sales. In addition, the pastoral women are facing considerable and increasing stress—resulting from environmental degradation in sourcing fuel wood and water.

RESEARCH METHODOLOGY

The collaring of two Zebu cattle enabled us to observe the varying responses of the nomadic pastoralists to fluctuating ecological and social conditions from group to group and person to person, which were at times gender-oriented. The understanding of these indigenous response strategies provided a better insight into the ecological factors that cause pastoralists to adjust their herding strategies from place to place and over time.

The data obtained from the collars were downloaded into a prototype robot for demonstration to the herder families. Field preparations were made before the demonstrations. The families were visited and we explained to them what we intended to do. We[1] then travelled to the Zebu A camp, cleared a small field, levelled it, invited the nomads, and launched the robot. As it moved, the prototype robot loaded with the GPS data drew with fine sand on the ground the recorded cattle tracks, in the presence of the nomadic families that were involved.[1] The men and children were the first to see the robot in activity, and this was immediately followed by the women. The nomadic group of Zebu A, the Woila'en, watched the forward and backward movements of the robot in excitement. We explained to the families that they were watching their own movements in conjunction with the collared Zebu, and we waited to see what the reaction of the family members would be. To our surprise, the nomads immediately recognized and partly interpreted the routes, and when guided they named the different locations. Based on the sand track, they explained the differences between the rainy-season and dry-season locations, pointed out places where cows were stolen, calves had been eaten by hyenas, and one of the men's wives—in despair at all the migration hardship-escaped to her parents, only to return after a couple of months. We asked the husband to draw the route of the wife, and he made a clear drawing of his wife's route from her father's camp, located more eastward, back to his. With excitement, one elderly herder, Kao (once sedentary) also attempted with some success to map out their transhumance routes and

ISSN: 2223-9944, e ISSN: 2223-9553

locations visited in the previous year.

We also did the same robot presentation for the women and it turned out that they saw the transhumance routes from a slightly different perspective. The women distinguished the different locations based on the possibilities of milk sale and could explain to us the differences in milk prices and price fluctuations resulting from changes in seasons and locations. The demonstrations of the milk machine brought out extraordinary details of the recorded movements played and visualized, in which the forward and backward movements of the herd were clearly marked out.

The presentation of the Zebu collar results enabled us to test what it would mean to these families when they actually visualize their own routes, and how the visualization relates to their own memories. During the demonstrations, the Zebu collar data did not show only daily cattle movements; it also showed the overall migratory pattern of the families. The interpretation of the forward and backward movements along a single migratory drift became possible during discussions that ensued as the families watched their own movements as presented by the robot. As explained by the nomads themselves, the forward thrust and backward movements are adjustment strategies to varying and unpredictable ecological and socio-economic conditions.

In addition to Zebu collaring, field interviews and three Participatory Rural Appraisal (PRA) workshops were organized with herders, farmers and fishers of the Waza Logone floodplain to obtain data used in this study.

RESULTS AND DISCUSSIONS

During discussions with the nomads, they indicated that retreat during their return journey is possible if the rainfall ceases at the start of the rainy season, when water and pastures become less available, if there are disease outbreaks, or when conflicts occur along the return journey. The interpretations of the Zebu data results in combination with on the field investigations provided the basis for the elaboration of the ecological influences (water, pastures, diseases) on pastoral development as explained below.

Ecological Influences on Pastoralism

Influences of Pasture Degradation

In the past four decades, pasture quality in Far North Cameroon has witnessed large-scale degradation. In 1978 USDA and FAC[1] signalled the dangers of a progressive replacement of palatable pastures, particularly of *Hyparrhenia rufa* and *Andropogon gayanus* by annual species such as *Setaria spp* and *Ludetia spp*. The reasons attached to pasture degradation are related to the narrowing down of pastoral space that results in pressures[1] of trampling and overgrazing by cattle on the soil and vegetation. Similarly, field evidence showed that the replacement of palatable perennials' pastures by thorn bushes is even much more serious. The proliferation of invasive species, notably *Guiera senegalensis* and *Acacia ataxacantha* (locally known as the *Koraje*). is the most unwanted by the herders because these plants' rapid proliferation and thorny nature leads to the extinction of open pastures. The navigation of herds and herders between thorny bushes is quite a difficult task, and the difficulty increase when the cattle spread out over a large area, exposing themselves to thieves, hyenas, and even lions. Thorn bushes are notably hideouts for livestock predators and are avoided by many groups of herders both for camping and herding. The avoidance of the bush areas by

ISSN: 2223-9944, e ISSN: 2223-9553

browsers has fostered further bush encroachment into the pastures zones. However, the Uda'en and the Adanko'en herders at times take the risk of herding and camping within sparse thorn bushes because their goats and sheep eat the leaves of these trees. Approximately 20 per cent (3,900 km²) of the overall pastoral surface (19,500 km²)[1] may be covered by these thorn bushes, and this disfavours extensive pastoralism.

The field results presented in Table 1.1 proved that the herders are aware of the decline in pastures both in quality and quantity. Pasture degradation is caused by two intervening factors, namely: the reduction in the surface area available for pasturage leading to a higher concentration of animals per unit area, and the expansion of degraded and abandoned cultivated surfaces. The rapid expansion of the surface area of millet farms has also greatly diminished the available surface area for natural pastures. Estimates indicate an annual average reduction of 3.8 per cent[1] of pasture lands due to the encroachment of farmlands and invasion by thorn bushes. Although millet stalks constitute supplementary feed for livestock, access to the farmlands occurs only after harvest. According to the herders, the droughts of the 1970s and 1980s, coupled with subsequent long dry seasons, are largely responsible for the current state of the poor pastures available today.

Table 1: Pasture type and quality

Local name	*Scientific name*	*Description*	*Value to livestock*
Huddoh wodeeho	*Hyparrhenia rufa*	Turf reddish and tall spiky grass, not suitable for cattle when matured. The stems are used for artisanal works.	Valuable as young shoots, after bush burning; but not tasty and difficult to chew when matured. The zone predominantly occupied by *huddoh wodeeho* is not attractive to the traditional herders.
Bourgou	*Echinochloa stagnina*	Does not grow tall and most common within or close to swampy areas.	High nutritional value but equally difficult to chew. It is more valuable in the dry season, especially during night herding around the Maga area when dew falls and softens it. The herders prefer the area where there is much *bourgou* in the dry season. The value of *bourgou* in the wet season is ignored because other fresh shots are abundant. The fresh shoots of *bourgou* are also highly solicited by the herders, especially at the beginning of the rainy season.
Nadderre /Dodbadje	*Oryza longistaminata*	Grows tall and develops spikes when in maturity.	Soft and easy to chew but less nutritive because livestock could eat much of it without getting satiated, nor do they look better in the end than those that grazed on *bourgou.*
Taygol	*Echinochloa pyramidalis*	Grows tall and becomes tough by the end of the rainy season.	Herders appreciate *taygol* at the time of entry into the floodplain; at this time it is blossoming and fresh. However, most of it is trampled upon rather than eaten. It also becomes useful later in the dry season when cattle can pick it directly from the surface. The *taygol* that remains standing in the dry season is basically useless because it stands over a meter tall and cattle cannot easily get the leaves.

Source: Field identification by the use of PRA techniques

ISSN: 2223-9944, e ISSN: 2223-9553

The traditional herders have over time developed a system of identification by name and ranking of pastures according to their nutritional value to cattle. The occurrences of these pastures vary through the seasons from the high plateau to the floodplain. The herders know the time and place to find these pastures. For instance, during my stay with the herders in the floodplain, the PRA method was used to identify and associate the pasture types and value to livestock, as shown in Table 1.

After the use of bush fires (*ladde woolde*) to regenerate pastures, the herders are able to distinguish the stages of pasture re-growth and the quality of the pasture at different stages. According to the herders, the different stages of pasture growth are as follows:

- ✓ the *foufol huddoh/carngne*, which are the initial fresh shoots of not more than 10 cm in height. The *foufol* is highly nutritious to all livestock but is associated with watery stool of cattle. The *foufol* of all the pasture species identified above are appreciated by the herders.
- ✓ the *nyalbere/gambarare* is when the fresh shoots grow above 10 cm, and pasture is still fresh and palatable. Pastures at this stage are still very much appreciated, and the herders stay longer when they camp in these locations.
- ✓ the *barare/wictcho* are pastures that have fully grown to maturity, with stems or spikes that make them difficult to eat. After this stage, the pasture dries out at the beginning of the dry season.

Both the quantity and quality of the pastures are said to have diminished, and the herders confirmed the progressive disappearance of most palatable species such as *Falande* (*Dactyloctenium aegyptium*) in favour of less palatable species such as the *Selbo (Ludetia togoensis).* a situation which has pushed cattle to eat tree leaves.

The presence of less nutritive pastures is easily recognized by some experienced herders, because according to them this leads to a decline in calving rate and low milk production. Most of the grasses that we found remaining are the annual grasses, which when set on fire, nothing grows again until the rains come. Cattle are therefore left with nothing to eat, and this is devastating to cattle health and growth if they don't migrate to other locations.

The Uuda sheep herders are known for the cutting down of tree branches to feed their sheep and cattle. The cutting down of trees to feed cattle in a Sahel region is, in the long run, is environmentally hazardous. Also, more intensive grazing pressures and degradation were observed during this study around water points and permanent settlements. The vegetation and soil became degraded during the wet season when put under high grazing pressure close to camp sites. Cattle trampling around the camps destroys vegetal cover, and mixes the vegetation and the dung into polluted mud, rich in bacteria. When this happens, the environmental quality of nomadic camps deteriorates owing to overgrazing and trampling. Children play in the muddy environment without adequate awareness of the health risk and their legs are not free of sores.

In addition to the destruction of vegetal cover, we observed that cattle's trampling on the mud makes it impossible for water to soak into the soil, and pools of stagnant water are a common phenomenon. At the advent of the dry season, when the water dries out, a hard, dry, bare surface develops. The zones adjacent to cattle drinking points equally suffer from large-scale trampling, eventually leading to the elimination of vegetal cover and top-soil erosion. The

ISSN: 2223-9944, e ISSN: 2223-9553

removal of the top-soil leads to vegetation degradation and the formation of hardened bare rock surfaces, the *Hardé* where "no grass grows or water infiltrates" (Moritz, 1994). Vegetation degradation is defined here as "decline in the quality and/or quantity of the natural biomass and decrease in the vegetative ground cover" (Douglas, 1994).

It was equally observed that as waterholes are approached, a grazing gradient becomes perceptible, as vegetal cover diminishes both in height and density. Transect walk measurements we conducted showed that herbivory (based on trampling and browsing as indicators) impact on the density and height of palatable grass species within 100 m of the waterhole of Mindif, as shown in Table 2.

Table 2: Plant density and height due to trampling and browsing near Mindif waterhole

Transect A from 10° 38' 08" N and 14 43'33" E to 10 38'99" N and 14 43'34" E (N to S)	*0 m*	*20 m*	*40 m*	*60 m*	*80 m*	*100 m*
Average plant density/ m²	0	7	23	38	54	69
Average plants height in metres	0	0.16	0.25	0.31	0.35	0.44
Transect B from 10 39'09" N and 14 43'33" E to 10 39'14" N and 14 43'44" E (W to E)	*0 m*	*20 m*	*40 m*	*60 m*	*80 m*	*100 m*
Average plant density/m²	0	6	19	42	57	75
Average plants height in metres	0	0.12	0.23	0.35	0.37	0.49

Source: Field measurements

Transect A has an average density lapse rate interval that declines by 15.5 plants[1] /20 m as we move towards the waterhole, while transect B shows an average density lapse rate that declines by 17.25 plants/20 m as we move towards the waterhole. The creation of waterholes often invites the development of permanent settlements, which in turn interrupt the traditional livestock mobility and seasonal grazing systems. Holding environmental factors constant, trampling and browsing considerably reduce vegetal cover near waterholes. Even during the wet season, complete recovery is not evident as the top-soil is hardened and exposed to erosion.

Water scarcities

Water scarcity in the Far North region of Cameroon is a temporary issue with devastating effects. During the dry-season period of about 8 months (November to June). water scarcity for man, cattle, and crops become most noticeable. Immediately the rains stop, water dries up, rapidly draining into the sandy soils. As the soil loses moisture, the vegetation starts withering, to eventually dry out and be consumed by bush fires. The rivers too are ephemeral and dry out just after the rains, leaving behind massive sandy deposits on the river bed. Great variety and large seasonal variations thus characterize the surface water resources of the region. The causes of the water scarcity are therefore varied and are principally linked to the climate, geology, and poor infrastructure. During dry season, nomadic herders oscillate from one zone to another as dictated by the availability or absence of water.

During discussions with the herders, they confirmed that pastoral development is not only affected by water availability but also its access is a major source of conflicts. Nomadic cattle largely depend on natural water-supply sources (rivers, lakes) because they are generally

ISSN: 2223-9944, e ISSN: 2223-9553

higher in ratio per person and difficult to manage if water has to be obtained from wells. The nomads therefore locate their camps close to the streams to permit their cattle access the water when in need. In the wet season, the nomads move towards the high plateau and settle beyond the limits of the inundated floodplain. The high plateau zone is served by intermittent streams flowing from the highland towards the floodplain.

The pastoralists' water problem in the Far North of Cameroun has thus been analyzed with the help of a sampled zone that possesses a plateau/flood plain relationship. The Maroua-Mindif-Pétté high plateau is a wet-season grazing ground which inclines towards the Logone floodplain, characterized by dry-season grazing. Between the Maroua-Mindif plateau and the Logone floodplain lies the Moulvoudaye-Bogo-Guirvidig intermediate zone, which harbours both sedentary and nomadic pastoralists. While the nomadic pastoralists crowd the south of Lake Maga in the late dry season, the sedentary pastoralists shuttle around waterholes. The degree to which sedentary pastoralists confront the water problem is therefore not the same as that of nomadic pastoralists. It is usually a habit for the nomadic pastoralists to move further away from water-overstressed areas (non-equilibrium ecology). though not without limits, while sedentary pastoralists are obliged to source alternatives or negotiate access to water all the time. The temporary lack of water is the main triggering factor for transhumance, especially for those who have many cattle.

The factors that influence the use of water in this region are related to the herd size, transhumance routes, the mobility system, cropping practice, and the level of sedentarization. Water is accessed by various methods of pastoral hydraulics. The method/technology used determines the water quantity and quality, which in turn influence in a major way the number of cattle that can be supported by the area. A range of welling techniques are deployed by the herders to make use of available water resources, whether these are on the surface or underground, in order for animals to have access to the water, which also serves rural inhabitants. The surface water resources in this case comprise periodic streams, natural or artificial *mares*, and wells in dry river beds and in wet valleys. Artificial ponds or *mares* retain canalized water from surface runoffs generated during rainfall. Some artificial *mares* such as that of Moulvoudaye and Mindif are very large and do provide water for over 1,000 head of cattle and people of the neighbourhood for about three months.

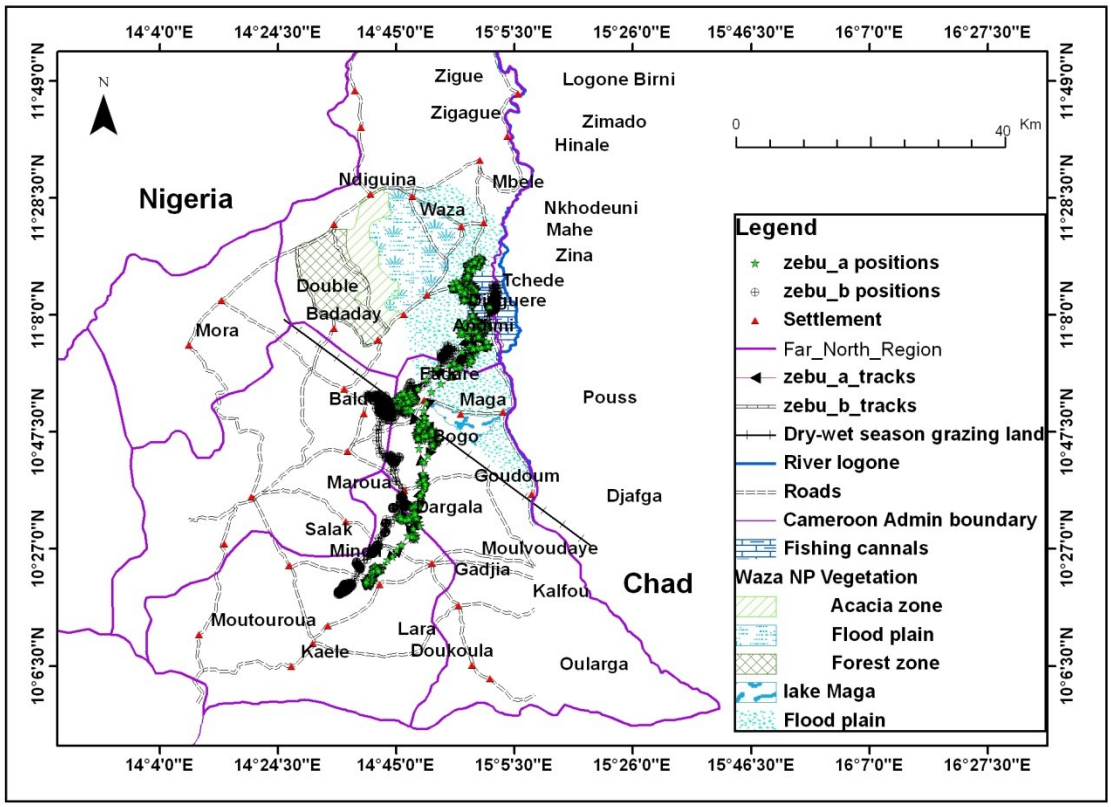
The poor water retention capacity of the soils, leading to the drying out of rivers, pre-empts the pastoralists digging wells in dry river beds to furnish water for their cattle. Welling in dry river beds allows water that has infiltrated into the river bed during the rainy season to be used in the dry season for the watering of herds. Sandy clays have peculiar characteristics as far as water retention is concerned. During the wet season they easily become saturated and water-logged while at the same time furnishing nearby rivers with water.

The traditional nomadic herders, who cannot afford the digging of wells and the purchase of water for their cattle, drift towards the transhumance floodplain at the start of the dry season. In the floodplain, the nomadic camps are located close the permanent rivers and water bodies such as river Logone, Petit Goroma, and the Maga dam. Nomads make little or no financial investment in their attempts to provide water to cattle. They therefore make the most out of natural streams, although during their to-and-fro movements they encounter difficulties along the way. These difficulties range from the blockages of transhumance corridors, to vegetable-garden cultivation on the banks of rivers and lakes, to the appropriation/privatization of water close to fishing canals.

ISSN: 2223-9944, e ISSN: 2223-9553

The results of the Zebu collar data show that the traditional pastoralists drift to the floodplain during the dry season in search of water. They spend most of their time (about four months) around the Lake Maga area, where water is most abundant, and part of the dry season close to the banks of the River Logone. This is an important demonstration of the vital role of water in traditional pastoral herding. The detailed movements of Zebu A are illustrated in Map 1.1, in which most of the time cattle spend in the floodplain is very close to major water bodies. The mapping of the collar data of Zebu A showed that it covers an estimated one-way straight-line distance of 80 km from the start point in the wet season camp (July) to the end point in the dry season camp (January). This distance can be multiplied by two (160 km). including shuttles of about half the distance (40 km) in between the main points. In practice, the same routes are taken by the pastoralists year after year, following in most cases the cattle corridors where farmlands and settlements do not permit the spreading out of cattle during migration. At the entry into the floodplain, from the west end of the Maga Lake, cattle movement is very swift due to the dense croplands and settlements in Kaikai and Guirvidig. Cattle from the southwest end of the lake have just one day to go across this volatile zone, strongly guarded by farmers who protect their farmlands from cattle. Movements within the floodplain follow the banks of the Petit Goroma for water and fresh pastures. It is within this zone that hundreds of fishing canals spread out, obstructing cattle movement, and cattle have to move in between to avoid destroying them.

Map 1: Far North Cameroon showing movements of Zebu A and B



ISSN: 2223-9944, e ISSN: 2223-9553
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The availability of water and pastures was found to largely determine the movements of collared Zebu A and B. Map 1.1 presents the annual migratory patterns of Zebu A and Zebu B in search of water and pastures. The zone 10˚ N and 14˚40' E is the dry-season grazing zone. To the southwest (10˚ 00' N and 14˚45' E) of Lake Maga, Zebu B stayed for over three weeks during return to the wet-season camp. In less than a month the herd explored a zone of over 250 km². The delay is a strategic move[1] to allow more pastures to grow in the wet-season camp before the cattle's arrival. The stay close to Lake Maga at the beginning of the rainy season is due to the fear of early rains' cessation, which may lead to a drier period. Being close to Lake Maga provides a greater security to the herders from the impact of rainfall variability. This is also the same for the family of Zebu A, who were just at the fringes of the lake but for a shorter period (June 22 to July 06). The owner of Zebu B also has a family affinity in this zone, in the Bogo-Maga area. In fact, his sedentary wife lives here. He was himself once sedentary in this area.

Incidence of Diseases

Poor water quality poses a major threat to cattle and human health in areas where man and cattle use the same waterholes. Faeces from livestock and chemicals from vegetable gardens contaminate waterholes, and this contributes to harbouring diseases which affect humans and cattle. In addition to pollution, conflicts over access to this vital resource occur and this acts in disfavour of community cohesion. During this study, it was observed that standing water and dung were mixed in muddy surfaces resulting from the removal of vegetation by cattle trampling near homes, and this attracts disease-carrying insects. Man and cattle use the same waterhole because of the inability to create alternative water sources due to the poverty that affects the low-income rural dwellers. About 80 per cent of the deaths in children were associated with unsafe water, poor sanitation, and indoor pollution.[1]

Disease Incidence in Cattle

During this study, the traditional nomadic herders confirmed that they pursue disease-free zones to ensure the survival of their cattle. Traditional nomadic herders who go on transhumance to nearby rivers escape from diseases that infest standing pools and *mares*. Water in the *mares* remains stagnant for long periods and breeds cattle diseases such as *mbalkou*[1] or liver worms and intestinal worms. Liver worms, or *ver de foie* as it is known in the region, is the cause of multiple deaths of cattle, especially in the dry season when water and pasture are most scarce. Both nomadic and sedentary cattle are prone to the disease. While nomadic cattle are infected by remnants of stagnant water in the *yaéré* and swampy lake borders, sedentary cattle are infected by the stagnant water of artificial drinking holes or *mares*. The *mare* is also a zone of contact for different herds, and this encourages the contamination of healthy cattle by sick ones. The spread of food and mouth disease (*borou*)[1] is increased during contact with unhealthy cattle at these water-drinking points.

Equally, herders avoid swampy and muddy zones infested with a number of disease vectors in favour of open, dry land and grassy terrain. In the Far North of Cameroon, the presence of disease-free zones is relatively hard to come by in the swampy floodplain and borders of the Maga Lake. Several cattle congregate particularly around water points and one sick animal can contaminate a thousand others. What has saved the sedentary pastoralists is the regular vaccination of their cattle against many common epizootics. In spite of this, the sedentary herders blame the nomadic cattle for being permanent disease carriers, as the floodplain

ISSN: 2223-9944, e ISSN: 2223-9553

transhumance zone they frequent is noted for its abundant stagnant water and flies that tend to facilitate the transmission of diseases. This is a source of tension between the traditional nomadic herders and the modern agro-pastoral herders, as explained in later chapters.

Further, during this study it was confirmed that stagnant water is a major source of the transmission of *Thelaziosis,* particularly in the Maga and Pouss area.[1] Some nomadic herders, and particularly transhumance herders, are drifting to a sedentary life because according to them the advantages derived from the fresh pasture are outweighed by high cattle mortality owing to diseases. The increasing dryness of the floodplain leads to early depletion of the fresh pastures and an early dry season return of cattle to the safe haven of the Maga neighbourhood, where the highest concentration of cattle (38–70 cattle per km²) and the spread of diseases occurs during difficult times. In the months of March and April, carcasses of cattle, horses, and sheep could be seen littered here and there owing to the scarcity of pastures and prevalence of diseases. The mortality rate can be estimated at approximately 2 per cent[1]of the over 180,000 cattle that frequent this zone. In terms of numbers, cattle mortality owing to diseases and drought conditions triples losses incurred when compared with cattle theft. In addition to the diseases, the stress of armed conflicts associated with cattle theft imposes an immeasurable stress on the herders.

Disease Incidence in Man

Human health has an obvious linkage to environmental degradation and poverty. Health remains a much-neglected issue within the major development aspects of the floodplain. Except for some villages that were provided with hand-pumped wells by the defunct Waza Logone project, all nomadic camps lack access to potable water supplies and proper sanitation facilities. During the wet season, large natural pools of water accumulate in depressions, and nomads settle near these pools to enable their cattle access the water. Nomads camping close to the standing pools of water are prone to mosquitoes and some nomads that consume the water suffer from water-borne diseases such as diarrhoea, cholera, dysentery, typhoid, intestinal worms, and schistomiasis.[1] The Mindif District hospital consultation data that we analyzed showed that 40 per cent of declared illnesses are related to water problems. Nomads are therefore susceptible to multiple water-borne diseases and malaria. Nomadic pastoralists are said to be less prone to malaria because they constantly move outside the flight range of infected mosquitoes (Nathan et *al.* 2005). although in Far North Cameroon this is not the case, as in the Maga area and wet-season settlements, mosquitoes are a constant menace.

The relatively high mobility of nomadic pastoralists is supposed to protect them from high rates of parasitic infections, but unfortunately they hardly ever have good drinking water. Nomadic herders drink and bathe with the most polluted water and are therefore very exposed to diarrhoea, dysentery, and intestinal worm infestations. Women and female children, as the primary water carriers, managers, and end users, suffer the most. They are in constant contact with polluted water from streams and stagnant pools. Women and children are therefore the groups most vulnerable to water-related diseases. It was also observed that the women encourage the men to dig shallow wells near their homesteads or they settle near water sources to ease their task.

The absence of alternative sources of water supply for man has put local authorities of Far North Cameroon in a state of dilemma, in which the inability to prevent people from using

ISSN: 2223-9944, e ISSN: 2223-9553

cattle drinking waterholes leads to the spread of diseases. In spite of the fact that existing regulations[1] prohibit people from using constructed cattle waterholes, the local authorities are left with no choice but to allow people withdraw as much water as they need from the waterholes, irrespective of the impending health and associated cattle water-shortage problems. In the words of the Divisional Delegate for livestock of Mindif, "it is better to allow them collect the dirty water from the *mare* than to let them die of thirst".[1]

Furthermore, most of the illiterate cattle herdsmen drink the *mare* water out of ignorance. The herders seem not see any link between drinking the brown stagnant water and the illnesses they suffer from, because in their opinion, stomach worms do not come only from dirty water. "Look at the water. It is clean. It has good taste and I think it is good for drinking".[1] However, the people who live in the neighbourhood of the *mare* have realized the danger it poses to the health of their children. In the past they filtered the water before drinking it because of the visible presence of mosquito larvae. Now, they no longer drink it. "Only animals drink the water and people from afar who do not know the dangers it poses".[1] The Mindif District hospital doctor[1] admitted to us that it is hard to convince some of the people of the relationship between the water they drink and the illnesses they suffer from. He regretted the absence of an opportunity for a massive sensitization campaign against the use of polluted water by people in his locality, pollution which directly affects cattle as well. However, in spite of their presumed reticence about visiting health centres when ill, nearness to health centres is an important factor considered by the nomads in their attempt to decide where to locate their camps. Although this is a secondary factor, it is still vital enough as nomads are exposed to the vagaries of nature that cause illness and conflicts that may result to injuries that may need medical care.

Responses to Changes In Ecological Conditions

Mobility

Ecologically induced mobility occurs in response to spatial and temporal variations in the availability of resources such as pastures, water, building materials, fuel wood, and dry land sites. The nomadic herders are much more susceptible to variations in ecological conditions and move over great distances, covering over 180 km (confirmed by the Zebu collar data) per year from their wet-season camps to the dry-season transhumance sites. Distances to transhumance sites varies, from an average of 40 km for rotating sedentary pastoralists to 180 km for nomadic pastoralists, excluding in-between tactical retreats and daily grazing shuttles. The search for water (for human and livestock consumption) and forage are the principal factors that trigger mobility and migration. Mobility as a strategy to stabilize carrying capacity alone is not enough as prescribed by the non-equilibrium ecologists (Scoones, 1999). However, other herders go in for alternative technology options of intensification (Boserup, 1965) through supplementary feeding of livestock to ensure ecological sustainability.

In search of Water and Pastures

The deployment of Zebu collars and GPS Garmin devices during this study proved that nomadic pastoralists trek over great distances in search of water and pastures. In general, distances trekked to water are greater than distances to grazing sites because water availability plays an important role in determining grazing sites. The distance trekked by these pastoralists to livestock water sources also increases as the dry season intensifies. The

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nomadic pastoralists were found to be more mobile, and they consider movement as an inherent contingency response strategy that helps them to avoid loss and to optimize production within the heterogeneous landscape of great seasonal and ecological variability. Seasonal movements are essential for pastoralists of this region, as variations of rainfall and temperature result in marked spatial and temporal availability of pastures and water. Other reasons that cause herders to move include the conversion of cattle kraals into muddy surfaces by excessive rain and trampling, the need for food, and the search for more abundant grazing are the major causes of mobility during the wet season.[1] Owing to swampy conditions in the wet season, some localities such as Moulvoudaye and Bogo witness increased insect bites, incidences of diseases, and malaria, a situation that forces the herders to migrate.

The mobility of the herders is found to occur in different patterns—from pure nomadism (opportunistic, no fixed base). through various forms of transhumance (seasonal migrations following fixed corridors and camping sites). to modern sedentary agro-pastoralism (associated with short-distance rotational transhumance and supplementary feeding)—each demanding various levels of participation by household members. During migrations and in response to ecological conditions, the nomadic pastoralists divide their herds (*lucci*). *Lucci* is a system of herd separation in which the herd owner splits his cattle into different groups by age, sex, type, and productivity. During *lucci,* the herd is split into the home and satellite herds; the satellite herds comprise strong grown-up males and non-lactating females of the generally larger livestock species, mainly cattle and a few donkeys. The home herd consists of young and lactating cattle, horses, and small ruminants (home herds) left around the homesteads. The satellite herds trek long distances with the young, energetic, and brave men in order to conserve the less distant sources of water and forage for the home herd. The women, the elderly, and children are usually left behind at the campsites to take care of the home herd (*saareji*). Satellite herds (*horeji*) are usually more numerous compared with the home herds. The satellite herd is also usually designed for long-term uses, while the home herd serves for daily functions such as milk production. Generally, during the dry season, the main nomadic camps remain intact with family members, especially women, children, and the elderly, while the young energetic men move the livestock to remote, abundant pastures.

Frequent Camp Displacement

The analyses of interview results showed that the frequency of camp displacement is strongly tied to the ecological conditions of the habitat. It was observed that the most frequently displaced herders are the ones that have greater diversity and number of livestock, which need a diverse habitat quality. The poorer the ecological conditions of the habitat in terms of pasture and water availability, the higher the frequency of displacements. In addition, frequently displaced camps suffer from inadequacy in construction techniques and are always wanting in facilities. The decision to construct nomadic dwellings in a particular location is strongly linked to the expected time the nomads have to stay in that particular location and is assessed from the initial ecological conditions of the habitat. The traditional nomadic pastoralists frequently move their camps and spend the night with all or part of their herds.

The ecological quality of the habitat is an important determinant of the frequency of nomadic camp displacements. Nomads that are frequently on the move, such as the Alidjam'en and Uuda'en, have poorly constructed camps. Table 1.3 shows the frequency of camp displacements due to habitat quality, as assessed by the various groups (lineage

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characteristics) and according to the needs of the animal species herded. Habitat quality is influenced by multiform factors, including palatable pastures, water, and disease-free zones. However, it was observed during this study that a location abandoned by one group may be appealing to another, depending on the dominance of the species herded. The requirements for cattle are not the same as for goats or sheep. While sheep, goats, donkeys, and horses cherish wooded areas, cattle cherish open grasslands. The different groups herd different species and move according to the needs of the species herded. In field surveys we conducted during 2008 and 2009, 33 of the 69 households interviewed proved relevant and had camps which were displaced owing to fluctuating ecological conditions.

Table 3: Frequency of campsites' displacement

Sub-group (Lineage)	*Dominant species herded*	*Number of household heads interviewed (n=33)*	*Average displacements of campsites per year*[1]
Woila'en	Zebu cattle	9	5
Alidjam'en	Zebu cattle	4	8
Adanko'en	Zebu cattle and goats	5	7
Shoa Arabs	Zebu cattle	8	5
Mara'en	Zebu cattle and goats	2	6
Uuda'en	Sheep and donkeys	5	17

Source: Data from interviews

Seasonal and frequent herd mobility due to fluctuating pasture quality describes what is widely known as opportunistic grazing wherein temporal structures are occupied by entire families that are always on the move, such as Uuda'en and Alidjam'en. The characteristics of a settlement reflect the degree to which the community has evolved over time and the nature of activities carried out. The Uuda'en nomadic pastoralists, mostly sheep herders, have the most poorly constructed camps. They cover the greatest distances, coming from Niger and Nigeria and changing camping sites as often as 17 times a year. Next to the Uuda pastoralists come the Alidjam'en, with an average of 8 displacements per year. All of the Alidjams that were interviewed during this study reside in Cameroon but are considered by the other nomadic pastoralists as sorcerers and primitive, fierce fighters (Drent, 2005) of vicious habits. The Alidjam, just like their Uuda companions, construct their huts in a simple way, which consists of a bed in the form of a suspended platform on poles, usually under the shade of a tree. In contrast, the Woila'en and the Shoa Arabs posses the most spacious and beautifully constructed huts, with about a third of the floor surface just in front of the bed. The space at the entrance of the hut is reserved for women to spend the day in the shade and for cooking. The Uuda and the Alidjam women take cover under trees, and where trees are absent they use plastic coverings.

The spatial mobility of the traditional pastoralists does not favour the construction of durable structures; they live in temporal structures that they build and dismantle as they move along. We observed that hut-building is amongst the priorities accorded to the newly wedded to satisfy their needs for a new hut. The moving and reconstruction of camps is the woman's

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responsibility, and more frequent moves due to the deterioration of the rangelands means that this activity is becoming much more tedious. These responsibilities have become increasingly time-consuming and exhausting, as longer distances are covered to find and gather sufficient water, pastures, and construction material.[1] The nomadic pastoralists invest little effort (time or money) in the construction of camps. Nomadic camps are therefore temporal structures, easily dismountable with little accommodation facilities. Nomadic camps last longer in one location during the wet season compared with the dry season. In the dry season, nomadic pastoralists basically spend the days and nights outside just the same as their cattle. All they have to contend with are the cold nights, particularly at the beginning of the dry season. During the dry season, their grass-thatched huts are hardly distinguishable from the surrounding countryside from a distance. Household belongings are usually anchored under the shade of a tree, with beds exposed under the sun and no sizeable huts around. Although the nomadic pastoralists carry along most of their belongings, including building materials, they mainly camp in close proximity to the sources of these materials. Their migratory routes also follow the traditional points or sources of these building materials. The need to settle close to the sources of building materials is very high, as on many occasions thieves do not spare the cattle transporting these homes. Many cattle with little manpower results in insufficient cattle surveillance while on transit along transhumance cattle corridors. Cattle transporting the belongings of the nomads, including their dismantled homes loaded on oxen, disappear along the way.

In Search of Open Spaces and Dry Land Sites

While in the field it was observed that nomadic pastoralists are very sensitive to the environment in which they live. Nomads cherish open spaces and less muddy sites for their camps. In fact, nomadic campsites in most cases—and except for some Uuda'en and Adanko'en—are situated in preferably less wooded sites, to avoid thieves and predators. Wooded sites are considered by the nomads to be hideouts for predators and bandits. However, the Uuda'en indicated that they prefer wooded sites for their sheep, which eat the leaves of the thorn bushes. The nomads in general have a preference for dry-land sites in the location of their camps. They avoid swampy areas[1] as much as possible during normal times because they consider such sites to be disease-infested. When their camp sites become too muddy as a result of cattle trampling, they change the area to a more favourable one. In the wet season and in spite of the abundance of pastures, nomads change the location of their camps as a result of too much mud. Under swampy conditions, particularly at the time of entry into the floodplain and given that all options for a dry-land site are closed, nomads construct their camps in these swampy conditions and coral their animals at a safe distance. They use the technique of suspended beds in the huts to stay safe from mud and water. The technique of suspended beds is also utilized during the wet season to prevent surface runoffs from destroying household property.

In Search of Fuel Wood

This is a particular concern in the floodplain, given that the only technique of cooking rests on the use of fuel wood. The floodplain is notably grassy without any substantial tree cover. Isolated trees are spotted here and there within the neighbourhood of settler villages. Nomads do not have access to these resources. Nomadic pastoralists largely depend on the dry stems of ferns, which burn quickly, as fuel wood. Other nomadic pastoralists buy firewood in the floodplain from settler villages. Proximity to fuel wood is therefore an essential determining

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factor of nomadic camp location. The decline of bush land (Wassouni, 2006) and water resources and the prevalence of periodic floodplain night-cold stress are additional realities that the nomadic people have to confront. Reduced access to fuel wood for cooking and confronting the early dry season night cold cause some families to make adjustments in their diets. "Today I will cook rice instead of millet. To cook millet I need to make soup in a different pot and this will burn much firewood. I will cook the rice in one pot. Millet is our preferred meal, but we have to change for today. The rest of the firewood will be used for the evening fire".[1] The role of fire in nomadic camps cannot be over emphasized since it is amply cited in the literature (Dupire, 1962; Stenning, 1959, 1971). The nomads use fire to scare off wild animals, drive mosquitoes away, and burn medicines that protect the herds. Fire is also linked to the origin[1] of the nomads and their cattle.

Furthermore, the multifarious duties of the pastoral women involve them in a close interaction with and dependence on the natural environmental resources in a number of ways, including collecting fuel wood, water, wild berries, building materials, and medicinal herbs, and foraging for animal consumption. Environmental degradation, land fragmentation, and privatization result in restricted availability of rangeland resources. Environmental degradation contributes significantly to increasing women's workloads while reducing their capacity to meet their household provisioning obligations. Many women have to spend extra time in subsistence activities, which reduces the amount of time available for other economic activities. The degradation and diminishing availability of these rangeland resources which the women depend on have particular repercussions especially in poorer households. Pasture-land degradation increases the amount of time that has to be spent caring for young, sick, and feeble livestock which are kept at the homestead or within the camps. Moreover, degradation of the pasture lands contributes to the deterioration of fodder supply and animal production, both of which considerably increase the work burden on women. The deterioration in the quality of grazing, due to inadequate pastures, is rapidly translated into a reduction in milk quality and quantity. It is therefore evident that pasture degradation has a particular impact on women by further reducing the milk supply, a supply which is very vital to a household's subsistence and to women's income and livelihood. For poor women of hired herders, who have limited access to resources, the impact on their livelihood is even greater.

Herd Composition

In response to ecological conditions, the herders have developed time-tested practices and do not build up their herds haphazardly. The herd composition is adjusted through the practices of *lucci* and various forms of off-take (sales and slaughter). Each animal kept in the herd will depend on its potential ability to overcome adverse ecological conditions and the production and reproduction role it can play. The composition of herds is therefore largely determined by the production objectives of the pastoralists, their livelihoods strategies, and the projected outcomes of their herding activities. It was observed during this study that the nomadic pastoral herders maintain a female-dominated herd to assure reproduction of the herd and milk production for the family. A socio-economic analyses of 69 nomadic households showed that on the average, all households maintained female-dominated herds; proportion of female cows to bulls, an average ratio of 10:4 (60 per cent female) was observed.

Nomadic herders confirmed that a good control of herd composition results in almost evenly distributed livestock births during different seasons, and this assures them of regular milk supplies, which they use to supplement their food and income. The objectives of maintaining

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a female-dominated herd by some traditional pastoralists, especially the Arab Shoa, is to offset the long calving intervals in order to stabilize milk production and assure a healthy and consistent herd growth even during adverse ecological conditions. Nomadic herders confirmed the prevalence of a high calving rate during and at the end of the transhumance period. They confirmed that transhumance offsets multiple risks resulting from the vagaries of climate, and it allows them to take advantage of favourable periods and sites of pasture growth, if and when they occur along their trajectory.

Herd diversification

The choice of which animal to rear depends more on ecological factors than on a combination of the socio-cultural values and market options which the herders are exposed to and are expected to benefit from. The herders we held discussions with during this study consider herd diversification as a strategy to cope with adverse ecological conditions, although they equally viewed diversification as a symbol of wealth since livestock is highly valued in the region. Livestock, particularly cattle, is not seen only as property for sale but provides income and food in the form of meat, milk, labour, and hides, as well as conferring social status on its owners. When the herders combine diverse and complementary animal species (cattle, donkeys, sheep, and goats) they become most viable, reducing the impact of ecological adversity and livelihood risks by enhancing the diversification of their income to satisfy both their material and social needs. Herd diversification as an ecological and livelihood strategy is particularly useful in this pastoral, resource-scarce, and ecologically unpredictable environment, in which advantage is taken of the various adaptations of different livestock species (cattle, sheep, horses, goats and donkeys). In addition, different livestock species are valued for different reasons. For example, the horse is highly valued as a form of transport, whereas small ruminants are highly valued as a convenient source of income and meat, and for slaughter during traditional ceremonies such as the feast of the ram.[1]

Herd Size Adjustments

The regulation of the herd size yields both ecological and economic advantages to the herders. The nomadic pastoralists regulate their herd sizes depending on the availability of pastures, water, and the production as well as reproduction objectives mentioned above. The socio-economic data on average herd size put the nomadic pastoral household herd size at 75. A nomadic pastoralist may have 5 or 6 herds distributed in different locations. Herd size regulation is therefore a common herd management strategy developed to assure the survival of livestock and to insure livelihood. Within the nomadic pastoral set-up, herd size regulation is achieved by herd splitting (*lucci*). cattle sales for subsistence, and slaughter. Herd splitting as a response to varied ecological conditions requires skills. The regulation of herd size by *lucci* is done through the division of livestock into home and satellite herds. The nomadic pastoralists also regulate their herd sizes in terms of sales. The nomadic pastoralists do away with weak animals during the dry period owing to lack of feeding.

Livestock Sales and Slaughter

In this study, cattle sales and slaughter as a response strategy to varying ecological conditions was significantly different between households of traditional and modern pastoralists. The estimates arrived at come from personal observations and random interviews of some herders (27 modern pastoralists and 14 traditional pastoralists). Based on observations I made during

ISSN: 2223-9944, e ISSN: 2223-9553

the period 2006–2009, the overall annual average cattle sales per household were estimated to be below 12 per cent and slaughter rates were below 3 per cent. In general, the herders have a tendency of maintaining the herds by perpetuating production and reproduction. Modern pastoralists involved in cattle-fattening, however, had a cattle-sale rate of over 60 per cent of fattened cattle that were destined for commercialization; the remaining 40 per cent were weak cattle that were fattened for reintegration into the herd. The sales of small ruminants were also below 12 per cent but had slaughter rates of 4 per cent, which were slightly higher than those for cattle. It appears that traditional pastoralists increase sales of livestock either prior to or during peak dry season, when mortality rates are high. Regarding cattle sales, most households recorded their highest sales' rates during the peak dry season to avoid losing weak animals and to buy food. However, fewer traditional pastoralists prepare for the peak dry season by increasing sales of their animals, because they may have no need for the cash at that moment and such anticipation is not always feasible.

Slaughter rates were at their highest towards the end of the dry season, and the aim was to reduce the risk of mortality, because since the herders are mainly Muslims they do not eat dead animals which have not been ritually slaughtered. These pastoralists prefer to slaughter small ruminants rather than cattle, probably for economic reasons. The modern agro-pastoralists (who have abundant alternative feeding) recorded the lowest slaughter rates because they had possibilities of providing alternative feed and medical treatment to weak animals. Cattle sales were done in advance for ageing and weak livestock to counter the impact of drought. Other form of sales, however, are economically motivated, and most animal slaughter was culturally motivated (feast of the ram, marriages, child naming, etc.) rather than for food needs alone.

Disease Management

The vagaries of the ecological conditions lead to persistent disease threats in the region, such as the contagious bovine pleuroneumonia (*bomsude*). rinderpest (*pettu*). blackquarter (*labba*). foot and mouth diseases (*borou*). liver worms (*gilchji/Bohle*). tuberculosis (*kikowu*). and waterhart (*ngaybu*). which must be carefully managed to avert animal loss. The loss in animal life in times of epidemics seriously impacts pastoral livelihoods, since they have high dependency on animals and animal products. The management of animal and human diseases (malaria and intestinal infections) was therefore a regular issue observed in pastoral households. Within the household, Fulbe pastoralists acquaint their children with the pathology of livestock while they are still young, as they coral animals particularly in the evenings and gradually become active in herding. Both human and livestock diseases are a common phenomenon and intensify during the stress periods, notably in the dry season. Preventative measures are put in place, such as avoidance of susceptible areas, migration, and hygienic practices. The treatment of these diseases was performed mainly using ethno-therapeutic methods for traditional pastoralists and modern medicine for the sedentary modern pastoralists. The ethno-therapeutic methods observed include the squeezing of tree leaves and the boiling of roots to make animals drink, the burning of animal skin by heated iron rods, the smoking of the sick animal with herbs, and the cutting and removal of animal parts such as the teeth, hooves, etc. However, I also witnessed some occasions where traditional pastoralists used modern medicine (antibiotics) to inject their animals and treat diseases that they know best.

ISSN: 2223-9944, e ISSN: 2223-9553

CONCLUSION

The forgone analysis show how adverse climatic conditions and pasture degradation in Far North Cameroon exert diverse pressures on man's activities. Over time pastures have changed both in quantity and quality. The vegetation of the region has been tampered with by man through over-grazing and fuel-wood harvesting, leading to a scarcity of palatable pastures in the plateau zone—a situation which has led to the invasion of pastures by thorn bushes, which serve as hideouts for predators and cattle thieves. However, the ecological contrasts of the region provides a great advantage to the pastoralists, as they make good use of different niches in response to seasonal resource variations. Ecological conditions may favour the expansion/decline of the herd, and this is most important in a nomadic pastoral context because little is done to harness the environment.

However, the exploitation of the different ecological niches by pastoralists is highly conditioned by water availability. The drop in the water table during the dry season and the vagaries of the weather narrow the scope of human and livestock development. Seasonal variations in water availability result in drastic soil-moisture deficit during a prolonged dry season, arresting vegetation growth and restricting pasture availability to livestock. Water scarcity during the dry season engenders greater pastoral mobility for pastoralists who cannot afford waterhole digging and supplementary feed for their cattle, a situation that limits livestock production.

In this study, we also gathered data on some of the livelihood and survival strategies practised by these pastoralists, including movement and migration in search of water and pastures. Various herd management strategies identified included the maintenance of a female-dominated herd structure and the diversification of livestock species to make good use of the diverse ecological niches. Herd size accumulation and partitioning into home and satellite herds were also observed. Equally, the livelihood strategies differed between traditional and modern pastoralists.

It was observed that the renewal of pastures by the use of bush fires, overstocking around homesteads, and browsing and trampling around water holes in Far North Cameroon threaten the environment, the source of livelihood for man. Overgrazing and trampling provoke soil erosion and the extinction of some plant species, especially close to waterholes and homesteads. Disease management was a major challenge, and practices such as the use of modern medicine, avoidance of disease-infested zones, and the use of ethno-therapy were common.

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