

Country Pasture/Forage Resource Profiles

NIGER



by

Dieter Geesing and Hassane Djibo



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1. INTRODUCTION

Niger (French *République du Niger*) is landlocked in the heart of West Africa. It is bordered by Algeria and Libya on the north, Mali on the west, Burkina Faso and Benin on the southwest, Nigeria on the south and Chad on the east (see Figure 1). It has a total area of 1 267 000 km², but only half of this is habitable due to adverse climatic or soil conditions. Niger is divided into one capital district and seven departments, which are subdivided into districts and communes. Niamey is the capital, and largest city; Zinder, Maradi, Tahoua and Agadez are the other principal towns. French is the official language, but Hausa is the language of local trade. Other African languages, such as Fulfulde, Tamachek, and Djerma are also used extensively.

Since the end of the Stone Age different groups began to settle in the more humid environments around the Air massif, along the borders of the former mega-lake Chad, and in the Niger valley. The knowledge of writing as one factor of cultural development did not appear before the arrival of Islam in the eighth century with the Arabs. Royal empires of unknown age already existed at that time. Finally, after their power decreased in the 19th century Niger was a French military territory and then became a colony in 1922 under a military regime. On 3rd August 1960, after elections, Diori Hamani became the first president of the independent Republic of Niger.

Only 29% of primary school-age children receive education. In 2001 the average life expectancy at birth was 42 years; the infant mortality rate was 124 deaths per 1 000 live births (2001 estimate). According to the World Factbook the population in July 2006 was estimated at 12 525 094 with a 2.92% annual growth rate. More than 60% of the population lives below the poverty line.

Economy. A particularly harsh climate, inhospitable geographical features and a completely land-locked situation, such are the underlying economic realities of the Republic of Niger. However, subsistence farming and stock-rearing contribute approximately 40% to the GDP (second only to services, which provide 42%) and nearly three-quarters of the labour force is employed in this sector. Based principally on agriculture and livestock breeding, the country's economy is still largely at the mercy of the vagaries of the climate. Niger has tin, gold, and uranium mining operations. Large deposits of uranium are located in northern Niger and still, it counts for about three quarters of export earnings. Salt is also mined in Niger in small quantities. Industry is limited mainly to food processing and construction, manufacturing enterprises are mostly very small. Burning wood and other traditional fuels accounts for 80% of the country's energy consumption.

Agriculture. Less than 4% of the country is arable, 9% are permanent pastures and only 2% are forests and woodlands. Agriculture is limited in the north by the 350 mm isohyet beyond which the millet (*Pennisetum glaucum*) production practically ceases. The Nigerien Sahelo-Sudanian and Sudanian zones are considered as potentially sedentary areas (in contrast to the northern zones where primarily



Figure 1. Map of Niger

nomad activities are found). Here, mainly millet (*Pennisetum glaucum*) and Sorghum (*Sorghum bicolor*) - traditional extensive crops and covering most of the cultivated soil - cowpea (*Vigna unguiculata*) and groundnut (*Arachis hypogaea*) are found. Some cotton (*Gossypium* spp.) appears further south, in the Sudanian zone. The depressions of recent and ancient rivers are for vegetable (tomatoes, onions, etc) growing or some fruit trees. Rice is cultivated around the river Niger and river Komadougou. Other crops of lesser importance are sugar cane, maize, and sweet potato.

The yearly production is presently approximately 3 500 000 tonnes of cereals, supplemented by thousands of tonnes of international aid. The mean yield is around 400 kg/ha for millet and around 190 kg/ha for sorghum, but there are big differences between the regions. Cowpeas, cotton and groundnuts are cultivated for export. Millet (Niger is the world's top producer per capita), sorghum, cassava, pulses, rice, sugar cane and some vegetables are grown for local consumption. Fishing is conducted in Lake Chad and the Niger river, and the catch is consumed or exported locally.

The share of cultivated land is increasing and competes severely with livestock keeping. In fact, livestock keeping is now limited to the northern part of Niger: domestic animals are widespread, staying the whole year or moving one part of the year to northern zones. Agriculture benefits from organic fertilization that maintains soil fertility in the vicinity of settlements. In search of an increase of arable soil, woodland is cleared. Clearing and wood-exploitation reduces considerably the original vegetation: just for the capital city Niamey, more than 11 000 tonnes of firewood per year are needed. Additionally, fallow land is lessened and rotation brought down to 2–3 years, further diminishing soil fertility.

Wildlife. About 7.7% of the Niger's land is officially protected. Although Niger has banned hunting (except for scientific purposes) throughout the country, rampant poaching seriously threatens wildlife populations. But other reasons also play an important role in the decline of the Nigerien wildlife population: the destruction of the habitat by agriculture, deforestation, fire, and the competition with domestic animals. Natural events such as the heavy droughts have also reduced the pasture grounds for wild animals.

In Niger, the principal fish habitats are the Niger river and lake Chad. Some fish species are adapted to an environment with no water for a certain time by surviving dryness in a torpid state inside the sediments or covered by a mucous protection membrane or in the egg stage. A few fishes have locally a considerable economic importance (e.g. Nile perch, *Lates niloticus*). Amphibians in Niger are generally bound to permanent water places, but some species have a more terrestrial life and survive the long dry season by a very short life cycle during the rainy season and/or by digging themselves into wetter soil layers.

Among the noteworthy Nigerien reptiles are species protected by international conventions such as the Nile crocodile (*Crocodylus niloticus*) and lizards (e.g. *Varanus griseus*, *Varanus niloticus*). Interesting species are also Python snakes (*Python sebae*, *Pregius*), water turtles (e.g. *Trionyx triunguis*, *Pelomedusa subrufa*) and tortoises (e.g. *Testudo sulcata*). More than 600 bird species are found in Niger, many of which are threatened. Among the most interesting birds are eagles and vultures (*Accipiteridae*), ground-hornbills (*Bucorvus abyssinicus*), and the ostrich (*Struthio camelus*). Guinea fowl (*Numida meleagris*) and pigeons (*Columbidae*) are frequent and embellish the daily rural diet. Mammals are listed with 131 species and numerous species are endangered. None of the mammals are endemic. Important species include antelopes such as the Scimitar Oryx (*Oryx dammah*), the Addax (*Addax nasomaculatus*), the Dama gazelle (*Gazella dama*) or the Slender-horned Gazelle (*Gazella leptoceros*). Conspicuous but rare mammals are the African Elephant (*Loxodonta africana*), the Cheetah (*Acinonyx jubatus*) and the Lion (*Panthera leo*). Hippos (*Hippopotamus amphibius*) inhabit the waters of the Niger river. East of the Niger river are areas with a few nomadic giraffes. In Nigerien savannas relatively frequently encountered are warthogs (*Phacochoerus africanus*), monkeys such as Baboons (e.g. *Papio cynocephalus*). Hyenas (*Hyaena hyaena*) can be found all over Niger.

The Nigerien government tries to preserve animal lives in reserves such as the 'W' National Wildlife Park (220 000 ha - also an important tourist attraction) and the Tamou Nature Reserve (78 000 ha) which are located 125 km south of the capital Niamey. In the southern northern/northern Sahelian zone, the Air and Ténéré Strict Nature Reserve (7 700 000 ha), and within it, the core Addax Sanctuary Strict Nature Reserve, were set up in 1988. The latter closed area protects the very rare Addax from the vehicles of hunters and tourists who formerly chased them.

2. SOILS AND TOPOGRAPHY

Niger is a vast, undulating plain at an average altitude of 300 m above sea level. There are, however, a number of extensive depressions, usually filled with sand, the tops of the ridges sometimes being formed from volcanic structures, the highest of which is Mount Greboun (2 310 m) in the Air Massif. The country can be roughly divided into three zones: the north, centre and south. The northern zone, covering about two thirds of the surface area, is in the Sahara. It is an elevated region formed by plateaux and mountains, and with the exception of some isolated oases, vegetation is rare. The centre is part of the Sahel (the Ténéré region). It is a semi-arid region with few trees. The south is the only fertile and wooded region and where it rains enough for food crop farming without irrigation.

Apart from a few more or less permanent pools and seasonal water courses, Niger's main hydrographic network consists of one major river, the Niger, a smaller river, the Komadougou Yobé, and Lake Chad. The river Niger crosses the country in the south-west over a distance of 550 km. The river Komadougou Yobé marks the boundary between Niger and Nigeria over a distance of 140 km. The Nigerien part of Lake Chad covers some 3 000 km². The lake itself is the vestige of an ancient quaternary sea, at an altitude of 280 m and today at no point is more than 4 m deep. Islands proliferate in the lake and the evaporation rate is extremely high; 98% of its water supply comes from the Chari River and from rainfall.

In the extremely dry areas in the north and northeast of Niger, scarcity of water and vegetation inhibits soil formation. Some parts have, however, been subject to mechanical fragmentation. Strong winds take away the finer parts, sand and silt. The A horizon is little or not developed and the organic matter content is generally less than 0.5% in the upper 40 cm (in the former World Reference Base (WRB) of FAO, many of these soils have been classified as *Yermosols*, but this soil group was deleted in the revised WRB. Since, the soil map of Africa has not been updated, the name *Yermosols* will therefore be retained here. According to the revised WRB, these soils would now, depending on certain properties, belong to *Calcisols*, *Cambisols*, *Durisols*, *Gypsisols* or *Arenosols*). In mountainous regions (Air or the Djado plateaus), rocks are covered by a shallow and coarsely fragmented soil layer (*Leptosols*). Productivity is low and these soils can be used only for extensive grazing (see Figure 2).

Further to the south a large strip of sandy soils crosses Niger from Mali to Chad. The slightly weathered soils, *Cambic Arenosols* in the eastern part, show even thin layers of clay accumulation in the central and western part (*Luvic Arenosols*). As rainfall and thus weathering becomes more regular, soils start to show a light coloured upper horizon with little organic matter, and a reddish lower horizon due to a higher iron-concentration. *Arenosols* have a low water retention but are permeable and easy to work. They have a low natural fertility, a low cation exchange capacity and deficiencies of minor elements are common. These soils may erode easily by wind and water as soon as vegetation is gone. They are suitable for little-demanding agricultural crops such as millet or groundnut.

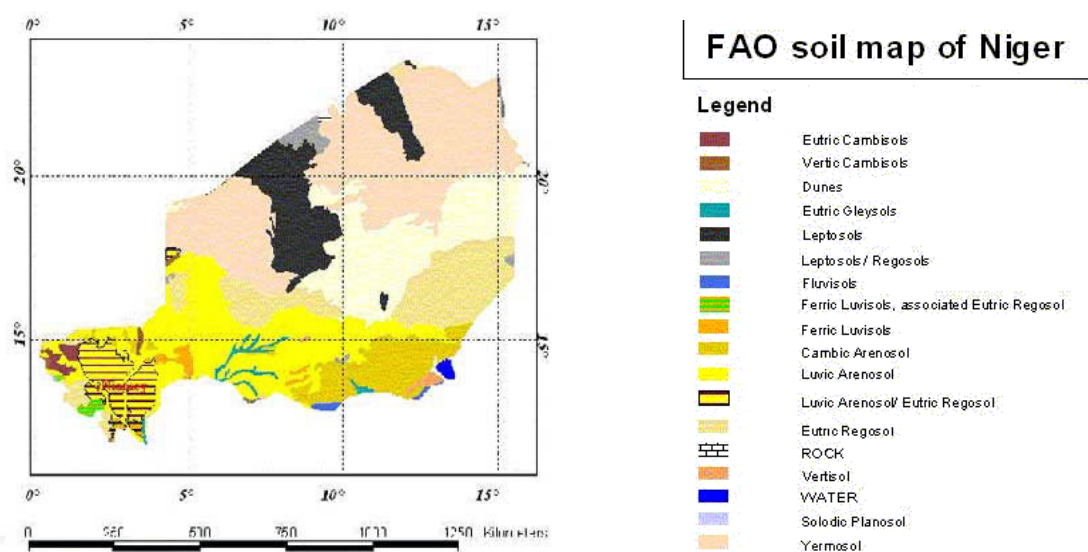


Figure 2. Soil map of Niger

On the terraces between the Niger river and the Dallol ('valley') Bosso and the Dallol Maouri, in the south-western part of Niger, the *Arenosols* are associated with *Regosols*, i.e. soils on loose parent material that are almost without soil development. The hydromorphic soils, with a high groundwater, in the depressions of south-central Niger (Tarka valley, Goulbin Kaba and Goulbin Maradi) and at Lake Chad, and the soils on alluvial deposits (*Fluvisols*), generally offer good and intensively used agricultural soils. *Cambisols* (moderately weathered soils) and *Vertisols* (heavy clay soils) are only of limited extent in Niger.

3. CLIMATE AND AGRO-ECOLOGICAL ZONES

Niger is situated in one of the sunniest regions of the world, and has a mainly dry climate with considerable temperature variations. Potential evaporation is 2 to 4 m per annum, while rainfall nowhere exceeds 800 mm and even falls to below 100 mm over almost half the country. The rainfall pattern is Saharan in the north, with some 160 mm falling in less than one month, except in the desert where it practically never rains, and Sudano Sahelian in the south, where some 600 mm of rain falls during three to four months (June-September). Rainfall varies, however, from one region to another and its distribution is very erratic with levels falling sharply as one moves northwards. Temperatures can exceed 40 °C in the shade from March to June, period of the 'harmattan' wind. During this period come the first rains usually announced by heavy clouds moving across the sky. From November to February, temperatures drop considerably, particularly with nightfall. Annual temperature differences vary from around 16 °C in the northeast to around 9 °C in the southwest.

Vegetation. Niger covers two geobotanical zones: the Saharo-Sindian in the very north and the major part, the Sudano-Zambezian zone. Biogeographically Niger covers three areas: the Saharan, the Sahelian and the Sudanese. The transition between them is not clear-cut. Within tropical Africa, Niger presents one remarkable characteristic: the Ténéré (in the northern part of Niger) - one of the world's floristically poorest zones: there are fewer than 10 different species per 10 000 km².

The **Saharo-Sindian zone** in the north: little and very irregular, or sometimes no rain. The dominant vegetation of the plains, if there is one, is a discontinuous grassland (often referred to as "steppe" in French publications) which is mostly limited to depressions. It belongs to the *Acacia-Panicum* grouping, dominated by *Panicum turgidum*. Plants are adapted to the absence of water. On the dunes *Cyperus conglomeratus* is abundant in the herbaceous carpet associated with various Poaceae, like *Aristida mutabilis*, *Tragus racemosus*, *Cenchrus biflorus* or *Lasiurus scindicus*. On the plateaux *Aristida hordacea*, *Aristida funiculata*, *Cenchrus ciliaris*, *Eragrostis pilosa* and *Schoenefeldia gracilis* are common. In the dry valleys, *Cymbopogon schoenanthus* is dominant in the grass carpet. The very scarce woody layer includes, especially, *Acacia raddiana*, but also *Acacia ehrenbergiana*, *Cordia sinensis*, *Maerua crassifolia* and *Grewia tenax*. Variations in the vegetation are mostly due to small changes in the micro-climate, the soil or relief. Thus, the formations of the mountains of Aïr show substantial differences compared to those of the plains. The formations of the lower stage of the Aïr (between 500 and 900 m of altitude) have woody stands made up often of *Maerua crassifolia*, *Leptadenia pyrotechnica*, *Calatropis procera* and *Salvadora persica* that are associated with *Balanites aegyptiaca* and various *Acacia*. Among the grasses, *Stipagrostis* spp., *Aristida* spp. and *Eragrostis* spp. are common. On the higher levels of the Aïr (> 900 m) formations of Acacias (*Acacia raddiana*, *Acacia ehrenbergiana*, *Acacia laeta*, *Faidherbia albida* 'Gao') with *Boscia senegalensis*, *Commiphora africana*, *Balanites aegyptiaca*, *Ficus cordata*, *Hyphaene thebaica*, *Ziziphus mauritania*, *Anogeissus leiocarpa*, *Bauhinia rufescens* and *Salvadora persica* are found. The Poaceae are represented by *Aristida mutabilis*, *Cymbopogon schoenanthus*, *Tripogon multiflorus* and *Desmostachya bipinnata*.

The **Sudano-Zambezian zone** is divided into two parts: the Sahelian belt in the north and the Sudanian belt in the south. The **Sahelian belt** shows steppe vegetation whose woody layer thins out from a cover

ranging between 15 and 60% in the south, to a shrubby aspect in the north. The grass layer is made up mainly by annuals. The Sahelian belt is again subdivided into two economic sectors, roughly at the 350 mm isohyet: A northern sector (Sahelo-Saharan), known as a zone of transhumance, because the cultivation of millet is hardly possible, and a southern sector (Sahelo-Sudanien), the sedentary zone, with many villages (where, however, cattle are still very numerous but away during the rains on a transhumance towards the north in order not to damage the crops). In all subzones, vegetation is distributed following the pattern of three major soil types: sandy soils, soils with sufficient clay and silt content and soils on outcrop parent material.

The woody species of the **sahelo-saharian sector** are mainly of trees such as *Faidherbia albida*, *Sclerocarya birrea*, *Boscia senegalensis*, *Balanites aegyptiaca*, *Hyphaene thebaica*, *Acacia raddiana* and shrubs like *Salvadora persica*. The grass layer is made up of *Cenchrus biflorus*, *Cenchrus prieurii*, *Brachiaria xantholeuca*, *Brachiaria villosa*, *Schoenefeldia gracilis*, *Panicum turgidum*, *Aristida mutabilis* and *Eragrostis tremula*. In the eastern part of this sector, i.e. on the sandy alluvium of the Tal desert or the clayey plateaus of the Kadzel, the woody layer includes *Acacia raddiana*, *Piliostigma reticulatum*, *Balanites aegyptiaca*, *Commiphora africana*, *Grewia villosa*, *Grewia tenax*, *Guiera senegalensis*, *Combretum micranthum*, *Acacia senegal*, *Acacia nilotica*, *Hyphaene thebaica*, *Sclerocarya birrea*, *Piliostigma reticulatum* and shrubs like *Leptadenia pyrotechnica* and *Calotropis procera*. The grass layer is mainly composed of *Cenchrus biflorus* ('cram-cram'), *Cenchrus prieurii*, *Tragus racemosus*, *Eragrostis tremula*, *Dactyloctenium aegyptium*, *Aristida funiculata* and *Aristida adscensionis*.

In the **Sudano Sahelian sector**, trees are commoner and even thickets are found. The steppe vegetation persists on sandy soils of dry valleys with trees such as *Guiera senegalensis*, *Acacia nilotica*, *Combretum micranthum*, *Piliostigma reticulatum*, *Prosopis africana*, *Faidherbia albida*, *Acacia senegal*, *Ziziphus mauritania*, *Acacia raddiana*, *Balanites aegyptiaca*, *Hyphaene thebaica* and *Boscia senegalensis*. The grass layers of these steppes are rich in *Aristida adscensionis*, *Eragrostis tremula*, *Brachiaria villosa*, *Cenchrus prieurii*, *Cenchrus biflorus*, *Aristida mutabilis*, *Aristida funiculata*, *Enteropogon prieurii*, *Dactyloctenium aegyptium* and *Schoenefeldia gracilis*. Plateaux carry savanna formations and thickets occupy the southernmost Sahelian belt and extend on the lateritic surfaces covered with thin soil. Shrubs and trees of Combretaceae, Tiliaceae and Mimosaceae form what is called the 'tiger bush' and 'spotted bush' in which stripes of woody vegetation and bare ground alternate. The grass layer contains, for example, *Aristida adscensionis*, *Elionurus elegans*, *Eragrostis tremula*, *Pennisetum pedicellatum*, *Schoenefeldia gracilis*, *Tripogon minimus*, *Brachiaria xantholeuca*, *Dactyloctenium aegyptium*, *Eragrostis tremula* and *Eragrostis pilosa*. These forest ecosystems are a major element for livestock holding in Niger. The Sudanian belt is relatively small in Niger, mainly in the west of the country and south of Niamey. It is more wooded than the Sahel and carries a vegetation characterized by an uninterrupted herbaceous layer where perennial species of larger size dominate. The grass layer is heterogeneous and particularly developed in clearings. Common species on lateritic plateaux are *Loudetia togoensis*, *Brachiaria xantholeuca* or *Digitaria gayana*; in the valleys or on gentle slopes, *Andropogon gayanus* and *Pennisetum pedicellatum* are frequent. The woody vegetation is characterized by a great number of sometimes dense stands of Combretaceae, and by the presence of species useful to man, like *Butyrospermum parkii* (the 'shea tree') or *Parkia biglobosa* ('nééré'). The woody layer of variable density can form large stands, like open forests with *Anogeissus leiocarpus*, *Bombax costatum*, *Acacia macrostachya*, *Daniella oliveri*, *Piliostigma reticulatum* and more. Gallery forests that border the major rivers have a tree layer which can reach 20–25 m height and include trees like *Mitragyna inermis*, *Cola laurifolia*, *Azizelia africana*, etc.

North of the 12th parallel of latitude, most of the south-west of Niger is covered by savannas with a woody layer dominated by Combretaceae and trees such as *Faidherbia albida*, *Bombax costatum* and *Sclerocarya birrea*. The grass layer is very often formed by *Andropogon gayanus*, *Aristida* spp., *Loudetia hordeiformis*, *Panicum nigerense* and local spots of *Cenchrus biflorus*. In some valleys (i.e. Dallol Maouri), depending on the ground water, trees like *Prosopis africana* or *Khaya senegalensis* are found and palms such as *Hyphaene thebaica* or *Borassus aethiopum* can be frequently seen.

4. LIVESTOCK PRODUCTION SYSTEMS

Livestock production contributes to 35% of the agricultural gross domestic product (GDP) and thus 12% of the total GDP (1995). More than one million people are working full time in livestock production, and more are in the agro-pastoral sector. After uranium, it is the second largest export product of Niger, but its share dropped from over 20% to less than 7% in 1995. Nigerien livestock production is based on extensive grazing but climatic vagaries, the extent and quality of pastures, sanitary and economic constraints set limits to its performance. The precarious situation favours two kinds of livestock:

- Camels excel because of their excellent adaptation to a dry environment; only they can exploit the entire Sahelian zone, especially the northern parts. Economically, it is a long term investment. By this strategy, the number of camels have increased by 50% since the severe droughts of the 1970s and 1980s whereas the number of cattle dropped by 20% in the same period.
- Small ruminants are a short-term investment and their numbers have doubled since the 1960s, increasing from 18% to 33% in numbers of TLU [one TLU = Tropical Livestock Unit = 250 kg of liveweight = 1 dromedary = 1.25 bovine or horse = 2 donkeys = 10 small ruminants]. In particular the number of sheep (see Table1) have increased (more than 70% in the last twenty years), although the number of goats is currently still superior (sheep 13% and goats 20% of the Nigerien total TLU). Due to their prolificity, small ruminants are favoured since a drop in number after a drought can quickly be rebuilt. Besides, they have a higher productivity compared to big ruminants.

In recent years, livestock production has shifted more and more into the agropastoral zone (and the agropastoral zone has extended into the pastoral zone), except for the extensive livestock keeping of the Bororo zebu. It is estimated, that approximately 2/3 of the bovine livestock are in the agropastoral zone today. Especially in the south-west of Niger, livestock fattening and dairy production is more and more intensified.

The use of complementary feed or additives depends on the level of livestock production. In the traditional domestic production in the villages, harvest residues and pod shells from field (cowpea) or tree legumes (Acacia, Tamarind, etc.) are used. In improved livestock production systems, close to urban centres and encouraged by international programmes, bran, brewer's residues or oilseed cakes are sometimes used. The volume of veterinary medicaments is difficult to estimate since there is an extensive black market but it is estimated to be below 0.05% of the economic value of the entire livestock.

Generally, milk is much liked in Niger and it constitutes the staple diet of people like the Peulh, Tuareg, Toubou and Arabs. Although Nigerien breeds of cattle such as the Azawak or the Kouri rank among the best milk cows in West Africa, the actual production is limited by malnutrition. For the most part, domestic milk production is for the private use of the livestock owner and less than one% of domestic milk production is commercialized. Domestic milk production does not meet the demand, and milk imports amounted to more than US\$ 13 250 000 in 1995 (38,000 tonnes of milk equivalent). On the other hand, the amount of milk available per capita dropped from 168 litres in 1968 to 37 litres in 1994. Industrial dairy production is predominantly based on imported milk powder.

Although the numbers are uncertain, it is estimated that in 1995 approximately 200 000 bovines, 30 000 camels, 600 000 sheep and 1 300 000 goats were slaughtered for consumption. Another important sector of Nigerien livestock marketing is hides, skins and leather, especially from goats. Estimates are 188 000 bovine hides, 85 000 sheep skins and more than 1 600 000 goat skins in 1994. Numbers of livestock by Department (1991–2000) are given in Table 1 and livestock numbers, meat and milk

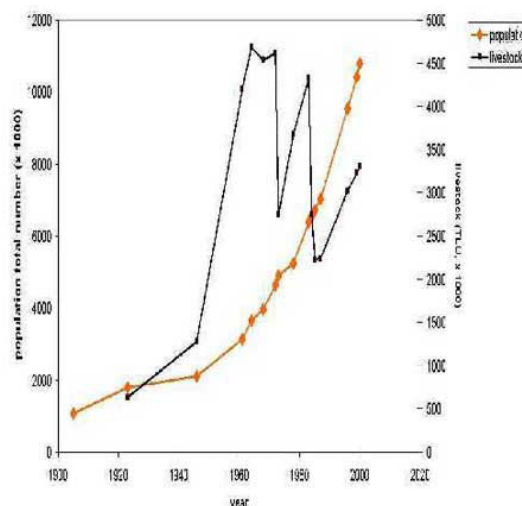


Figure 3. Development of population and livestock in Niger since 1991

Table 1. Number of animals per Department

Department	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sheep										
Agadez	80 533	84 600	87 100	89 700	92 400	95 200	98 056	100 997	104 027	107 148
Diffa	1 446 410	1 518 700	1 564 200	1 611 100	1 659 400	1 709 200	1 760 476	1 813 290	1 867 689	1 923 720
Dosso	45 436	47 700	49 100	50 600	52 100	53 660	55 270	56 928	58 636	60 395
Maradi	197 441	207 300	213 500	219 900	226 500	233 300	240 599	247 817	251 252	258 910
Tahoua	517 787	543 700	560 000	576 800	594 100	610 570	628 887	647 754	667 187	687 203
Tillabery	425 895	447 200	460 600	474 100	488 300	502 900	517 987	533 527	549 533	566 019
Zinder	539 229	566 200	583 200	600 700	618 700	637 260	656 379	676 070	696 352	717 243
MCN	11 300	22 000	nd	55 500	57 200	58 900	60 667	62 487	64 362	66 293
Total	3 264 031	3 437 400	3 517 700	3 678 400	3 788 700	3 900 990	4 018 321	4 138 870	4 259 038	4 386 931
Goats										
Agadez	162 360	170 300	174 500	178 900	183 400	188 000	190 820	193 682	196 587	199 536
Diffa	1 245 954	1 307 000	1 339 700	1 373 200	1 407 500	1 442 700	1 464 340	1 486 305	1 508 600	1 531 229
Dosso	132 230	138 700	142 100	145 600	149 200	152 900	155 180	157 508	159 871	162 270
Maradi	321 235	337 000	345 400	354 000	364 600	373 700	167 875	170 393	172 949	175 543
Tahoua	1 056 308	1 108 100	1 135 800	1 164 200	1 193 300	1 223 100	1 241 446	1 259 888	1 278 786	1 297 968
Tillabery	1 027 602	1 078 000	1 104 900	1 132 500	1 160 800	1 189 800	1 191 658	1 370 406	1 390 362	1 411 826
Zinder	1 268 436	1 330 600	1 363 800	1 397 900	1 432 800	1 468 600	1 490 629	1 512 988	1 535 682	1 558 717
MCN	8 167	23 000	nd	33 300	34 100	34 900	35 423	35 954	36 493	37 040
Total	5 222 292	5 492 700	5 606 200	5 779 600	5 925 700	6 073 700	5 937 371	6 187 124	6 279 330	6 374 129
Cattle										
Agadez	10 770	11 300	11 500	11 700	11 900	12 140	12 382	12 629	12 881	13 139
Diffa	321 930	336 700	343 400	350 300	357 300	364 450	371 739	379 174	386 758	394 489
Dosso	312 162	326 500	333 000	339 700	346 400	353 330	360 396	367 604	374 956	382 455
Maradi	264 456	276 600	282 100	287 700	293 500	299 370	305 357	311 464	317 633	324 047
Tahoua	201 973	211 300	215 500	219 800	224 200	228 680	233 253	237 918	242 676	247 530
Tillabery	474 818	496 700	506 600	516 700	527 000	537 540	548 290	559 256	570 441	581 850
Zinder	203 602	213 000	217 200	221 500	225 900	230 420	235 028	239 729	244 524	249 414
MCN	12 100	20 400	nd	20 700	21 100	21 500	21 930	22 368	22 815	23 271
Total	1 801 811	1 892 500	1 909 300	1 968 100	2 007 300	2 047 430	2 088 375	2 130 142	2 172 684	2 216 195
Dromedaries										
Agadez	22 710	23 100	23 400	23 700	24 000	24 400	25 010	25 635	26 276	26 933
Diffa	58 870	60 000	60 900	61 800	62 700	63 600	65 190	66 820	68 490	70 203
Dosso	3 295	3 400	3 400	3 500	3 550	3 600	3 690	3 782	3 877	3 974
Maradi	17 360	17 700	17 900	18 200	18 500	18 800	19 270	19 752	20 246	20 752
Tahoua	122 551	124 900	126 700	128 600	130 500	132 500	135 812	139 207	124 687	146 254
Tillabery	37 686	38 400	39 000	39 600	40 200	40 800	41 820	42 865	43 936	45 034
Zinder	93 770	95 600	97 000	98 400	99 900	101 400	103 935	106 533	109 196	112
MCN	181	nd	nd	200	300	300	307	315	323	331
Total	356 423	363 100	368 300	374 000	379 650	385 400	395 034	404 909	397 031	313 593
Horses										
Agadez	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Diffa	37 139	38 300	38 700	39 100	39 500	39 900	40 299	40 701	41 108	41 519
Dosso	2 402	2 500	2 520	2 500	2 520	2 540	2 565	2 591	2 616	2 642
Maradi	1 206	1 300	1 310	1 300	1 300	1 300	1 313	1 339	1 352	1 365
Tahoua	2 172	2 200	2 220	2 200	2 220	2 240	2 262	2 285	2 308	2 331
Tillabery	8 348	8 600	8 700	8 800	8 900	9 000	9 090	9 180	9 272	9 365
Zinder	33 961	35 000	35 350	35 700	36 000	36 400	36 464	36 829	37 198	37 590
MCN	nd	nd	nd	300	300	300	303	306	309	312
Total	85 282	87 900	88 800	89 900	90 740	91 680	92 296	93 231	94 163	95 124
Donkeys										
Agadez	13 722	14 300	14 500	14 800	15 100	15 700	15 857	16 015	16 175	16 336
Diffa	105 606	109 800	112 000	114 200	116 500	121 200	122 412	123 636	124 872	126 121
Dosso	7 421	7 700	7 800	7 900	8 100	8 400	8 484	8 568	8 654	8 741
Maradi	8 517	8 900	9 100	9 300	9 500	8 900	8 989	9 080	9 170	9 262
Tahoua	168 384	175 100	178 600	182 200	185 800	193 200	195 132	197 083	199 054	201 044
Tillabery	69 470	72 200	73 600	75 100	76 600	79 700	80 497	81 302	82 115	82 936
Zinder	75 582	78 600	80 200	81 800	83 400	86 700	87 567	88 423	89 307	90 200
MCN	nd	nd	nd	600	1 600	1 665	1 681	1 697	1 714	1 732
Total	448 702	466 600	475 800	485 900	496 600	515 465	520 619	525 804	531 061	536 372

nd = not determined MCN = municipality of Niamey

[Source: Ministry of Animal Resources]

Table 2. Niger statistics for livestock numbers, meat and milk production, live animal exports and milk imports for the period 1996–2005

	1996	1997	1998	1999	2000	2001	2002	2003	2004*	2005
Cattle nos. (,000,000)	2.1	2.1	2.1	2.2	2.2	2.3	2.3	2.3	2.3	2.3
Camel nos. (,000)	386.0	392.0	398.0	404.0	410.0	415.0	415.0	420.0	420.0	420.0
Sheep nos. (,000,000)	3.9	4.2	4.1	4.3	4.4	4.5	4.5	4.5	4.5	4.5
Goat nos. (,000,000)	5.9	6.0	6.3	6.6	6.7	6.9	6.9	6.9	6.9	6.9
Asses nos. (,000)	506.0	516.1	562.4	570.0	570.0	580.0	580.0	580.0	580.0	580.0
Beef and veal prod. (,000 mt.)	36.0	38.0	39.0	40.0	41.0	42.1	35.0	37.0	37.0	37.0
Sheep meat prod. (,000 mt)	13.6	13.9	14.2	14.6	14.7	15.7	12.8	15.2	15.2	15.2
Goat meat prod. (,000 mt.)	22.6	22.8	23.4	25.2	24.6	25.2	21.6	25.2	25.2	25.2
Total milk prod. (,000 mt.) [of which cow]	290.6 [168.0]	291.5 [168.0]	296.4 [172.0]	301.2 [176.0]	306.1 [180.0]	315.4 [184.0]	315.4 [184.0]	315.4 [184.0]	315.4** [184.0]	315.4** [184.0]
Live cattle exports nos. (,000)	138.4	89.3	98.7	90.0	136.4	180.0	93.5	73.8	75.0	n.r.
Live sheep exports nos. (,000)	298.5	280.8	267.9	229.3	371.8	466.3	388.6	208.3	220.0	n.r.
Live goat exports nos. (,000)	329.3	405.5	341.3	267.2	455.5	719.5	535.1	308.8	340.0	n.r.
Live Asses exports nos.(,000)	78.1	67.8	68.2	67.8	104.8	69.8	69.2	31.7	31.7	n.r.
Milk equiv. imports (,000 mt)	29.9	31.2	39.6	33.4	30.8	34.2	48.2	49.8	30.7	n.r.

* Other meat production in 2004: chicken meat 28 960 tonnes; meat of asses 1 760 tonnes; camel meat 7 800 tonnes and game meat 15 000 tonnes.

** In 2004 goat milk production was 105 000 tonnes.

Source: FAOSTAT 2006; n.r. no record

production, live animal exports and milk imports for the period 1996–2005 (FAO database) are given in Table 2.

Livestock trade is organized through strong traditional networks linking producers, intermediaries, and traders. Most animal sales by producers take place in local markets. Nigerien urban centres and towns attract livestock for local consumption, but most is destined for export, mainly to Nigeria. The principal entry points to Nigeria follow major roads and rivers, even though animals are typically trekked across the border to avoid detection by customs agents. Table 2 provides details of live cattle, sheep, goat and ass exports from 1996–2005.

Ethnic Background and Transhumance. In Niger, the stockbreeders belong primarily to two ethnic groups, the Peulh (Fulani) and the Touareg. The Peulh are present throughout the Sahel and nearly all over Niger (8% of the population) but nowhere are they a majority. The principal areas of their presence in Niger are, however, the south-western part, an area circumscribed by Dakoro, Agadez, Arlit and Tchén-Tabaraden, in an area between Zinder and Gouré; and finally in the south-eastern part, in the Manga region north of Diffa. The migrations of nomad Peulh in the northern pastoral Sahelian zone – it might be more accurate to call them infiltrations – are relatively recent.

It is necessary to distinguish the Peulh with their agropastoral activities from the exclusive Peulh stockbreeders who generally live further to the north. The nomad stockbreeders are most generally called Bororo, but name themselves Wodaabes. During the dry season, the Wodaabes are dispersed at many water points, quite far from each other. With the first rains, the camps move towards the first water holes, before gathering around the ponds and the new grass for the great annual regrouping ('worso'). The extent of this movement is not very significant and seldom exceeds 150 km. It is thus transhumance on a rather small scale which exploits water and fodder resources that allow more or less strong concentrations of cattle: at some ponds during the rains until sometimes December, to some wells supplied by a shallow water table between December to

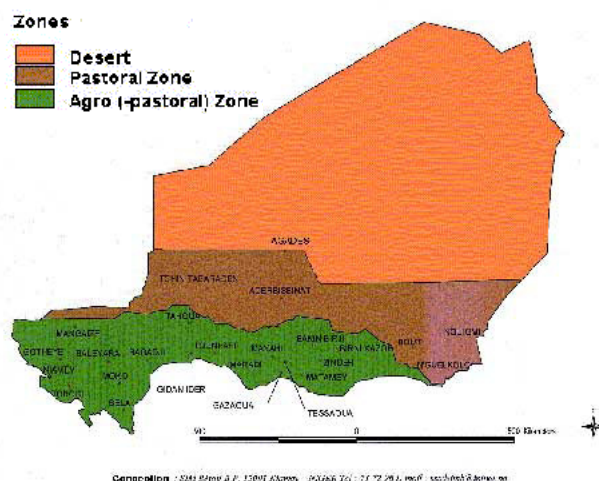


Figure 4. Niger – agricultural zones and important livestock markets

February. Then from March until the return of the rain, they move to places equipped with deeper wells with pumping devices. During the tough months (February to the beginning of the rains), herd-splitting becomes an important survival strategy.

Peulh are predominantly cattle breeders but it is the small ruminants that provide red meat for a family while cattle are capital investment and prestige. Within the family, the herding responsibilities are shared among different age and gender groups. Usually, the management of the herd is done by the men and children, while the culinary responsibility and food processing falls on the women, but they all learn the herding skills, too. Most Peulh continue herding well past middle age. The family owns the herd, although every animal has a designated owner. Meat surplus to immediate requirements may be dried, for later use, or for sale. The meat is cut thinly, beaten even thinner and spread over bushes. The Peulh show a particular behaviour ('pulaaku') that links them beyond economic differences. For example, the institution of solidarity of 'the attached cow' (habbanae), makes it possible to reconstitute a lost herd. The lender allows the borrower to take one of his heifers, three years in general, until this one has calved between one to three times, according to previously drawn up clauses. These calves belong to the borrower who will bring back the cow after the weaning of the last calf.

The agropastoralist Peulh occupy the southern Sahelian space. But even the transhumant Peulh groups are not strictly limited to stock-rearing: they usually sow millet near the fringe of cultivation during their migration. It is difficult to define exactly the share of agriculture and stockbreeding, and the activity of each social group is variable. In some cases old men and adults cultivate, whereas the young people lead the herds. In other cases entire families move with the herds while the head of the tribe stays with the fields. In all cases, stockbreeders have to move their herds far away from the cultivated zones during the rains, except for some calves and a dairy herd that remain in the villages. While it is essential for the agropastoralists to have the animals moved from the zone of cultivation, it is important for them to leave the areas of ponds infested by mosquitoes and midges, and to let the dry season grazing places recover.

The **Touareg** (or rather Kel Tamajeq as they call themselves according to a linguistic criterion) have a very feudal society, with nobles, clergy, vassals, artisans, and one-time slaves. They make up a group of equal importance (8%) to the Peulh, but unlike the Peulh, they are a majority in all the lightly populated pastoral areas west of a line joining the Eastern edge of the Aïr massif to Gouré (east of Zinder).

The Touareg habitually live in relatively small clans, that for ad-hoc defence of some common interest, can be merged quite easily with each other. Agriculture was initially practiced only in time of need and considered as a degrading activity. Now, Touareg are divided into many groups: some are still in transhumance and are exclusively stock breeders; others are still part of a pastoral economy, but stay in villages or camps close to their fields or their gardens; others add caravanning to their activities.

The exclusive stockbreeders occupy, in general, the land that is unsuitable for rainfed crops, to the north of the agropastoralists. Those among the Touareg who still live in the Aïr massif (the 'Kel Owey') are an exception since they can practise irrigated agriculture thanks to a high water table in the principal valleys of the Aïr.

Further east, the Touareg (called 'Iwellemmeden Kel Denneq') occupy a territory that goes from the agricultural zone to the desert according to a transect south-north without the obstacle of a border. During the dry season, these families move to different places in the south but during the rains, most of them converge on the area of Tegidda with its springs. Thus, the extent of transhumance is variable but generally longer than for the Peulh, sometimes close to a total of 1 000 km. More and more frequently, however, families stay at their fields and only some herdsmen and the young move with the herd.

The Touareg, who live in the sedentary zone of Birni' N-Koni, Madoua and Dakoro (the 'Kel Geress') sometimes have large herds of sheep and camels, which are taken in the dry season to the fallows of Nigeria (area of Sokoto) and in the rains to the springs of Tegidda. Those living in the north of the area (see section 5 below) of the 'salt cure', (in Abangarit, Tamesna), often have big herds which, in the dry season, live on pastures with 'alwat' (*Schouwia thebaica*) which exempts them from being watered. During the rains, they move in the opposite direction, to the south, to the area of Tegidda. The Touareg in the western departments (Niamey and Dosso) lost their mobility and are in an agropastoral economy. The transhumance of their herds is more and more opposed and limited by the extension of cultivated land and the presence of national borders.

The Toubou are only a marginal group of stockbreeders who live in eastern and north-eastern Niger. They are of a low numerical importance since they do not reach one% of the native population of Niger. The Toubou call themselves Teda, when mainly involved in camel-raising or Daza, if cattle are the primary livestock.

Among the other stockbreeders, it is necessary to mention the **Arabs**. They form a small community in the east of Niger and north-west of Tchén-Tabaraden, but play an important role in camel-raising.

Livestock

In that part of the country north of the 350-mm isohyet which is unsuitable for agriculture, livestock are usually the primary source of food and income. However, livestock make an important contribution to the livelihood of the agropastoral farmers south of the 350-mm isohyet and are a source of insurance against some shocks brought by weather and economic disruptions.

Cattle breeds in Niger:

- a. **The long-horn zebu** is mostly of the Bororo breed (approximately 60% of all bovines) and the Peulh type (10%). The Bororo breed (zebu bororodji) is a relatively tall animal with bulls of around 1.50 m in height and a weight of 300–400 kg. The female is smaller. The horns are lyre-shaped and the colour of the animal black or flame red. The skin has short shiny hair. The big ventral part of the belly is characteristic. The development of zebus is rather slow and it takes up to six years to complete growth entirely. At birth, calves weigh around 15–20 kg and the annual growth is around 70 kg per year. Lactation is usually six months and milk production relatively low with 3–4 litres at the beginning and 1.5 litres at the end of lactation. It is a fierce animal but it is very robust and suitable for transhumance since its body allows it to cover long distances. The animals are only slightly fattened and the meat yield is not more than around 45%.
- b. The initial area of distribution of the Peulh breed (zebu djeli) was the Niger river, but it can now be found all along the southern border up to Lake Chad. It is usually white with crescent shape horns, smaller than the Bororo type and with a pronounced hump and ventral part of the belly. It is mostly reared by Peulh who practice a very limited transhumance and it is a better meat producer than the former type. Usually milk production is fair with around 2 litres per day for six months.
- c. The **short-horn zebu** makes up approximately 25% of the cattle, and consists mostly of the Azawak type which is found on the whole Nigerien territory. The height of the Azawak bull is around 1.20 to 1.30 m, the weight around 300–350 kg, for the cow 200–250 kg. It is often of wheat colour but white, black, black and white, and other colours are also found. The horns of the bulls are short and thick; the cow has crescent shaped and thinner horns. It is a good animal for meat production that fattens easily, but the yield is quite low. It is also a good milker, under favourable conditions it produces for 7–8 months a year between 6–8 litres per day at the beginning and 2 litres at the end of lactation. The Azawak is normally a calm animal that can also be used for animal traction. It is especially found in the Touareg herds, and in the herds of the sedentary Hausa and Bouzou.
- d. Finally, as a matter of interest, the **Kouri taurin** (*Bos taurus typicus*) should be mentioned. This animal, actually a good milk and meat producer, can still be found in small numbers around the Lake Chad. It has however some importance since it is an ancestor to many hybrid varieties.

Three breeds of **sheep** (with many crosses) are the most common in Niger.

- a. The **Peulh sheep** has two principal breeds. The Bali-Bali is usually white with black or yellow spots around the eyes or ears. It is found in the northern zone since it does not tolerate the humidity of the Sudanian zone. The Oudah type also has a quite characteristic skin: A very clear-cut black or brown front and a white behind. A few animals are entirely white and obtain a high price at the time of Islamic festivities. This breed is typically part of the Peulh herds north of the zone of Trypanosomiasis. The size of the male Peulh sheep is around 80–90 cm in height and it weighs between 40–45 kg, whereas the female is smaller and weighs around 35–40 kg. The ram has strong spiral-shaped horns, while the simple horizontal horns of the female are sometimes absent. It fattens easily. At birth, the lamb weighs some 3 kg but reaches more than 8 kg after the first month and over 25 kg after 6 months. The milk production of the ewe is poor, around 0.2 litres per day during 6 months.

- b. The **Ara-Ara** breed is generally found in the western part of Niger, from the south of the Saharan belt to Niamey. The male animal is between 80–90 cm in height and weighs around 40 kg; the female is between 60–70 cm and weighs around 30 kg. The colour is tawny or white sometime with black spots. The ears are short and the strong horns are spiral-shaped and much smaller for the female. The neck of the ram has frequently a roll of flesh. It is mainly the sheep of the Touareg pastoralists with herds of small ruminants. It produces a high quality meat and the milk production under good conditions can reach up to 0.6 litres per day during 6 months. The milk is consumed raw or transformed into a nationally famous cheese, the ‘Tchoukou’.
- c. The presence of the **Koundoum** race is limited to the vicinity of the Niger river and the Kolo islands close to the Malian border. It is much smaller (around 60 cm in height and 30 kg for the male), with a bare head, members and belly. The fleece is black, or white with black or tawny spots. This race was formerly used for wool production by the sedentary Djerma of the area. Although this race is usually not reared any more, it is often crossed with other breeds. The meat production is low but of high quality.

Goats are an important source of meat for nomads. Equally important is the production of hides. Two races are distinguished:

- a. The **Sahelian** breed (with the Bouzou and the Peulh varieties) is found in most parts of the country. The buck is around 80 cm in height and weighs around 25 to 35 kg (the goat 75 cm and 30 kg). It is tri-coloured: black, white and red. The hair is very short, except for some withers with the buck. The meat production is low. The lactation is about 6 months and the goat produces an average of 0.6 litres per day.
- b. The **Red Goat of Maradi** (known as Sokoto Red in Nigeria) is - as the name indicates - widespread in the area of Maradi. It is exclusively part of a sedentary livestock system, since it is not adapted to the hardship of the Sahelian climate and transhumance. It is a rather small animal (60 cm in height with a weight of 25 kg) with a beautiful chestnut colour and short shiny hair. Horns are only small. The milk production is considerable: the goat produces for more than 6 months around 0.7 litres per day and is, for some villages without bovines, the only milk source. Meat yield is good especially among the castrated males. Its real importance, however, lies in its worldwide highly appreciated leather quality.

Camel breeding plays an essential part in the life of the people in the north of Niger. Several breeds are known, i.e. the ‘River’ camel, the camel of ‘Tibesti’, the camel of ‘Manga’, the camel of Aïr or the ‘Toubou’ camel. Camels are used not only as a means of transport, but also as a source of meat and leather, and are often exported to neighbouring countries (Libya, Algeria).

The number of **horses** in Niger is considerable compared to other West African countries. Most breeds are derived from Barbs, Arab or Dongolow horses. The common breeds are the Djerma, the Hausa, the Songhoï and the Bozzan horse from the area around the Aïr. Horses are almost exclusively used for transport. Other animals of transport in Niger are donkeys, which in some areas are also used for animal traction in agriculture.

Swine raising is, for religious reasons, very limited and mostly for foreigners.

Poultry production plays a prominent role in the everyday meat supply. Chickens and Guinea fowl are the most important species. West African fowl breeds are innumerable, but generally, they are small and of little weight. Over the last decades, many American and European breeds have been introduced and crossed with local ones, i.e. Sussex, New Hampshire or Rhode Island Red.

Animal health. Nigerien livestock and poultry are hit by many diseases among which the most important are:

- parasites: internal parasites (roundworms, tapeworms, hookworms, coccidia, etc.); external parasites (scabies, lice, ticks, etc.); blood parasites (Trypanosomiasis, Heartwater, Babesiosis, avian Spirochetosis, etc.);
- bacterial infections: contagious Pleuropneumonia of bovines and goats, Pasteurellosis of bovines and sheep, Anthrax and Blackleg, bovine Brucellosis and Tuberculosis, avian Salmonellosis;
- viral infections: Rinderpest and other plagues, Newcastle disease, Rabies, Blue Tongue, poxvirus with sheep, goat and camels, Lumpy Skin disease, Foot and Mouth disease

These diseases are subject to medical treatments (parasites), prophylaxis (Trypanosomiasis) or medical and sanitary prophylaxis (pests, Pleuropneumonia, clostridial infections, Salmonellosis).

Until recently, animal health affairs were exclusively managed by the government animal health services. Prophylaxis against the major animal diseases was mandatory and free. In 1979, with the founding of the central veterinary pharmacy (VETOPHAR, now LABOCEL), the livestock owner had to bear the costs. However, in spite of considerable rural extension, owners did not accept this change. So free vaccination was carried out until 1991. Today, vaccination is largely subsidized but still widely rejected by stock owners.

The current situation of animal health in Niger is characterized by the following situation:

- a persistent menace of contagious diseases (Pleuropneumonia, Pasteurellosis, clostridial infections);
- the release of prophylactics against Pasteurellosis and some clostridial diseases;
- the absence of prophylactics against avian diseases;
- the absence of a network of veterinary clinics and an efficient distribution network for veterinary medicines;
- the opposition of stock owners to contributing to animal health costs.

5. THE PASTURE RESOURCE

Permanent pastures occupy approximately 60 000 000 ha in Niger and acquire their greatest extent in the Sahelian zone, the present Nigerien pastoral zone. The area of pastures is limited in the north by the semi-arid zone (100-mm isohyet) and to the south by the northern limit of agriculture, marked by the 350-mm isohyet. The location of the isohyets varies considerably from year to year. The ecological conditions make crop-raising a risky speculation, but are disposed towards livestock keeping, in spite of the variability of rainfall.

Water is a key factor for survival and development, ensuring the growth of natural pastures and the maintenance of the domestic herds: more than 3 000 water points were listed within the pastoral territory (1970). Thus, in Niger, pastoral management is basically a question of management of water, i.e. how to balance the size of the herd with the watering capacity of the water points and the family labour available to satisfy the watering of the animals in the minimum time and the best possible conditions.

The variability of rainfall involves unpredictability of fodder production, as much in space as for the food value of the pastures. Other factors also have to be taken into account, such as the influence of the selective grazing, natural and man-made fires and the way of exploitation of the pastures. The action of man can play a paramount role in the composition and structure of the vegetation by opening more or less the herbaceous soil protection, thus supporting or, on the contrary, limiting the growth of certain woody plants.

Owing to the variability of rainfall, annuals are often more competitive, especially on sandy soils. While the availability of water plays a paramount role in the productivity of the pastures in the northern part of the Sahelian zone, it appears that soil fertility acts as a limiting factor in the southern part where there is a better water supply. Fodder availability varies according to area and in general increases from north to south.

Forage in the **Saharo-Sindian zone** is often provided by perennials and supplemented by the irregular appearance of annuals induced by random precipitation. Only the transhumance of large herds of small ruminants and camels allows the rational exploitation of this sporadic vegetation ('acheb' of Touareg). Some Poaceae play a paramount role in livestock feed, like *Panicum turgidum*, *Lasiurus scindicus*, *Chrysopogon plumulosus*, *Centropodia forskalii*, *Stipagrostis vulnerans* and *Stipagrostis acutiflora*. Other annuals seem to be very significant: *Schouwia thebaica* (Brassicaceae), *Citrullus colocynthis* (Cucurbitaceae) or *Astragalus vogelii* (Leguminosae).

Unlike the Ahaggar area of Algeria where the pastures contain numerous plants rich in salt, the Aïr has none. Touaregs lead their herds to the south-west of the massif where groups of stockmen meet at the time of the 'salt cure' (salt licks for the herds) in Ighazer, north of InGall. The salt grounds of this area are covered with a very dense herbaceous layer in the rainy season: *Ipomoea verticillata*

(Convolvulaceae), a dominant species in the herbaceous carpet, is regarded as best fodder for the goats, sheep and dromedaries.

The pastoral part of the Sahelian zone extends from West to East over 1 400 km through Niger and reaches a width of 250 km. According to the rainfall and geomorphology, the pastoral zone can be divided into three subzones: north, south and centre.

In the **northern Sahelian zone** (between the 100-mm isohyet in the south and the semi-desert of the north), on soils covered by sand (the majority of soils), trees are few and the commonest ones are *Acacia raddiana*, *Commiphora africana*, *Leptadenia pyrotechnica* and ubiquitous trees such *Balanites aegyptiaca*, *Maerua crassifolia* and *Ziziphus mauritania*. The latter two are relished by goats and camels throughout the year. On highly deteriorated soils, *Calotropis procera* pioneers, only eaten by goats and sheep when other plants are scarce. The herbaceous layer is dominated by perennial Poaceae, in particular by *Panicum turgidum*, a good fodder plant with stalks that stay green beyond the rain season, and various *Stipagrostis* spp. On the same soil *Cornulaca monacantha* and *Cornulaca aucheri* (Chenopodiaceae) can be found. These species constitute pastures that produce - under good conditions - approximately 400 kg of dry matter/ha. On soils with more clay and silt (depressions and valleys), the grass layer is mainly annual: *Aristida hordeacea* and *Aristida funiculata* are particularly frequent. The productivity of such pastures is slightly higher and can reach 500 kg of dry matter/ha.

On clayey soils an important plant formation is provided by *Sorghum arundinaceum* and *Sporobolus helvolus* which, in Ighazar (north of InGall), form immense pastures on salty land in the rainy season. The significant evaporation related to the endorheic water (internal drainage) has led to the accumulation of salts (sodium chloride and sulphate) in the surface layers of the soil. The very rich pasture on these grounds, is the cause of the gathering of many herds: it represents a true social rite at that time of the year, where the difficulties of the dry season disappear with the arrival of the rains. (There is a famous annual gathering of Touaregs and other Saharan nomads for a festival/reunion/market event at InGall, an oasis village two hours by road from Agadez. It is said to be one of the oldest and largest of such gatherings in the Sahara). This 'salt cure' (cure salée) is in fact a convalescence of the livestock after the long difficult months: a significant nutritious contribution of rock salt, a purgative action and intestinal worm cure for the animals.

The **central Sahelian zone** is between the 100 mm isohyet in the north and the 200–350 mm isohyet in the south. Annuals prevail in this subzone, not only due to a low rainfall but also because of fire and grazing. The open woody layer consists mainly of various *Acacia* and the species mentioned in the preceding zone. On sandy soils, the herbaceous layer is now more or less continuous and the commonest plants are *Panicum turgidum*, a perennial, and annuals such as *Aristida mutabilis*, *Cenchrus biflorus*, *Eragrostis tremula*, *Brachiaria xantholeuca* and *Schoenefeldia gracilis*. Other families are represented with annual plants such as *Indigofera* spp., *Blepharis linariifolia*, *Gisekia pharnacioides*, *Borreria* spp., *Mollugo* spp. and others. The productivity of these pastures reaches 1–1.5 tonnes of dry matter/ha. On soils with higher clay and silt content, mostly in depressions, the distribution of species is more heterogeneous and the herbaceous layer consists mainly of *Schoenefeldia gracilis*, *Aristida funiculata* and *Cymbopogon schoenanthus*. The latter formations are very seasonal, they appear with a relatively high productivity at the beginning of the rainy season but they dry very fast at its end.

The **southern Sahelian subzone** extends its border to the south until the northern limit of agriculture which corresponds to the 350 mm isohyet. It includes fallow land of former arable lands whose extension towards the north had once taken place in years of sufficient rainfall. Sandy soils on dunes or plateaux carry savanna formations of Mimosaceae and Combretaceae which show the traces of the degradations of the former extension of the agricultural land. Still, the grass layer contains a strong share of therophytes (annual plants that persevere in unfavourable climatic conditions as seeds) like *Schoenefeldia gracilis*, *Aristida mutabilis* and *Cenchrus biflorus*. The productivity of these pastures can exceed - depending on their floristic composition - two tons of dry matter per hectare. On soils with a higher clay and silt content, the grass cover does not differ very much from the one of the preceding central subzone. On hydromorphic soils – bordering Lake Chad – species such as *Panicum repens*, *Panicum porphyrrhizos*, *Sporobolus spicatus* and *Sporobolus helvolus* are dominant and on more sandy sites, *Schoenefeldia gracilis* and *Echinochloa colona*. They are excellent pastures that can be exploited during the whole year.

The whole **sedentary part** of the **Sahelian zone** is occupied by agriculture, on the clayey as well as on the more sandy soils. Grazing is thus possible only from November after harvest or on fallow land: in both cases, it mainly benefits domestic herds. The floristic composition of the fallow lands varies with their age and their productivity but does not exceed one tonnes of dry matter/ha. First, fallows are invaded by annual Poaceae, but later productivity improves with an increasing number of perennials: *Eragrostis tremula*, *Aristida mutabilis*, *Aristida funiculata* are thus replaced by *Andropogon gayanus*, *Aristida sieberiana*, *Cymbopogon schoenathus* and *Hyperthelia dissoluta*.

On ferrallitic sandy soils of the savannas of the **Sudanian zone**, dominant plants of the grass layer are *Panicum nigerense* and *Loudetia hordeiformis*, on the slopes of the Dallol ('valley') Maouri *Aristida mutabilis*, *Aristida sieberiana* and on some isolated dunes *Andropogon gayanus*. These are found in company with *Eragrostis tremula*, *Diheteropogon grandiflorus*, *Aristida stipoides*, *Cenchrus biflorus*, *Digitaria gayana* and other grasses. On the more clayey soils of the wooded savannah along the Niger river, species such as *Hyparrhenia involucreata*, *Hyparrhenia cyanescens*, *Brachiaria xantholeuca*, *Andropogon gayanus* are found; on hydromorphic soils *Hyperthelia dissoluta*, *Andropogon pseudapricus* are frequent. On the plateaux, where we find the 'tiger bush' formation, the grass layer consists mainly of annuals such as *Elionurus elegans*, *Andropogon pseudapricus*, *Andropogon fastigiatus*, *Pennisetum pedicellatum*, *Eragrostis tremula*, *Eragrostis pilosa*, *Dactyloctenium aegyptium*, *Aristida adscensionis*, *Schoenefeldia gracilis*, *Tripogon minimus*, *Brachiaria xantholeuca* together with a few perennials that sometimes dominate: i.e. *Loudetia simplex* or *Loxodera lermannii*.

The Niger riverbed and temporary ponds are locally important pastures. '**Bourgoutières**' are pastures that are temporarily flooded by the Niger river. In Niger, the most important 'bourgoutières' are close to the Malian border. These formations are subjected to two annual floods: a first one ('white water') between mid-September and mid-October, and a second one ('black water') between mid-February and mid-March. Different types of bourgoutières can be distinguished: The bourgoutières with *Brachiaria mutica*, the bourgoutières with *Echinochloa stagnina* (the 'bourgou'), and the bourgoutières with *Oryza longistaminata* and *Echinochloa stagnina*. As the 'white water' withdraws (mid-October), the animals enter the bourgoutières with *Brachiaria mutica* and leave them only in December. The dry stalks are then burned to make them resprout. The livestock then returns to these sites as soon as the 'black water' withdraws in March. The bourgoutière with *Echinochloa stagnina* is grazed later, in April, and the herds remain there until the arrival of the white water. The productivity of the bourgoutières is in general high: for the formations with *Echinochloa stagnina*, it varies from 6 to 17 tonnes of dry matter/ha (in Mali, it can reach 30–40 tonnes). Unfortunately, under the effect of water deficit due to climatic changes, overgrazing, the exploitation of grass tufts (the grass is used for fattening domestic animals which are then sold on the markets), extensive rice growing and cultivation of the river banks, one observes a clear regression of the bourgoutières and an evolution of their floristic composition which has led to a drastic reduction in the fodder resources.

The fallow lands of the **Sudanian** area are, as per the fallow land of the Sahelian area, complementary fodder resources. At the beginning, the fallow land is dominated by *Eragrostis tremula*, associated with *Ctenium elegans*, *Loudetia hordeiformis* and *Schizachyrium exile*. They are later partly replaced by species such as *Pennisetum pedicellatum* and *Diheteropogon hagerupii*. The productivity of these fallows can be up to 4 tonnes of dry matter/ha.

Fodder. For farmers, weeds cause more harm than good if not controlled, and weed control causes a labour peak in crop production. However, livestock

Table 3. Productivity and carrying capacity of different pastoral zones

Zone	Biomass	Liveweight	TLU	Ha/year
	Dm kg/ha	kg ha/year	Days ha/year	LTU
Northern Sahel				
Dunes	400	14.5	21	17.2
Sandy-loamy plains	500	18.2	26	13.9
Central Sahel				
Dunes	1 000	36.4	53	6.9
Sandy plains	1 200	43.6	63	5.8
Sandy-loamy plains	2 200	80	115	3.2
Unweathered mineral soils	800	29.1	42	8.7
Bourgoutières'	9 000	X	470	X
Southern Sahel				
Dunes	1 500	54.5	79	4.6
Sandy-loamy plains	1 200	43.6	63	5.8
Loamy-clayey depressions	3 000	109.1	158	2.3
Unweathered mineral soils	800	29.1	42	8.7

Table 4. Consumption of fodder trees

Name	Part of the plant eaten			Especially eaten by				
	Leaves	Flowers	Fruits	Bovines	Sheep	Goats	Camels	Wild game
<i>Faidherbia albida</i>	x	r	x	r	x	x	x	x
<i>Acacia laeta</i>	x	r	x	r	x	x	x	x
<i>Acacia nilotica</i>	x	r	r	x	x	x	x	?
<i>Acacia raddiana</i>	x	r	x	x	x	x	x	x
<i>Acacia senegal</i>	x	r	x	r	x	x	x	?
<i>Acacia seyal</i>	x	r	x	x	x	x	r	x
<i>Acacia sieberiana</i>	x	x	x	x	x	?	?	x
<i>Adansonia digitata</i>	x	r	?	x	x	x	?	?
<i>Anogeissus leiocarpus</i>	x	?	n	x	x	x	r	?
<i>Balanites aegyptiaca</i>	x	?	x	x	x	x	x	x
<i>Bauhinia rufescens</i>	x	?	x	r	x	x	x	x
<i>Boscia angustifolia</i>	x	?	?	x	x	x	?	?
<i>Cadaba farinosa</i>	x	n	x	x	?	x	r	r
<i>Cadaba glandulosa</i>	x	?	?	x	r	x	?	?
<i>Combretum aculeatum</i>	x	?	x	x	x	x	?	x
<i>Commiphora africana</i>	x	n	n	?	r	x	x	?
<i>Feretia apodanthera</i>	x	?	r	x	x	x	r	?
<i>Grewia bicolor</i>	x	?	r	x	x	x	r	x
<i>Grewia tenax</i>	x	?	r	r	x	x	x	r
<i>Guiera senegalensis</i>	x	x	r	r	r	x	x	r
<i>Khaya senegalensis</i>	x	n	?	x	x	x	x	?
<i>Maerua crassifolia</i>	x	x	r	x	x	x	r	x
<i>Phoenix dactylifera</i>	r	n	x	r	x	x	x	?
<i>Piliostigma reticulatum</i>	r	?	x	x	x	x	r	?
<i>Piliostigma thonningii</i>	r	?	x	x	x	x	r	?
<i>Prosopis africana</i>	x	?	r	x	x	x	?	?
<i>Prosopis juliflora</i>	r	x	x	x	x	x	?	?
<i>Prosopis pallida</i>	r	x	x	x	x	x	?	?
<i>Pterocarpus lucens</i>	x	?	r	x	x	x	x	r
<i>Salvadora persica</i>	x	x	?	x	x	x	x	?
<i>Sclerocarya birrea</i>	r	?	r	r	r	x	?	?
<i>Tamarindus indica</i>	x	r	r	r	x	x	r	n
<i>Ziziphus mauritania</i>	r	?	x	?	x	x	x	x
<i>Ziziphus mucronata</i>	r	?	r	r	r	x	r	r

x = eaten, r = limited palatability, ? = no information, n = no consumption

plays a key role in the traditional household economy and various weeds are traded as feed, food or construction material. Especially in mixed-farming systems, in the rainy season, feed demands of animals can be satisfied by fresh grasses and herbaceous plants. At the onset of the dry season, animals prefer millet leaves and weeds to millet stalks. During the dry season, feed is mostly limited to the scarce biomass from natural pastures and the decomposition of stover. At rural markets, fodder weeds such as *Alysicarpus ovalifolius*, *Zornia glochidiata* (both Leguminosae), *Commelina forskalaei* (Commelinaceae) or *Eragrostis tremula* (Poaceae) are sold. Laboratory analyses of these weeds revealed a crude protein content twice that of low quality roughages such as millet stover.

Livestock keepers show a preference for different weeds, such as *Eragrostis tremula*, *Commelina forskalaei*, *Cenchrus biflorus* (Poaceae) and *Merremia tridentata* (Convolvaceae), a perennial creeper. The grass *Eragrostis tremula* can be cut several times during the rainy period and is eaten by all animals. It can be ensiled (another use is broom production). *Commelina forskalaei* is a good fodder and suited for the preparation of silage. Under wet weeding conditions it regenerates fast. Both *Eragrostis tremula* and *Commelina forskalaei* emerge after the first weeding. *Cenchrus biflorus* is difficult to weed and rather persistent under humid conditions. It is grazed by most animals in its juvenile state and standing hay after the fall of the prickly spikelets. The fermentation process during ensiling softens the bristles which can subsequently be eaten by animals without harm. It is a reliable feed, since it persists until the next rainy period. Women gather *Cenchrus biflorus* seeds to prepare a porridge after cracking the seeds. *Merremia tridentata* is appreciated by all animals and remains on the grassland for about four months after the rainy period. It is well suited for preparing hay and silage. Further livestock diet improvement is attrib-

uted to *Mitracarpus scaber* (Rubiaceae) and *Ceratotheca sesamoides* (Pedaliaceae). They are not suitable for hay-making but for silage. The leaves of *Ceratotheca sesamoides* are used as a vegetable. *Mitracarpus scaber* remains green for about three months after the rainy season.

In the **Sahelian zone**, most grasses are well consumed by animals; some are preferred to others. Generally, those that grow on humid ground have larger leaves and are more tender (e.g. *Echinochloa colona*, *Panicum laetum*). Some grasses are more or less 'lignous' and are disdained, especially when dry (e.g. *Aristida hordeacea*, *Elionurus elegans*). In the north of the Sahelian zone, grasses such as *Panicum turgidum*, *Stipagrostis vulnerans* or *Lasiurus scindicus* are relished by all animals and sometimes taken as hay to feed the animals of the moving caravans.

The degree of acceptance of weeds by animals depends on many factors such as season and food scarcity. Under conditions of severe food shortage, even toxic plants are eaten, especially by goats. While the biomass increases with the age of the plants, the fodder value

decreases sharply after stem elongation. During the dry season, the fodder value of straw is low and has to be compensated by the consumption of leaves and fruits of trees.

Generally, the mineral content of weeds depends on their growth stage. In most cases in a tropical environment, grasses are low in sodium. During the stage of sprouting, they are rich in phosphorus, but its content and the calcium content decrease towards the end of the growth cycle. The content of cobalt and selenium is usually satisfactory, but zinc and copper are often deficient in straw, whereas a lack of iron is rarely found in tropical environments.

Pastoral Water Resources. In the agropastoral zone of Niger, the water supply for livestock is provided by water points around villages where transhumant herds stay in the dry season. In the actual pastoral zone, which is north of the agropastoral zone, the most important source of water is from natural surface ponds. Since the 1950s, the network of traditional wells and artesian springs - estimated to be approximately 1 500 in the pastoral area - has been supplemented by cemented wells (approximately 350) and deep boreholes, in some cases even equipped with pumps. Thus, the theoretical needs of the livestock (180 000 m³ / day for 4 500 000 tropical livestock units (TLU)) are met. The actual problem is,

Table 5. Nutritional value of fodder

		CD	OM	C	DM	DP	FU
Species	Growth stage						
Annual grasses							
<i>Aristida mutabilis</i>	Sprouting	79	919	352	32	38	0.55
	Flowering	77	911	345	33	36	0.56
	Development of fruit	49	920	383	60	10	0.46
	Straw (Oct. - Feb.)	39	921	391	95	1	0.44
	Straw (March - June)	21	910	410	95	tr	0.36
<i>Cenchrus biflorus</i>	Stem elongation	86	865	341	27	45	0.5
	Resprouts after grazing	160	882	303	23	113	0.64
	Straw (Oct. - Feb.)	31	910	388	94	tr	0.42
	Straw (March - June)	26	889	391	94	tr	0.37
<i>Schoenefeldia gracilis</i>	Stem elongation	73	913	361	30	33	0.53
	Flowering	60	904	385	44	21	0.43
	Straw (Oct.-Feb.)	34	928	400	95	tr	0.42
	Straw (March-June)	18	916	404	94	tr	0.39
Perennial grass/ inundated							
<i>Echinochloa stagnina</i>	Flowering	93	875	358	24	51	0.46
	Stalk inundated	46	916	423	15	7.5	0.32
	Straw (April)	29	926	379	92	tr	0.49
	Regrowth	144	833	270	27	99	0.64
Other weeds							
<i>Alysicarpus ovalifolius</i>	Stem elongation	175	887	286	24	127	0.70
(Leguminosaeae)	Flowering	182	863	249	35	134	0.75
	Development of fruit	138	891	246	41	93	0.80
	Straw (Oct. -Feb.)	52	933	307	94	13	0.72
<i>Tribulus terrestris</i>	Sprouts	142	804	202	23	97	0.77
(Zygophyllaceae)	Flowering	156	807	213	26	110	0.75
<i>Zornia glochidiata</i>	Stem elongation	156	918	352	22	110	0.75
(Leguminosaeae)	Development of fruit	160	934	297	32	113	0.75
	Straw (October)	134	904	292	94	89	0.4
Trees							
<i>Faidherbia albida</i>	Leaves (February)	178	936	175	31	130	1.0
(Mimosaceae)	Entire pod (March)	107	954	168	93	64	1.05
	Fruit pulp (March)	5.6	95.3	21.8	95	17	0.96
	Grain (March)	268	962	110	95	214	1.17
<i>Balanites aegyptiaca</i>	Dry leaves (February)	95	830	114	95	53	0.95
(Zygophyllaceae)	Fresh leaves/flowers (April)	200	891	203	35	150	0.90
<i>Pterocarpus lucens</i>	Old leaves (November)	194	927	256	42	145	0.83
(Leguminosaeae)	Dry leaves (February)	149	936	24	95	103	0.88

CP = crude protein (gr / kg dry matter), OM = organic matter (gr / kg dry matter), C = cellulose (gr / kg dry matter), DM = dry matter (in % of fodder), DP = digestible protein (gr / kg dry matter), FU = feed unit (net energy for the milk production from 1 kg of barley = 1700 kcal; generally 790 gr of digestible organic matter)

however, the uneven distribution of the water points related to the forage potential of an area. In addition, the legal status of the water points is often unclear and they are frequently appropriated, or users do not meet the costs of maintenance.

Droughts and Livestock Production. During the long period of drought (1969-1974), herds underwent very significant losses (50% of the cattle, 36% of the sheep, 27% of the goats). These losses, in cattle particularly, were more severe in the pastoral than in the agricultural zone, which increased the relative share of the herds of the south compared to those of north. During this period of droughts, Peulh nomads abandoned their usual course of migration, whereas Touareg clung to their spot thanks to their more diversified herds. The latter kept camels and goats, but lost almost all their cattle and sheep. In 1977, almost all the stockbreeders had regained their usual route. For the Peulh Woodabe it was an enormous detour, whereas only a few Touareg families had moved towards the cities or the food distribution centres. In 1981, the herds were reconstituted to 80% for the cattle and 110% for the small ruminants.

The long period of droughts followed some better, but still rain-deficient, years that ended with the catastrophic season of 1984. This season of catastrophic rains showed at the end of its summer that the fodder resources would be unable to ensure the survival of the herds. The stockbreeders who had not forgotten the difficulties of the years 1972–1973, and encouraged by the administration, left the pastoral zone, in their great majority in October. This time, Touareg were also concerned. A few families remained with some dairy cattle. The stockbreeders and their herds moved 150 to 250 km southwards. The loss of animals was very high and the crisis caused major changes in the pastoral society:

- an increase of the migration towards the cities;
- a progression of agricultural activities, often in the marginal zones, where insufficient rains make harvests random;
- a transfer in the possession of the cattle, particularly for the nomads close to the cities and Peulh Wodaabe. Tradesmen, state employees, townsmen bought the herds of those dispossessed stockbreeders who in turn became simple shepherds. Around Tahoua, Maradi and Agadez nearly 60% of the animals composing the herds do not belong to the shepherds who keep them.

Droughts and Pasture Resources. Years of deficient rainfall, which has marked the whole Sahelian zone since 1968, have resulted in a reduction of the biomass and a modification of the floristic composition. In certain areas of Niger, the productivity of the pastures with *Aristida mutabilis* and *Schoenefeldia gracilis* fell 50–70% between 1968 and 1985. In Tedjira (north-east of Zinder), for example, before the droughts, the herbaceous layer was dominated by the perennial *Cymbopogon giganteus* which was very well consumed by livestock. The productivity of these pastures often exceeded 2.5 tonnes of dry matter / ha. Now, this plant has more or less disappeared and has been replaced by *Aristida funiculata*, a small annual with a productivity never reaching 300 to 400 kg dry matter/ha. The current aspect of the grasslands (steppes) of the pastoral zone does not resemble the aspect of the time before the long periods of drought. Generally, the number of species has declined and the floristic composition of the herbaceous layer has been modified, very often to the detriment of perennial grasses: *Aristida sieberiana*, *Cymbopogon giganteus*, *Cymbopogon schoenanthus*, *Andropogon gayanus*, *Cyperus conglomerates* regressed considerably, even almost disappeared. Other annual species such as *Aristida mutabilis*, *Aristida funiculata* or *Schoenefeldia gracilis* have been replaced by therophytes with a shorter life cycle and thus more resistant to irregular rainfall, such as *Cenchrus biflorus*. Some plants, however, became more competitive as others vanished, for example *Tragus racemosus* or *Tribulus terrestris* which are easily disseminated by animals due to bur-like seed-cases. These species are however, relished by animals, and thus their increasing appearance does not necessarily lower the fodder productivity. In the ‘tiger bush’ formations of the plateaus in the south-west of Niger, the dryness led to the disappearance of *Andropogon gayanus* and the development of certain species far less productive (i.e. *Michrochloa indica*, *Tripogon minimus*). Overgrazing sometimes left large areas bare and prevented annuals from recovering. For many kilometres around water points, overgrazing, trampling and excrement have caused the disappearance of totally natural vegetation. Man-made fire and extensive lopping of trees are other sources that exacerbated the decline in the fodder value of Nigerien pastures.

6. OPPORTUNITIES FOR IMPROVEMENT OF FODDER RESOURCES

Pastoral areas in Niger are shaped by an unstable balance between livestock and vegetation, and the animals are the first to suffer when this equilibrium is broken. Indigenous plants are adapted to survive periods of drought. On the other hand, livestock have a beneficial impact on many aspects of the Sahelian ecology, and may actually help improve pastureland and increase the diversity of flora by dropping different kinds of seed in their dung as they move from one area to the next.

Range improvement and development in Niger is subject to various constraints. Irregular rainfall, for example, is a predominant reason for the failure of reseeding programmes. Experiences from other Sahelian countries (i.e. Mali) show that only a few perennial and annual legumes may survive the first dry season. Among the species are *Alysicarpus ovalifolius*, *A. vaginatus*, *Macroptilium atropurpureum*, *Stylosanthes fruticosa*, *S. hamata* and *S. viscose*. The establishment of woody browse species below the 400 mm isohyrt is subject to similar constraints, although some encouraging results are reported with *Bauhinia rufescens*, *Combretaceae*, *Piliostigma reticulatum*, *Ziziphus mauritiana*, *Prosopis ssp.* and *Acacia tortilis*.

The deferment of grazing for at least three years is essential for a successful establishment of newly sowed species and for the recovery of strongly grazed pastures. Since fencing is economically not feasible (although efficient, if not subject to theft), a legally supported rotating grazing management must be applied. Scarification of the soil surface for the re-establishment of some grasses (i.e. *Schoenefeldia gracilis*) has been successfully practised in a few projects, but it is generally cost-prohibitive. The same economic constraints apply to firebreaks.

Due to population growth and the sedentarization of former nomadic groups, agricultural land is encroaching upon pasturelands. This contributes to an overgrazing of the pastures and often results in land tenure disputes. In addition, according to legislation, pastoral areas are freely accessible and open to common use by pastoralists. Hence, a new concept of landownership and range management might be a considerable contribution to the improvement of Nigerien pastures. A new legislature has, however, to be based on a thorough study of the social links and the nomadic strategies of the pastoralists. A long-term security is in fact dependent on reciprocal arrangements and the capacity to move around, thus, ruling out the option of reserving fodder for one group while others go hungry in cases of serious shortage of fodder which are sometimes only limited to certain areas.

Range development is also water development. The number and location of new wells have to be the result of a careful study of the carrying capacity of the surrounding pastures and the transhumant traditions. However, public wells, as a common good, are often overused since they do not belong to anybody and therefore, the transfer of the ownership and the maintenance of the wells to the traditional users has to be part of a comprehensive pasture management plan.

In the Sudano-Sahelian ecoclimatic zone, overgrazing is due to the limited range of transhumance since livestock keeping is part of a sedentary agropastoral activity. However, due to higher rainfall, development strategies are more effective. Many trials showed a successful introduction of fodder plants such as *Andropogon gayanus*, *Pennisetum pedicellatum*, *Cenchrus ciliaris*, *Alysicarpus glumaceus*, *Stylosanthes hamata*, *Macroptilium atropurpureum*, *M. lathyroides*, *Lablab purpureus* and *Vigna unguiculata* (cowpea). The development scope of the introduction of these fodder plants is a nitrogen enrichment of the soil, the integration of crop and livestock husbandry and the countering of soil erosion. Further recommended action for this zone is the increase of agroforestry (i.e. *Faidherbia albida*) and intensive animal production (fattening).

7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

Ministry of Animal Resources

- Division of Financial and Administrative Affairs:
Mme Mariama ISSOUFOU Tel.: (00227) 733132

- Division of Animal Health
Dr. Seyni BOUBACAR (see below)
and
Dr. Abdou NABABA Tel.: (00227) 733184
- Division of Veterinary Laboratories
Dr. Mayana SALISSOU Tel.: (00227) 732009

Education and research

Professional training in livestock production is offered at two levels: at a vocational school and at university level.

The Institut Pratique de Développement Rural (I.P.D.R.) at Kollo has two courses of vocational training, both basically intended for state employees. A two-year training for livestock technicians, and training for livestock production assistants. The latter course lasts four years for students that are recruited directly from school with a junior high school degree, or two years for livestock production technicians with three years of working experience, after an entrance test.

At the Abdou Moumouni Dioffo University of Niamey, faculty of agronomy, students obtain the diploma of a technical engineer in agriculture. Students are high school graduates, and, after an entrance test, livestock production assistants.

Many Nigerien students are also trained in neighbouring countries (Burkina Faso, Morocco, Nigeria, Senegal or Mali), in France or in the USA.

Research is mainly conducted under the institutional frame of the National Institute of Agricultural Research of Niger (INRAN) and the above-mentioned university. The main areas of research in livestock science are fodder improvement, livestock nutrition and improved cattle breeds. Much of the research is financed by the Agency for Higher Education and Research of the French-speaking Communities (AUF-UREF), the Interstate University of Veterinary Medicine and Science at Dakar (EISMV) together with the French International Agricultural Research Cooperation Centre (CIRAD).

Non-governmental organizations and contacts

Organisation Nigérienne pour le Développement de l'Élevage (ONDEL), B.P. 1050, Niamey

Promotion du Développement Rural (PDR), B.P. 11995, Niamey

Association Nigérienne pour la Promotion Socio-Economique et Culturelle, B.P. 662 Niamey, Niger

Association Nigérienne pour la Ré dynamisation de l'Élevage au Niger (AREN), B.P. 12669, Niamey

Association pour le Développement Agro-Pastoral (ADAP), B.P. 11412, Niamey

Éleveur sans Frontières (ESF), B.P. 651, Niamey

Amadou BOUREIMA, Environment Researcher at the department of geography, Abdou Moumouni Dioffo University of Niamey, Clepgeo@intnet.ne

Dr. BAZO, Expert in animal production, faculty of agronomy, Abdou Moumouni Dioffo University of Niamey. Tel: (00227) 732290

Dr. Boulkassim SALIFOU, coordinator of the Panafrican Program for the Control of Animal Diseases, (PACE), Ministry of Animal Resources, B.P. 12198, Niamey. Tel: (00227) 738386, Fax: (00227) 738453

Boureima AMADOU, Statistical Service of the Ministry of Animal Resources, B.P. 12091, Niamey. Tel: (00227) 737296

Dendant ISSA, expert for agro-silvo-pastoralism, Ministry of Animal Resources, B.P. 12091 and 12241, Niamey

Dr. DOUMA, National Institute of Agricultural Research of Niger (INRAN), B.P. 429, Niamey. Tel: (00227) 722070/722714

François ACHARD, Research Institute for Development (IRD, former, Orstom), B.P. 11416 Niamey. Tel: (00227) 753115

Dr. Idé TAHIROU, coordinator of the Natural Resources Management Project, B.P. 12946, Niamey. Tel: (00227) 752717

Sanoussi FODE CAMARA, expert in pastoralism at the Natural Forests Management Project (PAFN), B.P. 12677, Niamey

Dr. Seyni BOUBACAR, Department of Animal Health, Ministry of Animal Resources, B.P. 12241,

Niamey. Tel: (00227) 733184
 LABOCEL, B.P. 485, Niamey. Tel: (00227)732009
 Department of Veterinary Laboratories, Ministry of Animal Resources, B.P. 12241. Tel: (00227) 732009
 and 741805
 Department of Veterinary Clinics, Ministry of Animal Resources. Tel: (00227) 733581

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9. CONTACTS

This profile was prepared in November/December 2001 by Dieter Geesing and Hassane Djibo; Dieter Geesing will also undertake periodic updating.

Contact details are:

Dieter Geesing

Lecturer and Researcher

Department of Plant Science (Chair of Plant Nutrition)

Technical University of Munich

Am Hochanger 2

85350 Freising, Germany

Tel ++0049 8161 71 5264

Fax ++0049 8161 71 4500

E-mail: dieter@geesing.biz; geesing@wzw.tum.de; dgeesing@yahoo.com

Hassane Djibo

Fax (00227) 72 37 55

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