



HAL
open science

Livestock production systems in the semi-arid savannah of the Central African sub region

Daniel Nzingu Awa, Aboubakar Njoya, Youssouf Mopate Logtene, Jacques Anicet Ndomadji, Joseph Onana, Anastasia Asongwed-Awa, Anne Clarisse Ngo Tama, Mathias Djoumessi, Benjamin Loko, Ali Brahim Bechir, et al.

► **To cite this version:**

Daniel Nzingu Awa, Aboubakar Njoya, Youssouf Mopate Logtene, Jacques Anicet Ndomadji, Joseph Onana, et al.. Livestock production systems in the semi-arid savannah of the Central African sub region. 2003, 13 p. hal-00137977

HAL Id: hal-00137977

<https://hal.science/hal-00137977>

Submitted on 22 Mar 2007

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Livestock production systems in the semi-arid savannah of the Central African sub region

Daniel Nzingu AWA*, Aboubakar NJOYA*, Yousouf MOPATE LOGTENE**, Jacques Anicet NDOMADJI***, Joseph ONANA*, Anastasia ASONGWED-AWA*, Anne Clarisse NGO TAMA*, Mathias DJOUMESSI*, Benjamin LOKO*, Ali Brahim BECHIR**, Arnaud DELAFOSSE**, Angaya MAHO**

*IRAD-PRASAC, BP 1073, Garoua, Cameroon

**LRVZ-PRASAC, Farcha, BP 433, N'Djamena, Tchad

***ICRA-PRASAC, BP 122, Bangui, RCA

Abstract — The rural people of sub-Saharan Africa live mainly on diverse agricultural activities including livestock keeping, which plays a major role in the socio-economy of the region, as it accounts for an average of more than 11% of the gross domestic product (GDP) of the countries of the region (Cameroon, Central African Republic – CAR - and Chad). But livestock productivity is generally low. This study was conducted to identify existing livestock systems, their constraints and potentials, in order to better target innovations for increased productivity. It involved the cotton-producing belt of Cameroon, CAR and Chad and consisted of a survey, a 1-year cohort and a bibliographic review of previous work. Six livestock systems were identified based on the relative importance of livestock keeping and crop production, predominance of species and rearing practices. Constraints included lack of adequate feed resources due to diminishing pasture space, disease, high mortality and conflicts. These were linked to farm type. Natural pasture productivity was found to be very low (3-4 tons DM/ha) in more arid areas which paradoxically have a higher livestock density compared to areas with rainfall > 1000 mm (7-8 tons DM/ha) but unfortunately infested by the tse-tse fly and other disease vectors. Health problems include dermatophilosis, foot-and-mouth disease and trypanosomosis in cattle, peste des petits ruminant and helminthosis in sheep and goats; Newcastle disease in poultry.

Résumé — Les systèmes d'élevage en zone semi-aride des savane d'Afrique centrale. En Afrique subsaharienne, les paysans vivent essentiellement de l'agriculture et de l'élevage Cette dernière activité joue un rôle socio-économique important et représente 11% du produit intérieur brut dans les pays de l'Afrique centrale (Cameroun, République centrafricaine (RCA) et Tchad). Mais la productivité de l'élevage est en général faible. Cette étude avait pour objectif l'identification des systèmes d'élevage actuels, leurs contraintes et opportunités afin de mieux cibler des innovations. L'étude s'est déroulée dans les zones cotonnières du Cameroun, de la RCA et du Tchad en trois phases : une enquête, un suivi d'une année des exploitations et une revue bibliographique. Six systèmes d'élevage ont été identifiés sur la base de l'importance relative de l'agriculture relative à l'élevage, espèces prédominantes et des pratiques d'élevage. Les principales contraintes ont été les ressources alimentaires inadéquates dues à la réduction des espaces pastorales, les maladies, une forte mortalité et les conflits agropastoraux. La productivité des pâturages naturels reste faible dans les zones plus arides (3-4 tonnes MS/ha) alors que là où la pluviométrie est supérieure à 1 000 mm, elle est relativement bonne (7-8 tonnes MS/ha). Ces dernières sont malheureusement infestées par les glossines et d'autres vecteurs de maladies. Les pathologies les plus fréquentes étaient la dermatophilose, la fièvre aphteuse et la trypanosomose chez les bovins ; la peste des petits ruminants et les helminthoses chez les petits ruminants ; la peste aviaire pour la volaille.

Introduction

The rural people of sub-Saharan Africa live mainly on diverse agricultural activities including farming, livestock keeping and fishing. Cotton and livestock play a major role in the socio-economy of the Central Africa semi-arid region where this study was conducted. Livestock contributes 18% of gross domestic product (GDP) and 30% of gross agricultural product, equivalent to 33% of total export revenue in Chad (Mbayam, 1997). It contributes 12% of GDP in Cameroon (Essang, 2001) and in the Central African Republic, cattle alone contribute 14% of GDP and 35% of the gross agricultural product (Vondo, 1998). Recent data indicate that Chad exports yearly about 500.000 cattle to Nigeria, Cameroon and CAR worth 78 billion CFA (Koussou *et al.*, 2001). The CAR exports yearly 160.000 cattle and Cameroon, 145.000, to Nigeria, Congo, Gabon and Equatorial Guinea (PRASAC, 2001), meaning that Cameroon and CAR also serve as transit routes to some of the Chadian animal. The demand for animal protein in the region is rising, as the human population keeps growing and the long time depressed economies of the region gradually picking up.

Semi-arid regions with rainfall between 750 and 1500 mm are potentially suitable for livestock rearing according to Mohammed-Saleem and Fitzhugh (1993), but are under-exploited particularly due to tse-tse infestation (Awa *et al.*, 2000). According to Winrock International (1992), 57% of ruminant population in sub-saharan Africa is located in the arid and semi-arid zones which make up 54% of the total land area of the region. The present study zone is semi-arid, covering 600.000 km² (the two northernmost provinces of Cameroon, southern Chad and the north of CAR - Figure 2). Rainfall varies along a north-south gradient from 700 mm to 1500 mm. It also represents the cotton producing belt in the three countries. Livestock rearing closely follows cotton cultivation like an economic activity. This zone is characterised by a growing demographic pressure on land use resulting in a rapid increase in crop production, mostly cotton and cereals which considerably reduces grazing lands. Furthermore, areas traditionally reserved for livestock are being classified as natural parks and game reserves in Cameroon. This acute competition for land use by animals, crop farming, and game reserves contributes to environmental degradation due to excessive exploitation of the vegetative cover of the soil. Thus the goal of increasing productivity to meet up with human population growth is compromised. The crop-livestock integrated systems approach (McIntire *et al.*, 1992) in the diagnosis of the complex interactions that characterise agriculture in this region has proved to be a useful tool in identifying pertinent production constraints and opportunities. The objective of this study was to identify the current livestock practices in the region – the interactions of the various factors that contribute to constraints and potentials (Figure 1) – in order to be able to better target innovations for increased productivity.

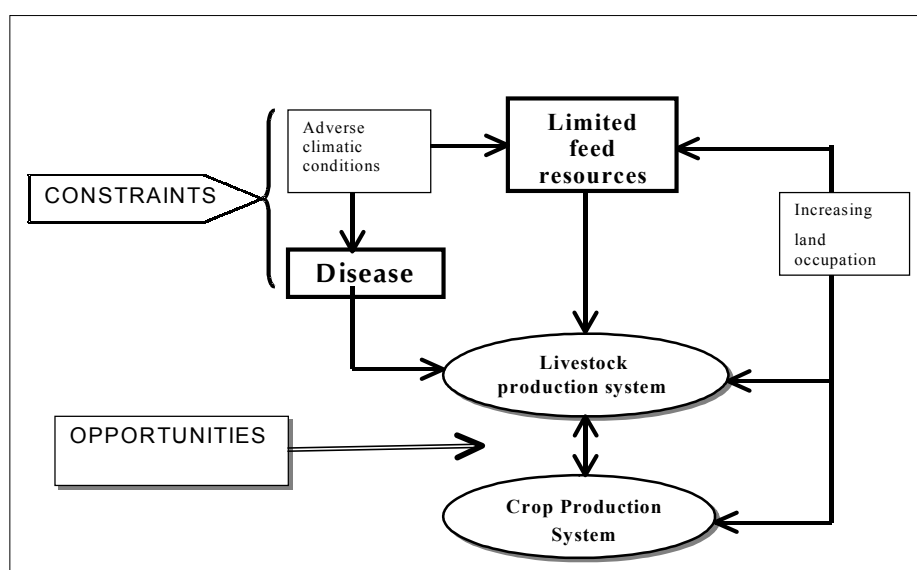


Figure 1. Conceptual model of factors influencing livestock-crop production systems.

Materials and methods

Study sites were villages chosen to be representative of different zones as described by Dugué *et al.*, (1994), using agro-ecological and socio-economic criteria such as rainfall, prevailing livestock and agricultural activities, demographic density and influence of urbanisation. Four sites were retained in Cameroon, three in the CAR and six in Chad (figure 2). A global diagnosis was first of all carried out in these villages on agricultural production systems with the view of identifying problems as a prelude to programming of research intervention. The preliminary results of the global survey led to the identification of specific themes for in depth diagnoses, among which was that of livestock production systems in different agro-ecological zones.

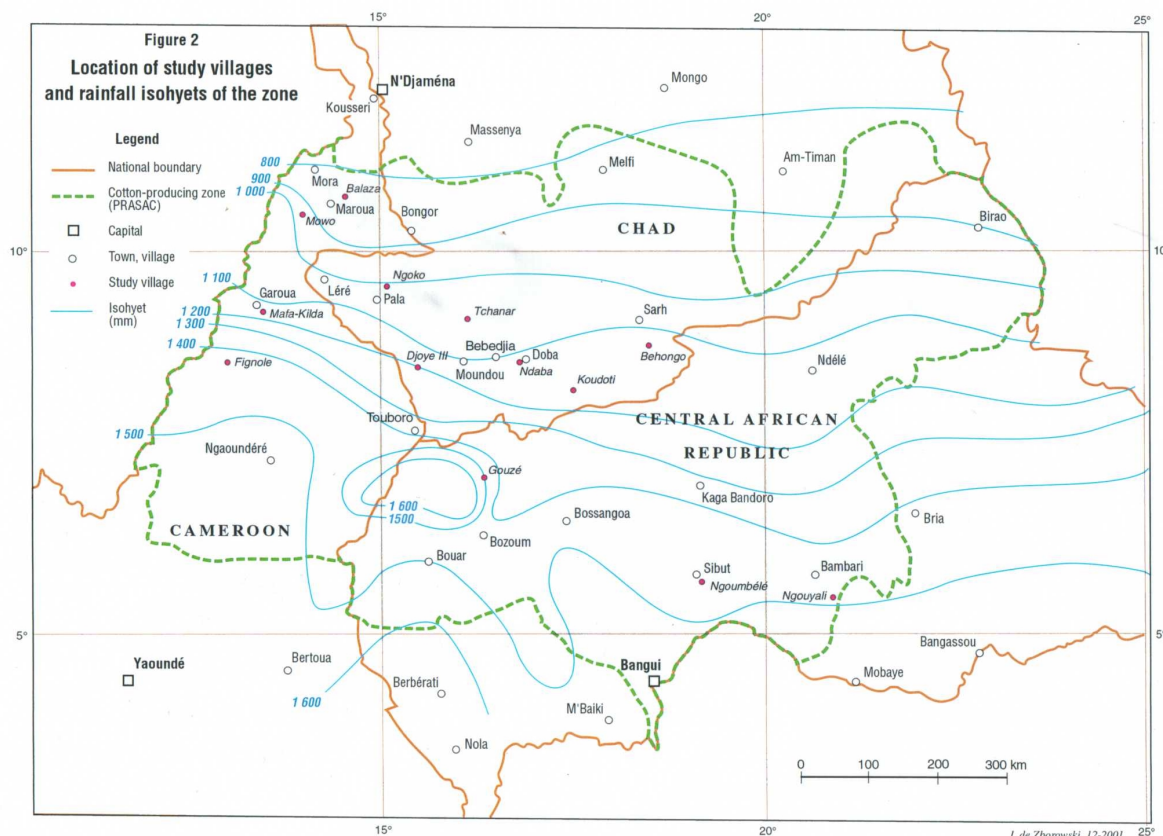


Figure 2. Location of study villages and rainfall isohyets of the zone.

Farmers involved in the study were chosen based on an inventory description of households in each village that gave details of the farmer's civil status, his livestock and cropping activities. The only selection criterion was the possession of livestock (cattle, small ruminants, poultry or pigs). A working sample was then randomly chosen from the pre-selection to give an average of about 20 farmers per village. The field study consisted of two parts: a cross-sectional survey with a structured questionnaire in all the villages and a 12-month cohort of a sample of farmers in Cameroon. Two hundred and seventy farmers (60 in Cameroon, 60 in the RCA and 150 in Tchad) were involved. The questionnaire solicited information on the farmer's civil status, his livestock and agricultural practices – general herd/flock management, feeding and health care strategies, constraints and possible solutions. The cohort comprised of bi-monthly visits during which information on the evolution of pastures, feed resources and health problems was recorded. Field monitors resident in each site visited each study herd at least two times a week and noted clinical symptoms and mortalities observed. During their bi-monthly visits, the research team retrieved this information in addition to collecting samples for laboratory diagnosis from clinical cases. Natural pasture productivity in some villages was determined through the construction of protective cages for measurement of annual herbage biomass. A review of bibliography was also done to complete information on related work done in the region.

Survey data were subjected to a multivariate analysis (multi-factorial correspondence analysis) which allowed for classification of the farmers into categories. Descriptive statistics were used to present the farm types. The cohort data was useful in determining seasonal trends in livestock practices, feeding strategies and disease occurrence.

Results

Characterisation of livestock systems

A typology, based on the multivariate analysis brought out four categories of livestock farmers.

Table I. Average livestock head ownership according to the farm types.

Type	Description	Average age of farmer (years)	Average livestock population		
			Cattle	Small ruminants	Fowls
I	Semi-sedentary agro-pastoralists with livestock production as main activity.	48	42	3	2
II	Aged agro-pastoralists with the two activities of almost equal importance.	53	20	10	10
III	Young to middle-aged farmers who are moderately scholarised with crop farming as major activity. They practise agriculture using mainly animal traction.	40	8	7	11
IV	Similar to type III but lack investment capital. They own only small ruminants (goats) and fowls.	42	3	10	10
V*	Transhumant pastoralists with livestock rearing as the only occupation.	-	55	5	8
VI*	Mostly traders who fattened animals or produce milk for sale.	-	57	4	5

*Source: adopted from Vondo (1998).

Table II. Productivity of cattle and small ruminants in the semi-arid region of north Cameroon.

Species	Age at 1 st parturition (months)	Parturition interval (months)	Fecundity rate (percentage)	Exploitation rate (percentage)	Mortality rate (percentage)
Cattle	48	17.8	52	20	2.3
Goats	16	8	161	13	27
Sheep	18	9	120	6	31

Source: Adopted from Njoya *et al.*, 1997; Cardinal *et al.*, 1997.

Type I

Made of semi-sedentary agro-pastoralists with livestock as their main activity. These are generally of Arab ethnicity in Tchad and of Foulbé or Peuhl ethnicity in Cameroon and CAR. They are under-scholarised and young to middle-aged (average age of 48 years). They own relatively large herds of cattle with average herd size between 20 and 40. These figures are however very unreliable, although they indicate relative trends. Some are as low as 20% of the true numbers. Herd owners, by tradition, never give true values. Average figures per type obtained in this study and in previous studies in RCA are presented in Tables I and II. Insufficient pasture space, feed and water resources were cited like major constraint of this category of farmers. Feed supplementation during the dry season with cotton seed cake or whole

grain is practised where these resources are available. The majority however do not have access to these supplements either because they are too far away from distribution points or, in some cases, they consider them too expensive. In the past, they had free access to crop residues after harvest. Today, they have to negotiate access to these, in order to avoid conflicts with farmers who need them for sale in local markets, or for their own animals (traction animals and small ruminants). This category is also conscious of the importance of animal health and so they make use of available veterinary services.

Type II

Semi-sedentary with an average age of 53 years, and are not scholarised. This type is described in Cameroon. They own more small ruminants and a fewer cattle than type 1. Crop production is an activity of almost equal importance as livestock. They also give feed supplements to animals during the dry season and practise good health care.

Type III

Constituted of young to middle-aged (average age of 40 years) farmers who are moderately scholarised. Crop farming is the major activity of this group. They own mostly small ruminants which are generally left to roam freely, and few cattle. In Cameroon, their cattle are generally used for farm work. This group takes less care of their animal health and so disease and elevated mortalities are a major constraint. Because their animals are often left to roam freely, conflicts with neighbours are common.

Type IV

Comprises moderately scholarised farmers with an average age of 42 years with cropping as primary activity. They own a few small ruminants (mostly goats) and fowls but do not own cattle. Disease and conflicts with neighbours because of roaming animals are their main constraints.

This typology was based on information collected from permanent settlements that were well defined as study villages in this work. Therefore it did not bring out a well recognised livestock type – the pure pastoral type (transhumance) which consists of annual cyclical movements in search of feed and water resources for animals. This type is well described for eastern Chad by Barraud *et al.*, (2001). Another category that this study did not bring out is businessmen who fatten animals or produce milk for sale in urban areas. These ones are found mainly in urban and peri-urban areas. Vondo (1998) found that in CAR this category on the average owns the highest number of cattle compared to other categories.

Herd structures

It was difficult to get the herd structures of the pastoralists (type I and II farmers) because, traditionally they are very discrete with their wealth and will not want a stranger to know how many animals they have. For the type III and IV farmers it was much easier to get the real numbers and estimate the ages in order to construct herd structures. Figures 3a and 4 respectively show the structures of cattle herds and goat flocks owned by these categories. They own very few cattle, averaging about 5 per farmer. Figure 3a shows that few animals are younger than three years and the majority are males. This type of structure is explained by the fact that the cattle are kept mainly for traction and fattening purposes and not for reproduction.

The goat flock structure is different, presenting more females than males (figure 4). About 50% of the males are younger than 6 months of age due to the high rates of mortality and offtake. Figure 4 also indicates that farmers are conscious of the necessity of the growth of the flock since they maintain many adult females. However, the larger proportion of adult females compared to the younger age groups indicates that either young females are also sold or eaten, or adults are least affected by mortalities.

An earlier longitudinal study conducted mainly on the type I, V and VI farmers for 7 years (Njoya *et al.*, 1997; Cardinale *et al.*, 1997) revealed precise information on herd structures (Figure 3b.), reproduction and exploitation of cattle and small ruminants in the same study zone in north Cameroon. It was found that some of the productivity parameters were improved by good feeding under field conditions. In well-fed cows, age at first calving was reduced from 48 to 45 months and fecundity rate was increased from 52% to 59%. Table II summarises information on productivity and exploitation of the herds.

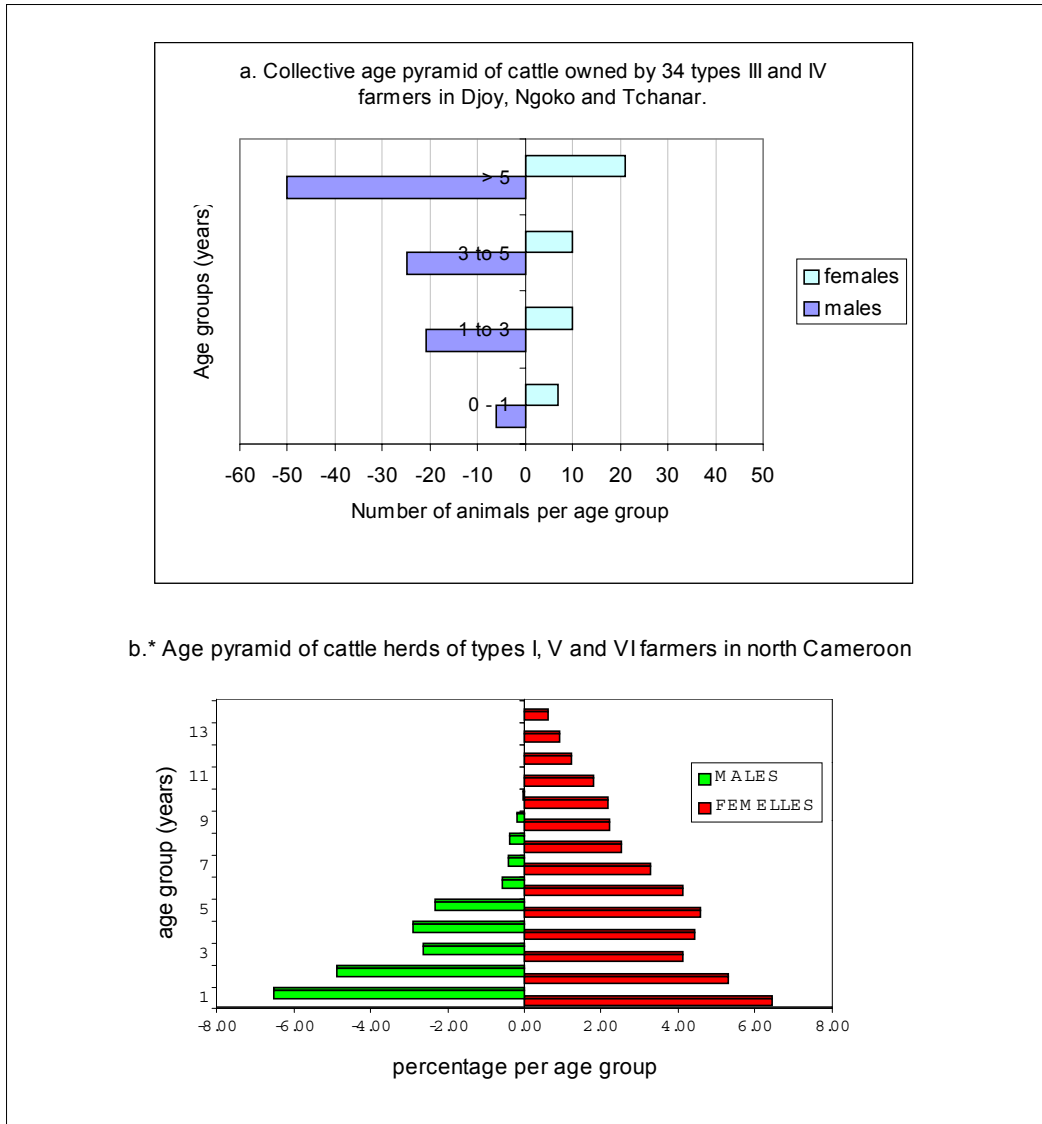


Figure 3. Cattle herd structures 3b. is adapted from Njoya *et al.*, 1997

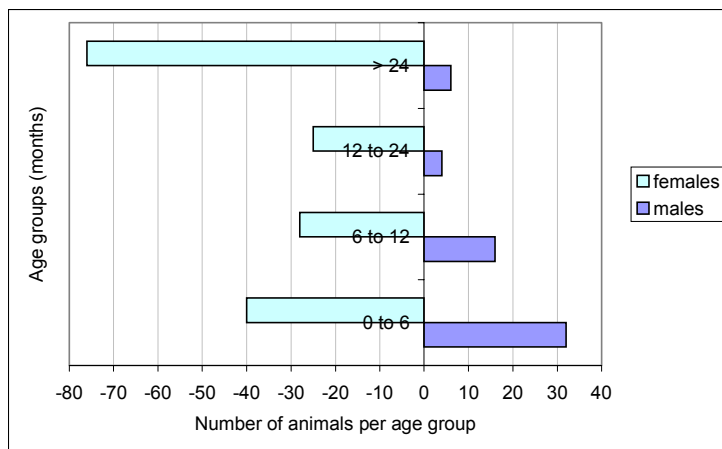


Figure 4. Collective flock structure of goats owned by 35 farmers in Djoy, Ngoko and Tchanar.

Evolutionary trends in livestock production systems

Until recently (1980s), cattle production was in the hands of the Arabs, Mbororos and Foulbes (Boutrais and Crouail, 1986). Today, new production systems have cropped up as a result of environmental, economic and social demands. While these changes have been largely in favour of the new systems, the traditional pastoralists seem to be lagging in the race. Statistics show that in under a decade, cattle head sizes in this category has reduced from an average of 125 to 55 heads (Le Masson and Remayeko, 1990; Vondo, 1998) - it is worth noting that this decrease in herd sizes of this category does not signify cattle population decrease in the region since the newer systems are taking an upper hand with growing herd numbers. The major reason for the decrease in stock size has been the following.

Diminishing feed and water resources due to the following reasons

Drought: Mohammed-Saleem and Fitzhugh (1993), predicted that pasture carrying capacities of the semi-arid zones of sub-Saharan Africa, which are already very low would further be decreased to 15 ha/TLU during drought periods. These impoverished pastures are already overstocked as Njoya *et al.*, (1997) indicated that stocking density in semi-arid north Cameroon is as high as 28.5 TLU/km². Under such circumstances, the livestock owner will either sell off some of the animals or they will die from starvation-related problems. Some pastoralists have turned to pure crop farmers after losing all their animals during drought periods (Ichowicz, 1995).

Expanding cropping activities into dry season forage reserves: Swampy regions along riverbanks or in low-lying areas are usually not grazed by animals during the rainy season when there is abundance of pastures. The vegetation in these areas therefore served as a dry season forage reserve. The increased cultivation of the dry season sorghum, *Sorghum durum* in these swamps at the beginning of the dry season compromises dry season grazing reserves. (Barraud *et al.*, 2001 ; Raimond, 1999 ; Picard, 1999).

Economic and social pressures

Farmers now sell more animals than they did before in order to meet up with family demands which include food, clothing and in a few cases education of children. There is also an abusive exploitation of herds in the form of tributes paid to local chiefs (Barraud *et al.*, 2001), an old tradition which is still in force in most parts of the region. Conflicts with crop farmers also contribute to reduction of herds of livestock owners since they often sell animals or give them directly as compensation for damaged crops. There are instances where traditional and administrative authorities involved in the settlement of such disputes abuse powers in their favour and oblige the helpless livestock owner to pay several times worth of what is actually damaged.

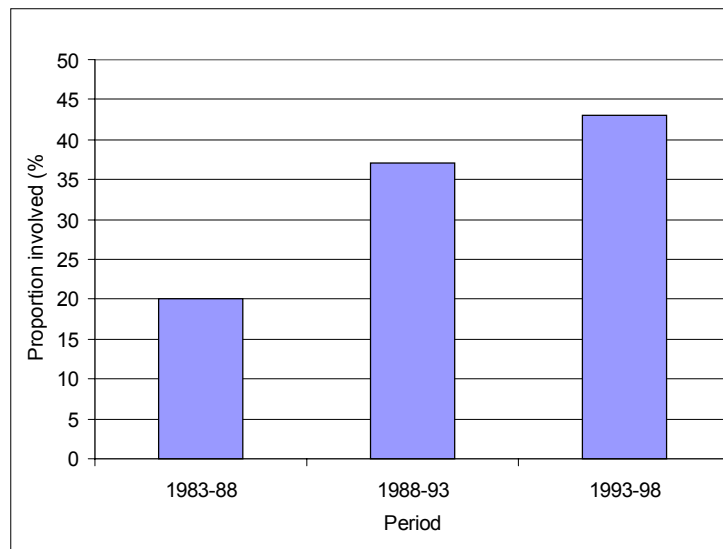
Emerging livestock production systems

From livestock to crop production: Pure pastoralists are finding crop production as a suitable solution to diminishing herd sizes. Some consider cropping as an economic diversification, which reduces the risk of losses in terms of mortality of animals during disease epidemics. In Cameroon, a survey of 180 pastoralists with large cattle herds indicated that 98% farm crops for consumption and sale (Njoya *et al.*, 1997).

From crop production to livestock : Thanks to the introduction of animal traction in the region, which has developed with cotton production, many traditional farmers who had only poultry and small ruminants, have started keeping cattle as savings from crop sales and as investment capital.

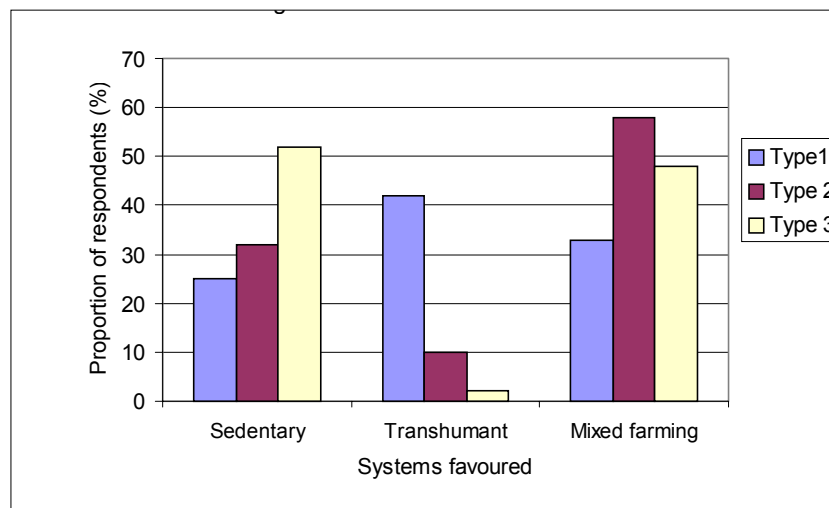
From trading and other lucrative activities to livestock production: Another emerging group of livestock producers are businessmen who fatten animals for meat or feed cows intensively for dairy production for the market.

Present and future trends in livestock production systems are presented in Figures 5 and 6. Trends both in practical terms and in the way of thinking show that the future of livestock production in the semi-arid regions lies in mixed farming systems with close integration of livestock and crop production.



Source : Adapted from Vondo, 1998.

Figure 5. Trends in the involvement of livestock farmers in crop production in the Central African Republic (adapted from Vondo, 1998).



Type 1 - Pure pastoralists

Type 2 - Agro-pastoralists with livestock keeping as primary activity

Type 3 - Agro-pastoralists with crop farming as primary activity

Figure 6. Perception of future livestock systems by different categories of farmers (from Vondo, 1998).

Forage resources and feeding strategies

Great variation in diversity and quantity of forage and other feed resources was noticed from one site to another and directly related to rainfall and population density. In areas with rainfall below 1000 mm (Mowo, Balaza in Cameroon and Tchanar in Chad), pasture productivity is poor. The situation gets worse where such areas are saturated with livestock and cropping activities. Annual herbage biomass production was estimated at 3 – 4 tons of dry matter (TDM)/ha. Consequently, crop residues (groundnut and cow pea husk, maize and sorghum stover and agro-industrial by-products especially local brewer's grain) play an important role in animal nutrition in these sites. Most of them are eaten on the farm by transhumant animals because of the difficulties of transporting home to stock. During the cropping season, small ruminants, particularly goats are confined and permanently fed indoors or attached to graze on the spot. Mortality in this species exceeds 50% in some sites during this season because, not only are they poorly feed, their housing conditions are poor and favour the occurrence of diseases.

Similar pasture conditions were observed in areas with rainfall exceeding 1000 mm but subjected to high land use pressure (Mafa Kilda, Djoy and Ngoko).

In other higher rainfall areas but with less pressure on land such as in Fignolé in Cameroon, Tchanar in Chad and most of the sites in CAR, pastures are productive enough (7 – 8 tons/ha DM) to handle the current stocking density of 1.8 TLU/km² (Picard,1999). This explains why harvest residues are of less importance to local herds which still have enough pastures during the dry season.

Three types of forage resources were identified in one of such sites (Fignolé):

- dry season pastures situated in low-lying swamps with permanent streams. Forage species here are mainly *Oryza longistaminata*, *Sétaria sphacellata*, *Andropogon gayanus*, *Echinochloa pyramidalis*, *Pennisetum purpureuma*;
- upland or rainy season pastures comprising mainly of *Andropogon pinguipes*, *A. gayanus* and *Setaria pimula* ;
- harvest residues which are essentially consumed on the farm mostly by transhumant animals.

In all the villages, feed supplements with mostly cotton seed cake, local brewer's grain and common salt are given to animals during the dry season. Feeding problems are aggravated during the dry season by the presence of transhumant animals which compete with local herds for crop residues in all the sites. The body condition of animals is generally poor during the hot dry season (March to May), a period during which the main feed resources are natural pastures and harvest residues. This indicates their insufficiency during this period and provokes thought on flock management strategies such as strategic offtakes and improved valorisation of harvest residues.

Cultivation of improved and highly productive forage species was generally lacking either due to ignorance or lack of technical supervision. The lack of forage seeds was a common complaint of farmer who had cultivated forage before.

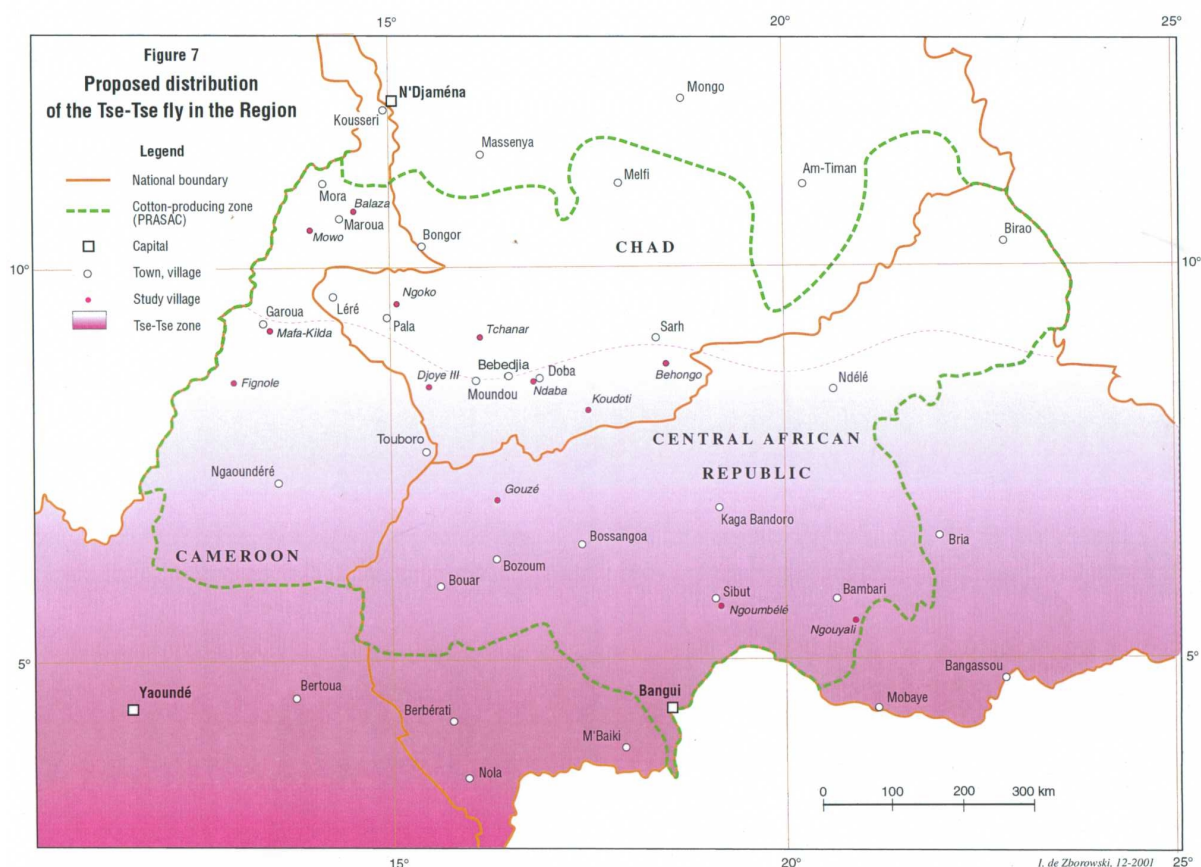


Figure 7. Proposed distribution of the Tse Tse fly in the region.

Animal health

Disease occurrence and its consequences

Health problems are similar in the different sites in the entire region. In cattle, dermatophilosis and foot-and-mouth disease (FMD) are endemic and of economic importance. More than 90% of cattle owners confirmed the existence of these diseases in their herds. Although affected animals rarely die, production losses are incurred through reduced traction force, milk production, other production parameters and reduced commercial value. Trypanosomosis is limited in distribution to areas with rainfall above 1000 mm (Figure 7) but considered most important where present. It was cited in Djoy (Tchad), Ngoumbele and Gouze (RCA), and Figlolé (Cameroon) and confirmed in the latter two sites with parasitaemia prevalence of about 50% and 7% respectively. *Trypanosoma vivax* and *T. congolense* were present at similar prevalence rates. Tse tse pressure is reported to be so high in Ngoumbele (RCA) that cattle are virtually absent in this site. Babesiosis was also shown to be of high prevalence in cattle in Gouze (50% positive in blood smears). Cattle fasciolosis was mentioned in most of the sites.

In small ruminants, helminthosis was identified as a major health problem in all the sites. Previous studies showed that gastrointestinal helminthosis is the main cause of diarrhea and elevated mortalities in this region (Cardinale *et al.*, 1996; Awa and Ngo Tama, 1997; Awa and Njoya, 1997; Awa *et al.*, 2000) with mortalities sometimes exceeding 50%. Suspected cases in some sites in Cameroon were confirmed by demonstrating significant levels of strongyle eggs in fecal samples (Table III). Respiratory problems generally associated with *peste des petits ruminants* (PPR) were also common in all the sites. In a diagnostic study following epidemics in small ruminants in north Cameroon, Awa and Ngo Tama (1997) found that PPR outbreaks caused mortalities as high as 80 %.

Table III. Clinical prevalence of gastrointestinal helminthosis in small ruminants in Balaza and Mowo (North Cameroon).

Site	Month	Morbidity (%)	Parasite prevalence (%)
Balaza	January	54	80
	March	10	67
Mowo	October	13	100

* Proportion of samples with egg count more than 1 000 epg.

Poultry production is severely hampered by epidemics that are characterised by very high mortalities (figure 8). Case fatality during outbreaks average above 90%. Farmers described signs typical of Newcastle disease (enteric, respiratory and nervous signs). The disease was confirmed serologically in samples from Djoy, Ngoko and Tchanar.

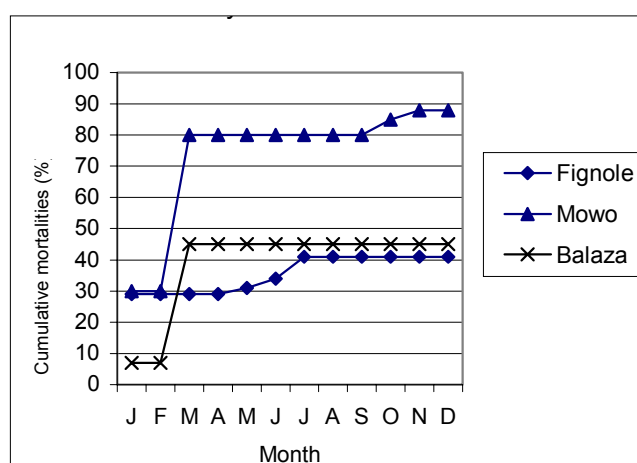


Figure 8. Cumulative mortalities in fowls by site.

Animal health services and traditional practices.

Animal health coverage by national veterinary services is generally inadequate or completely lacking. In Cameroon, an effort is made by DPGT to assist farmers by making drugs available to them as well as guide them in their use. Their intervention, as that of any other project is limited in spatial scope. In RCA, since farmers are organised in livestock initiative groups under the umbrella of ANDE, animal health care is better organised. Groups have easy access to veterinary staff who serve them with authentic drugs. In Chad, there are difficulties in obtaining drugs because veterinary services are not well organised on the field. Private veterinary practice is emerging mostly in Cameroon and Chad, but the present economic situation and legislation on private practice (Cameroon), which limits certain animal health mandates such as vaccination campaigns to official veterinary services, do not favour the effective functioning of the private veterinary services.

In the entire region, where the drugs are available, it is only farmers with important numbers of animals especially cattle (Types I and II) who are conscious of treating their animals. Where drugs are not available, they resort to traditional remedies which include extracts of leaves and barks of trees as well as unconventional ones like plant pesticides on animals. Small ruminant owners especially type IV farmers are those who make the least use of veterinary drugs. They use mostly traditional remedies which are ineffective.

The only regular intervention done by national veterinary services in the three countries is annual vaccination of cattle against important endemic diseases which include pasteurellosis, black quarters, anthrax and contagious bovine pleuropneumonia. In addition to these, cattle are also vaccinated against rinderpest in the Central African Republic border zone with Sudan which is not yet declared free of the disease. Small ruminant vaccination is absent. In Cameroon it is very sparingly practised in some areas despite the economic advantages of vaccination demonstrated by Awa *et al.*, (2000) through reduction of mortality of more than 50%.

Discussion

Although six types of livestock systems were generally described, similarities between types allow for regrouping in three broad categories:

Category I. Transhumant pastoralists who own large herds of cattle.

Category II. Sedentary farmers, who have livestock as a secondary activity to crop farming.

Category III. Semi-sedentary agropastoralists found in between categories I and II. These are mostly the Category I farmers who are getting more and more involved in crop production. Families stay permanently where they farm while the herdsmen go on seasonal transhumance with the animals. Crop farming to most members of this category started as a way of preserving grazing land by their permanent presence and to make use of the animal manure.

From the opposite direction, crop farmers have realised the advantages of keeping animals and integrating them in their farming systems. Figures 5 and 6 indicate that these converging trends are moving towards integrating livestock and crop production. Barraud *et al.*, (2001) however think that such a new system of production will compromise the existing complementary relationship between the pure pastoralist and the crop farmer, for example in the exchange of farm by-products like organic manure and harvest residues. They further state that transhumance should not be considered as a transitory step towards a sedentary intensive production system, but that it is rather environmental factors that dictate what system is most suitable. (Rochette, 1997) believes that transhumance is an ecologically and economically well-adapted mode of livestock in the sahel. While not opposing this view, (Guerin *et al.*, 2001) maintain that what is at stake is not maintaining old traditional systems which may not be productive but to create a favourable and sustainable innovation context in which farmers will be actively involved with enthusiasm.

Unfortunately, zones with more feed resources are unsuitable for livestock activity because of tse tse fly infestation. Nevertheless, transhumant animals from non-infested areas still take the risk to move into these zones during periods of scarcity to make use of the abundant forage.

In Cameroon, the fight against the tse-tse fly that began since the 1970s has been met with little success because of uncontrolled animal movements that led to the re-infestation of liberated zones (Reiss *et al.*, 1999). While new strategies for a lasting solution to the tse-tse problem are still being looked for, appropriate preventive treatment of transhumant animals from these overstocked zones should be enforced by national veterinary services when they move into infested areas.

The integrated approach to livestock production which seems to be developing naturally also needs to be followed up. Livestock-crop integrated farming systems have been shown to be economically advantageous in highly populated areas McIntire *et al.* (1992) where land has become a limiting factor. This approach will however require adjustments to farming techniques, feeding systems and land tenure (Tiffen *et al.*, 1993). Forage cultivation seems to be one of the attractive innovations to encourage. Not only should forage seeds be disseminated to farmer; there should be a follow up by research and extension service to help them overcome difficulties in management and perpetuation of forage species. Encouraging intensive animal production will also mean intensifying disease prevention and management measures. If given the mandate, veterinarians in private practice will likely provide better services in animal health care than it is the case at present. Important cattle diseases (dermatophilosis, foot-and-mouth disease and tse tse control) still remain a challenge to research and regional governments.

Innovations will be more efficiently introduced through organised communities like farmer association or common initiative groups. Progress has been made in the RCA in this respect. A farmer associations in Gouze (RCA) which combines both pure transhumant livestock producers and settled crop farmers works so well that crop farmers use animals for traction from the pastoralists in exchange for other services.

Conclusion

Constraints of livestock productivity in the semi-arid savannah of the Central African sub region are linked to the type of production system. Because of increasing demographic and agricultural pressure on land, diminishing feed resources become the major set back to extensive livestock systems. While some farmers belonging to this category are already responding by reducing herd sizes in favour of crop production, measures need to be taken to provide more grazing land (fight against tse-tse, definition and protection of grazing land) to those who still find extensive transhumant systems to be efficient. Intensive production systems are more confronted with disease. Encouraging this system will mean intensifying health care strategies. It will also mean adopting new farming techniques and feeding systems (cultivated forage, crop residues and agro-industrial by-products). Private veterinary services also need government support and collaboration to be efficient. Although the present study focused on ruminant production, pig, poultry production and fisheries are non-negligible activities on which attention needs to be focused to improve their contribution to human animal protein needs.

References

- AWA D.N., NJOYA A. NGO TAMA A.C., 2000. The economics of prophylaxis against peste des petits ruminants and gastrointestinal helminthosis in sheep and goats in north Cameroon. *Trop. Anim. Hlth Prod.* Vol. 32 : 391-403.
- AWA D.N., NGO TAMA A.C., 1997. Mortalities in small ruminants and poultry in Mayo Louti Division, PNVA-IRAD Garoua Station, Cameroon, Technical Report 12p.
- AWA D.N., NJOYA, A., 1997. Monitoring and control of helminthosis in local sheep in the sudano-sahelian zone of Cameroon, Paper presented at the 5th Annual Conference of Cameroon Bioscience, 17-19 December 1997, Yaounde, Cameroon.
- BARRAUD V., SALEH O.M., MAMIS D., 2001. L'Élevage transhumant au Tchad oriental. *VSF, Tchad* 137 p.
- BOUTRAIS J., CROUAIL J.C., 1986. Les projets de développement de l'élevage en Centrafrique. *In : L'exercice du développement.* Paris, ORSTOM, p. 71-92.

- CARDINALE E., NGO TAMA A.C., NJOYA A., 1996. Elevage des petits ruminants: Connaissance et amélioration de la productivité. *In* L. Seiny Boukar, J.F. Poulain and G. Faure (éds.). *Agricultures des savanes du Nord-Cameroun. Actes de l'atelier d'échange, 25-29 novembre 1996, Garoua, Cameroun*, p. 123-135.
- DUGUE P., KOULANDI J., MOUSSA C., 1994. Diversité et zonage des situations agricoles et pastorales de la zone cotonnière du Nord Cameroun. *Projet Garoua. IRA Garoua* 105 p.
- ESSANG T., 2001. Diagnostic de la filière bovine sur pieds au nord Cameroun. *Document Technique, IRAD Garoua*, 46 p.
- GUERIN H., LECOMPTE P., TOUTIN B., CARON P., LHOSTE P., 2001. Système d'élevage : durabilité des ressources pastorales et intensification raisonnée des ressources fourragères dans les systèmes mixtes polyculture-élevage. Contribution à l'UMR "Systèmes agraires et gestion des ressources et des territoires" SAGERT.
- ICKOWICZ A., 1995. Approche dynamique du bilan fourrager appliquée à des formations pastorales du Sahel tchadien. *Thèse du Docteur de l'université de Paris XII* 471 p.
- KOUSSOU M.O., DUTEURTRE G., TRUEBA J., 2001. L'organisation du commerce d'exportation de bovins sur pied du Tchad vers le Nigeria. *Communication présentée au 2^e Comité scientifique du PRASAC, Maroua, 5-9 février 2001*.
- LE MASSON C., REMAYEKO A., 1990. Les éleveurs Mbororo : étude socio-économique. *ANDE, Bangui*. 251p.
- MBAYAM T.D., 1997. Relation agriculture élevage : cas de Benoye en zone soudanienne du Tchad. *Synthèse bibliographique DESS. Ecole Nationale Vétérinaire D'Alfort*, 22 p.
- MCINTIRE J., BOURZAT D., PINGALI P., 1992. *Crop-livestock interactions in sub-saharan Africa. Washington: World Bank*.
- MOHAMED-SALEEM M.A., FITZHUGH H.A., 1993. An overview of demographic and environmental issues in sustainable agriculture in sub-Saharan Africa. *In* J.M. Powell, S. Fernandez-Rivera, T.O. Williams, C. Renard (eds). *Livestock and sustainable nutrient cycling in mixed farming systems of sub-Saharan Africa. Proceedings of an International Conference, ILCA, Addis Ababa, Ethiopia 22-26 November 1993*, p. 3-20.
- NJOYA A., BOUCHEL D., NGO TAMA A.C., MOUSSA C., MARTRENCAR A., LETENEUR L., 1997. Systèmes d'élevage et productivité des bovins en milieu paysan au Nord-Cameroun. *World Animal Review* 89 : 12-23.
- RAIMOND C., 1999. De la complémentarité à la concurrence. Agriculture et élevage dans les terres d'inondation du bassin tchadien. *In* C. Baroin et J. Boutrais (éds.). *L'homme et l'animal dans le bassin du lac Tchad. Actes du colloque du Réseau Mega-Tchad, Orléans, 15-17 oct. 1997. IRD Editions, Paris*.
- REISS D., CARDINALE E., N'CHARE A. LABONNE M., 1999. Des éleveurs face aux glossines au Nord-Cameroun. Une méthode de lutte adaptée à des pratiques et présentations pastorales. *In* C. Baroin et J. Boutrais (éds.). *L'homme et l'animal dans le bassin du lac Tchad. Actes du colloque du Réseau Mega-Tchad, Orléans, 15-17 oct. 1997. IRD Editions, Paris*, p. 575-598.
- ROCHETTE R.M., 1997. Pastoralisme et développement au Sahel. *Contribution à Sahel* 21, 38 p.
- TIFFEN M., MORTIMORE M., ACKELLO-OGUTU A.C., 1993. From agro-pastoralism to mixed farming: the evolution of farming systems in Machakos, Kenya, 1930-1990. *ODI Agricultural Administration (Research and Extension), London, UK, Network Paper* 45.
- VONDO M., 1998. Etude comparative entre les systèmes d'élevage émergents et le système traditionnel agro-pastoral en Centrafrique. *Mémoire de DESS, Ecole Nationale Vétérinaire D'Alfort, France*, 92 p.
- WINROCK INTERNATIONAL, 1992. *Assessment of animal agriculture in sub-Saharan Africa. Winrock International Institute for Agricultural Development, Morrilton, Arkansas, USA*, 125 p.