

Country Pasture/Forage Resource Profiles

BURKINA FASO



by

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1. INTRODUCTION

Burkina Faso, “the land of incorruptibles”, is the name which replaced the former colonial Upper Volta after the Revolution of August 4, 1983. It is a landlocked country in the heart of West Africa which borders Mali to the west and north, Niger to the east and Côte d'Ivoire, Ghana, Togo and Benin to the south. (Figure 1). The country covers 264 000 km², the capital is Ouagadougou and the official language is French.

Occupied in 1897 by the French after they took the Mossi kingdoms, the country was first integrated in Upper Senegal before becoming a separate colony under the name of Upper Volta and part of the



Fig. 1 Maps of Burkina Faso and its administrative division into 13 regions (IGB, 2001).

federal group of French West Africa. In 1932 the colony was divided between Niger, the French Sudan (the present Mali) and the Côte d'Ivoire. It was reconstituted in 1947 as Upper Volta and became independent on August 5, 1960. The colony was largely a source of labour for the great plantations of Côte d'Ivoire and suffered heavy military recruitment in two world wars.

According to the most recent census (l'Institut National de la Statistique et de la Démographie en 1996) the population estimate in 2001 was 11 800 000 inhabitants with an annual population growth rate of 2.4% (According to the World Factbook the July 2006 population estimate was 13 902 972 with a 3.0% growth rate). It has great ethnic diversity with about sixty groups of which the main ones are: Mossi (48%); Lobis (7%); Bobos (6.8%); Mandés 6.7%); Sénoufous (5.3%); Gourousni (5.1%); Gouramanchés (4.8%) and Touaregs (3.3%); the remaining thirteen% is made up of minor ethnic groups. Population density is relatively low, about 40 per km². Over 80% of the population is rural. The standard of living is very low; according to UNDP (PNUD, 2000) 44% of the people are below the poverty line and 20% in extreme poverty.

According to the Ministry of Livestock Resources (Ministère des Ressources Animales, 2000), the country's land resources are divided as follows: cultivated land 36 380 km², (13.3% of the national land and 40.4% of all arable land) (Barry et al. 1998); protected areas (forests, reserves, national parks 43 078 km² (15.7%); rainy season grazing land 167 501 km² (61%); other land - buildings, homesteads, roads etc (10%).

It should be noted that this distribution of land is not static; agricultural land is increasing at 3.6% annually at the expense of the grazing land. In fact grazing lands include fallows, marginal land and reserved land (land not yet cultivated).

More than 80% of Burkinabé are involved with livestock in differing degrees. Animal husbandry is an important national source of revenue; livestock products accounted for nineteen% of exports (mean for 1994–1998), the second most important source after cotton. Based on a national livestock survey in 1989 the national herd is estimated (in 2000) to be 4 798 220 cattle, 6 782 440 sheep, 8 647 290 goats, 622 493 swine, 26 297 equines and 14 762 camels (FAO data in Table 1 are slightly different). Annual increases are 2% for cattle, swine, equines and camels and 3% for small ruminants (Ministère des Ressources Animales, 2001). Table 1 shows livestock number and production data and some import and export figures for Burkina Faso from 1996–2005. The productivity of the livestock is very low, well below their potential and there is room for improvement.

Table 1. Burkina Faso statistics for livestock numbers, meat and milk production, cattle and milk imports and livestock exports 1996–2005

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cattle Nos. (,000)	5 313	5 561	5 820	6 092	6 376	6 674	6 985	7 312	7 653	8 010
Sheep Nos (,000)	5 731	5 861	5 993	6 129	6 268	6 409	6 554	6 703	6 854	7 009
Goat Nos (,000)	7 996	8 259	8 532	8 813	9 104	9 405	9 715	10 036	10 367	10 709
Camels (,000)	13.3	13.5	13.7	14.0	14.2	14.4	14.6	14.8	15.0	15.3
Beef and veal prod. (,000) Mt.	69.9	73.2	76.7	80.3	84.0	87.8	92.0	96.5	101.0	105.5
Sheep meat prod. (,000) Mt.	13.4	13.7	14.0	14.3	14.7	15.0	15.3	15.7	16.0	16.4
Goat meat prod. (,000) Mt.	20.7	21.4	22.1	22.8	23.6	24.4	25.2	26.0	26.9	27.8
Fresh milk prod. (cow) (,000) Mt.	116.8	122.3	128.0	134.0	140.3	146.8	153.7	160.9	168.4	190.8
Cattle imports (head)	257	124	72	100	2149	154	211	383	284	n.r.
Cattle exports (,000) (head)	150.6	147.6	135	133.6	174.2	241.8	203.5	154.3	165.5	n.r.
Goat exports (,000) (head)	85.5	100.2	127.9	122.9	146.6	232.0	165.5	147.3	161.9	n.r.
Sheep exports (,000) (head)	161.3	178.2	215.8	189.0	226.2	243.6	213.6	110.7	176.4	n.r.
Milk equivalent imports (,000 Mt.	29.3	34.1	32.4	51.2	45.9	19.8	16.4	16.3	18.1	n.r.

n.r.=no data

Data from FAO statistical database 2006

2. SOILS AND TOPOGRAPHY

Topography. The geological history of Burkina Faso is marked by (i) Precambrian volcanic activity (ii) Eburnean faulting and folding and (iii) fluctuations of sea levels, notably those contemporary with Hercynian movements (Zoungrana 1991). These geological events, followed by successive erosion cycles, gave rise to the basis of the relief which comprise an immense peneplain and sandstone plateaux.

The central peneplain. Over 80% of the country lies on a vast, flattish peneplain of monotonous appearance. Its mean altitude is between 250 and 300 m. That central peneplain is deeply dissected by the valley of the Mouhoun which cuts it into two distinct blocks: the western block or Plateau of Bobo-Dioulasso and the eastern block.

The Plateau of Bobo-Dioulasso is the highest part of the bedrock; its surface is sometimes rolling with gentle slopes, sometimes flat which betrays the presence of ferrallitic cuirasses either at the surface or at very shallow depth, which form great, gently sloping glacis with slopes of under 5%.

The eastern block is the largest and has more broken terrain. It gives the whole peneplain its general appearance. Nevertheless granite domes, inselbergs and some isolated and sparse secondary Birrimian ranges can be seen, their altitudes vary between 400 and 500 m.

The sandstone plateaux. These are cut, along with the underlying basement rocks by cliffs, sometimes massive between Bobo and Banfora, sometimes sculptured by erosion (Aiguilles de Sindou).

Soils. According to work by ORSTOM (Boulet, 1976) synthesised by Fontès and Guinko (1995) there are eight main soil types in Burkina. These are: leached ferruginous soils; poorly evolved soils of erosion; brown eutrophic soils; vertisols; ferrallitic soils; halomorphic soils, hydromorphic soils and raw mineral soils. The first two soils cover more than two thirds of the country.

Leached ferruginous soils cover the greatest areas; basically they are found in the central part of the Precambrian peneplain, south of the thirteenth parallel. These soils have a variable texture, generally tending to be sandy in their surface horizons and clayey in the deeper one (below 40 cm). They drain badly, in accordance with their physical characteristics (low porosity and permeability). They all have a poor cation exchange capacity. They are regularly associated with gravelly soils.

Poorly evolved erosion soils are mostly found in the northern half of the country. They are found over the granites and migmatites from which they are derived. They have a sandy surface horizon (15–20 cm) and an underlying clay horizon. The denseness and impermeability of that second horizon affects root penetration and the water regime.

Hydromorphic soils are found on river alluviums or on fine weathered material. They have poor drainage and are regularly waterlogged in the rainy season. They are mostly developed in the west of the country and are aligned with the drainage network of the main valleys of the Mouhoun, Nazinon and the Nakambé.

Brown eutrophic soils are characterised by their high clay content. The presence of swelling clays gives them a high exchange capacity and cation saturation. These are generally well drained soils; their surface structure is variable from crumbly to prismatic. This is the characteristic which governs their fertility. They are found, in small patches, throughout the country.

Vertisols have the same textural parentage as the brown soils. They are distinguished from brown soils by the prismatic structure of their B horizon; a characteristic influenced by their low topographic position which makes them poorly drained. They are particularly developed in the south-east and south-west (valley of the Sourou).

Raw mineral soils are poor, shallow and found on bed-rock or ferrallitic pans. The vegetation found on them may be sparse or, contrarily, dense because they are not suitable for cultivation so they are free from human intervention.

Halomorphic soils are found in the north of the country. Their texture varies; their structure is frankly degraded. They are poor soils which are covered by a weak shrubby steppe.

Ferrallitic soils are found in the south of the country. Their area is very limited. Their profile is related to that of ferruginous soils but their physical and chemical properties are clearly different. They are distinguished by the kaolinitic texture of their B horizon which gives them satisfactory permeability. They are good agricultural soil; their natural vegetation is wooded savannah.

3. CLIMATE AND AGRO-ECOLOGICAL ZONES

Climate. Burkina has a dry tropical climate. It is under the seasonal alternation of moist air from the monsoon coming from oceanic high pressure and dry air from the Sahelian latitudes. According to Fontès (1983) and Zoungrana (1991) the characteristics of the climate are:

- two marked seasons; a rainy season (hivernage) and a dry season
- a unimodal rainfall curve
- a dry season which is at least as long as the rainy one
- a total absence of a cool season (the annual minimum monthly temperature is $> 18^{\circ}\text{C}$)
- and an increasing aridity from south to north

Table 2 shows the bioclimatic subdivision of the country, based on annual isohyets and the length of the dry season, the longest data series provided by the national meteorological service. The north has arid Sahelian climates while the Sudanian ones are less dry. The separation of the two climates corresponds to a line from Ouahigouya-Kongoussi-Bogandé.

The climatic limiting factor for plant growth is rainfall which is generally tending to diminish, with increasing variation between years (Kagoné, 2000). These characteristics have to be taken into account in research and development programmes so as to anticipate food and forage crises in two consecutive drought years.

Agro-ecological Zones. Burkina Faso has not yet established an agro-ecological zoning in the strict meaning of the term. It is the phytogeographical zones defined by Monod (1957) and Guinko (1984) according to floristic and climatic characteristics, which take the place of agro-ecological zones. Figure 2 shows the four zones and their characteristics are summarised in Table 3.

Table 2. The bioclimates of Burkina Faso

Bioclimates	Climate types	Annual rainfall, mm.	Number of dry months ¹
Sahelian climates	North Sahelian	< 400	> 9
	South Sahelian	400 to 600	7 to 9
	Transition Sahelo-Sudanian	600 to 700	7 to 8
Sudanian climates	North Sudanian I	700 to 800	6 to 7
	North Sudanian II	800 to 900	6 to 7
	South Sudanian I	900 to 1 100	5 to 6
	South Sudanian II	> 1 100	< 5

¹ Months with under 50 mm rainfall

Source: adapted from Fontès et Guinko (1995).



Figure 2. Map of the agro-ecological zones of Burkina Faso derived from the map of natural vegetation and land cover of Fontès and Guinko (1995)

Table 3. General characteristics of Burkina Faso's agro-ecological zones.

Zone	% of national territory	Annual rainfall mm.	Land cover
Sahel	13.4	< 400	Steppe with thorny bushes and annual grasses Pastoral zone evolving to agro-pastoralism, mainly pastoral at present Subsistence farming based on millet, sorghum and cowpea Transhumant herding
Sub-Sahel	15.3	400 to 700	Steppe with combretum and annual grasses Agropastoral, mainly agricultural zone High population density and land fully occupied Subsistence farming based on millet, sorghum and cowpea Transhumant herding and sedentary agropastoral agriculture
North-Sudan	38.9	700 to 900	Savannas with trees or shrubs Agropastoral, mainly agricultural zone High human and livestock population density Cotton area with agriculture based on sorghum, millet, cowpea and groundnut Transhumant pastoralism and sedentary village stock raising
South Sudan	32.4	900 to 1 200	Savanna with trees or shrubs, sparse forests Agricultural area characterised by perennial crops (mangos, citrus, cashew etc.) cotton growing, yams and cereals (sorghum, millet and maize). Used by transhumants in the dry season with sometimes mortal conflicts between pastoralists and farmers. Sedentary village stock rearing of taurin cattle.

NB. Subsistence farming is very widespread; it is essentially manual with very few external inputs. Animal traction is mainly used in the cotton-growing tracts (cash cropping) where modernisation (mechanisation and use of agrochemicals) is well advanced.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

Because of the varied ecological conditions Burkina's livestock production systems show great diversity; this is also explained by social, cultural and economic factors (Touré *et al.*, 1985, IEMVT-CIRAD/SFC SEDES-CEGOS 1991; Sanon *et al.* 1995; Barry *et al.* 1998; MRA 2000 and Kagoné 2000). In this paper we present the systems of production of domestic livestock based on these documents. Two main types of system coexist in Burkina Faso: traditional extensive systems and modern, semi-intensive to intensive ones.

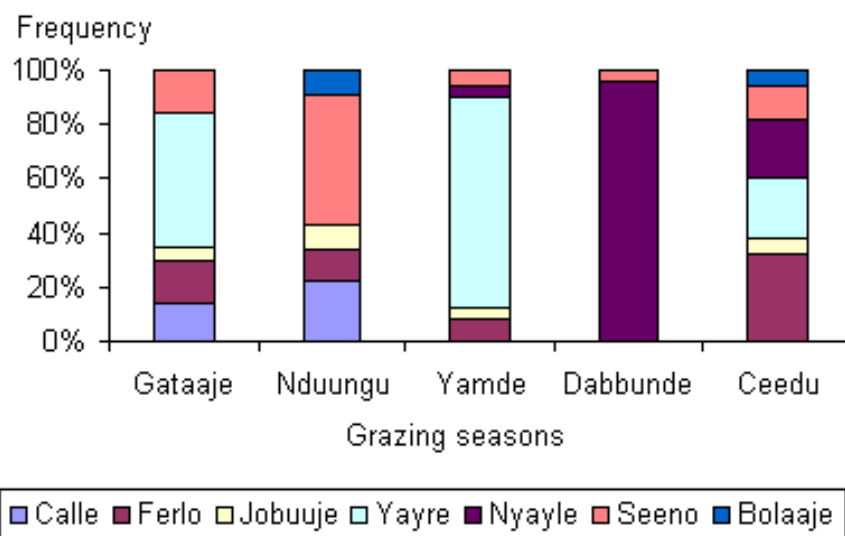
Traditional systems These are low-input systems, no concentrates (agro-industrial by-products) are used, or only in emergency when forage is scarce to save weak animals. Only some of the stocks are vaccinated, even for notifiable diseases. These systems comprise the transhumant Fulani system; sedentary village stock-raising and stock rearing in developed pastoral areas.

The transhumant Fulani system- is the most important numerically. It contains over 70% of the country's cattle. It is in the hands of the Fulbé ethnic group; herds may be single species or mixed, associating small ruminants with cattle. Most cattle are Sudanian Fulani zebu; the males are good beef animals with a mean mature weight of 320 kg and a carcass yield of 48%. The female is a poor milker giving two or three kilos daily, an annual yield of 700 kg over seven months. In the provinces of Mouhoun, Gourma (Matiacoali) and Komandari herds composed solely of sheep are found belonging to Fulani, Gourmantché or Bellah herders.

Feeding is by opportunistic exploitation of forage resources according to a yearly sequence of grazing involving five seasons and the different types of pasture available (Figure 3).

In most herding systems the cattle graze the vegetation of a pastoral territory, under a single herder. The daily grazing circuit is between three and seven km. The main characteristic of this system is its seasonal transhumance.

Following the definition of Lhoste *et al.* (1993) transhumance is the seasonal movement of herds, with several people in charge of them, generally paid shepherds or young family members; the main part



Gataaje = June - mid July ; Nduungu = mid July to late September ; Yamde = October to mid December ; Dabbunde = mid December to February ; Ceedu = March to May.
 Calle = ladde = hill grazing ; Ferlo = bush grouping several pasture types ; Jobuuje = recent fallows ; Yayre = low moist areas ; Nyayle = grazing crop residues ; Seeno = pasture on sandy soils ; Bolaaje = pasture on clays or clay loams

Figure 3. Calendar of traditional grazing by Fulani in the north Sudanian zone
 (Kagoné, 2000)

of the family group stay at home. In the Sahelian and north-Saharan forage availability varies greatly in both time and space. In such a context of risk, the strategy adopted by herders is mobility and this is the very foundation of pastoralism. Long transhumance respond to the following objectives:

- take advantage of the ecological complementarity of the Sahelian and Sudanian zones;
- provide a seasonal de-stocking of the Sahelian pastures since their carrying capacity is seriously over charged and so maintain the fragile equilibrium of the ecosystem between the livestock and the resources.
- save the stock from certain death during the difficult “hungry gap”.

The date for setting out on transhumance is not fixed, it is controlled by the state of the grazing and the weather. In the north Sudanian zone transhumance is from March to June. Figure 4 gives a map showing the main routes in the east of the country. There are two types of transhumance: the short transhumance which takes place in the interior of the region and the country and the great transhumance which often crosses national borders towards Benin. The region also receives transhumants coming from Niger. Protected zones, not open to grazing but which abound in water and pasture (young regrowth and perennial grasses) are in fact the zones used by these transhumant herds.

According to Toutain *et al.* (2001) the itineraries and stopping places of transhumant herds are firstly decided by experience from previous years but up-dated and adapted each time according to information collected by scouts or other sources (itinerant marabouts, travelling nomads, cattle merchants and such like). Information collected mainly concerns:

- the possibilities of using pasture resources: break of the rains, pasture quality, access to water points, stock routes, relations between the peoples of the zones and their welcome for herders;
- sanitary conditions for livestock; the principal diseases; availability and cost of veterinary products; cursed fields (anthrax infested pastures);
- security for herders and their livestock; the nature of conflicts, their frequency, the form they take; stock theft and physical aggression; harassment by the administration and customs services;
- Controls on transhumance in the country of their destination.

The sum of such information enables the herder to define the transhumance itinerary for that year according to the availability of grazing and water but also the absence of infectious disease. The precarious condition of the stock at the start of transhumance requires that the itinerary has adequate forage and water points. The route between the destination and the point of departure should be as short as possible to avoid the already weak animals dying of exhaustion.

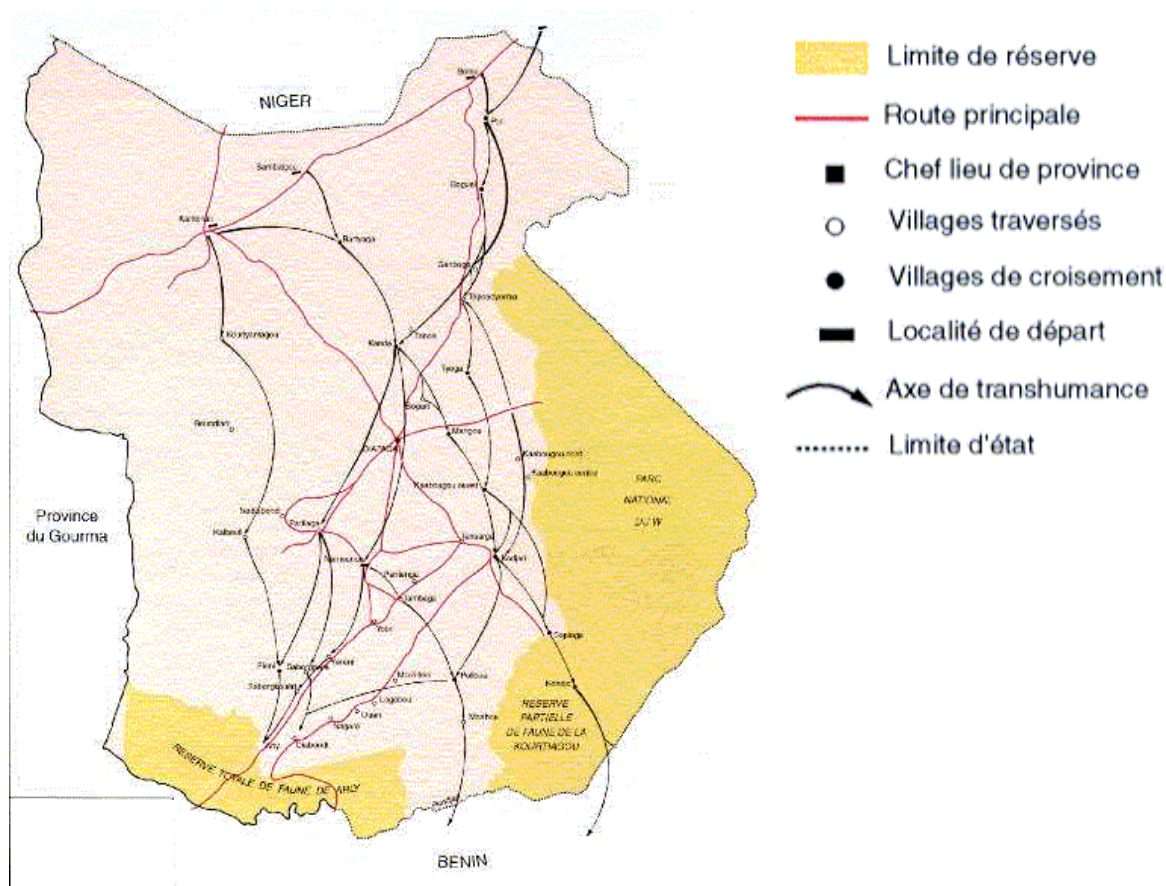


Figure 4. The main transhumance routes of Burkina Faso
(Toutain et al. 2001).

There are regulations governing transhumance at both national and sub-regional level in West Africa. National transhumance in Burkina Faso is controlled by decree number 2000-30/MRA/MEE/AGRI/MATS/MEM/MIHU of 21 July 2000 and trans-border transhumance by the decision A/DEC.5/10.98 concerning the regulation of transhumance between members of the Communauté Economique des Etats de l'Afrique de l'Ouest (CEDEAO) That decision, which was adopted at the twenty-first ordinary session of the Conference of Heads of State and Governments at Abuja in 1998 authorises transhumants to cross the borders of all states of the Community with cattle, sheep, goats, camels and asses. The main obligations for the transhumants are to hold an international transhumance certificate (CIT) and to respect the laws and regulations in force in the host country.

Sedentary village system. This system is recognised among farmer-stock keepers and sometimes pastoralists who have become sedentarised. It is especially common among such ethnic groups as the Gouronsi, the Lobi and Dagari. The aims of stock-rearing in this system are more socio-cultural (funerals, dowries and such) than economic, with a subsequent poor management of the herd. The stock are taurin types of the Lobi or Méré breeds, the result of crossing between zebus and taurin cattle. Herds often contain the cattle of several owners with a single herder in charge; a herd may also be the property of an individual or family.

The sedentary agro-pastoral system. This is the system used by farmers who put their crop residues to economic use by feeding them to livestock. Most ethnic groups and social and professional categories practice it (farmers, civil servants, traders). Two components can be distinguished in this system: sedentary and integrated stock raising. Cattle are herded on the fringes of the crop land by a family member or a paid Fulani. In the cropping season the night pen is outside the crop land and feed is based on natural grazing on the village lands or between villages. Integrated stock-rearing brings together and houses all the stock at the homestead and has numerous interactions with the crop sector. They comprise

draught and pack animals (oxen, asses and horses) and small ruminants (sheep and goats). In the dry season the stock are fed supplementary rations of conserved forage; crop residues and hay.

The system of planned pastoral zones. The strategy of these zones is to sedentarise the transhumant Fulani, to guarantee secure land rights for pastoral activities and improve herd productivity and rationalise the management of natural resources. Stock-raisers officially installed in these zones benefit from a strong extension input and a strong network of livestock infrastructure (water points, vaccination pens, sale points for inputs, small milk collection units and so on). In 1997 ten planned pastoral zones totalling 542 000 ha, 3 995 families, 133 000 cattle, 69 000 sheep and 70 000 goats were already in operation. In due course the number of zones should be over 50 with an accumulated area of 2 000 000 ha (Ministère des Ressources Animales, 1997).

Despite these efforts, the productivity of livestock in the planned pastoral zones does not differ significantly from that elsewhere. Semi-intensive dairying is, however, emerging; it is characterised by feeding some of the lactating cows with crop residues, some natural or sown fodder and agricultural by-products (cottonseed cake, wheat bran). The milk supplies mini-dairies, managed by groups of stock-owners as is the case at Bittou, Sondré-est, Sidédadou and Yallé. This type of dairying is sometimes seen in planned pastoral zones as with the l'Union des Producteurs de Lait (UPL), whose members are installed within a radius of 50 km of Bobo-Dioulassou and supply the dairy at Faso Kossam.

Improved livestock systems. These are systems where the producers make greater investments in inputs and labour, thus allowing the animals to better express their production potential. One type is urban and peri-urban dairying, another is specialised cattle and sheep fattening. Presently such operations are very popular and are worth supporting so as to provide job opportunities for youth and women and reduce the country's dearth of dairy producers.

Urban and peri-urban dairying. This system is semi-intensive to intensive. It involves dairy farms on the margins of or in the great urban centres such as Ouagadougou, Bobo-Dioulassou, Koudougou, Ouahigouya and Dori. This type of production is in full expansion and is in the hands of merchants, cattle exporters, modern farmers, politicians, senior army officers and civil servants.

The stock are usually local zebu but, more and more, others are being introduced. Thus Azawak, Sokoto Gudali, Gir and Girlando breeds are already part of the peri-urban stock or are joining it. Regarding the milking qualities of these breeds it is plain to see that milk production is booming. This dynamism is understandable when Burkina Faso expends about ten milliards of CFA francs annually on milk and dairy products. All milk produced is for the home market.

Fattening cattle and sheep. This takes place both in the countryside and in peri-urban and urban zones. Those involved are the same as for urban dairying along with some country people. Peasant sheep fattening is often done by women.

The animals fattened are three to five year old local zebus and for sheep Djallonké or Bali-Bali rams or crosses of these breeds. Almost all the fattened stock is exported to Côte d'Ivoire, Ghana, Togo, Benin or Nigeria. However many of the fattened rams are slaughtered locally during the Muslim Festival of Tabaski (Eid el Adha).

5. THE PASTURE RESOURCE

In Burkina Faso natural vegetation, herbs and browse, are the basis of ruminant nutrition; farmers have, however, access to crop residues and agro-industrial by-products as dry season supplements. Fodder crops are still very rarely used, even if they could be a way of intensifying production.

This brief description of the vegetation is based on Guinko (1984) and Fontès and Guinko (1995). Burkina is part of the Sudano-Zambian phytogeographic zone and her vegetation reflects the climatic and edaphic conditions as well as human interference. Steppes, various types of savannas and treed

woodland succeed one another from north to south. They are cut by gallery forests and there are scattered relic forests, usually sacred groves.

The steppes. These are found in the Sahelian and Sub-Saharan agro-ecological zones. They are usually shrubby, dominated by thorn-bushes of the genera *Acacia* and *Balanites*. They are under heavy pressure from livestock and the fodder trees and shrubs are overexploited by browsing, by lopping for fodder and hacking off branches. The grass cover is sparse which protects them from bush fires. The surroundings of ponds, and the ponds themselves are covered by humid or aquatic grassland.

The Sahelian zone is the sector of xerophyllous steppes with annual grasses such as *Aristida mutabilis*, *Cenchrus biflorus* and *Schoenefeldia gracilis*. In that zone you find typical Saharan and Sahelian species such as *Acacia ehenbergiana*, *Aerva javanica*, *Andropogon gayanus* var. *tridentatus*.

In the Sub-Saharan zone numerous ubiquitous Sudanian and Sahelian plants are found. The most characteristic are: *Acacia laeta*, *Acacia nilotica* var. *adansonii*, *Acacia senegal*, *Aristida hordeacea*, *Bauhinia rufescens*, *Combretum glutinosum*, *Cenchrus biflorus*, *Diheteropogon hagerupii*, *Andropogon gayanus*.

The savannas. The Sudanian zone is that of the savannas, sub-climax formations maintained by man and fire for 300 000 years. Sometimes the savannas are shrubby, sometimes treed according to the soil and human activities. The areas covered by savanna are used for extensive agriculture and grazing; most of the savannas in Burkina Faso are, therefore, only old fallows. The protected areas (national parks, wildlife reserves and classified forests) are concentrated in this zone.

In the north Sudanian zone the savannas are dominated by trees which have been retained for mainly economic reasons *Adansonia digitata*, *Butyrospermum paradoxum*, *Parkia biglobosa*, *Tamarindus indica*. Some Sahelian elements are still present but the most typical grasses are the annuals *Andropogon pseudapricus*, *Loudetia togoensis*, *Pennisetum pedicellatum*, and the perennials *Andropogon gayanus* and *Cymbopogon schoenanthus*.

The south Sudanian zone is characterised by the tree *Isobertinia doka*, an indicator plant for the boundary between the north and south Sudanian zones. Apart from being burnt every year the south Sudanian savannas are infested by Tsetse fly, vectors of animal trypanosomiasis.

Natural pastures

Sahelian pastures. These receive under 500 mm of rainfall in a period of two to three months. Their growing period and therefore their grazing period is 52 days. Depending on the topography several types of pasture occur of which the commonest are:

Dune pastures dominated by *Cenchrus biflorus*; these cover about 30% of Oudalan; these are grassy steppes with very sparse woody vegetation. The grass layer, almost monospecific on ancient erg (Oursi region) contains other grasses such as *Dactyloctenium aegyptium*, *Aristida mutabilis*, legumes such as *Zornia glochidiata*, *Alysicarpus ovalifolius* and other plants like *Limeum viscosum*, *Limeum pterocarpum*, *Tribulus terrestris*, and *Evolvulus alsinoides*. The maximum herbage yield of dune pastures is 4.3 tonnes or a carrying capacity of 1.3 ha/UBT/dry season (the Tropical Livestock Unit, "UBT" is used locally).

The pastures of the glaciais dominated by *Schoenefeldia gracilis* cover about 60% of the province of Oudalan. These are shrubby steppes where *Schoenefeldia gracilis* very much dominates the herbaceous layer, other common herbs are *Indigofera aspera*, *Mollugo nudicaulis*, *Evolvulus alsinoides*, *Boerhavia erecta*; *Cenchrus biflorus*, *C. prieurii* and *Eragrostis tremula* are also found. The woody plants are very scattered with occasional trees of *Acacia raddiana*, *Balanites aegyptiaca*, *Acacia senegal* and *Acacia erhenbergiana*.

The north Sudanian pastures. These develop between the 500 mm and 900 mm isohyets, so four to five months of rain. Their growing season is from 90–127 days. Vegetation groups are marked by agricultural activity, the present population pressure as well as bush fires. It has a parkland vegetation which owes more to human intervention than to soils and climate. The main land units are the pastures in bottom land and hydromorphic valleys, glaciais pastures and plateau pastures.

The pastures in bottom land and hydromorphic valleys are tied to the alluvial soils of the drainage systems. At Gampéla experimental station, along the Massili, there are two pasture types:

- a grassy savanna on the bottom land with *Panicum anabaptistum*, *Vetiveria nigritana*, *Mitragyna inermis* and *Anogeissus leiocarpus*;
- a treed savanna in the hydromorphic valley with *Butyrospermum paradoxum*, *Andropogon gayanus* and *Pennisetum pedicellatum*.

The glaciis pastures are the most widespread units of landscape and of vegetation in the north Sudanian regions; the vegetation is savanna with bushes or trees. The herbaceous layer is dominated by *Loudetia togoensis*, *Andropogon pseudapricus*, *Aristida kerstingii*, *Dactyloctenium aegyptium* and *Digitaria horizontalis*. The trees are mostly *Combretum* spp., *Acacia seyal* and *Terminalia avicennioïdes*.

The plateau pastures develop on buttes with laterite pans. The vegetation is degraded treed savanna depending on the age of the fallow; these savannas are regularly visited by livestock. Characteristic plants of the plateaux savanna are *Butyrospermum paradoxum* and *Schizachyrium exile*; there is also savanna with *Butyrospermum paradoxum* and *Andropogon gayanus*.

South Sudanian pastures. These consist of densely treed savannas on old fallows, savannas with trees and sparse forest in little disturbed areas. A study at Sidéradougou identified four types physiognomic of pasture vegetation:

- savanna with sparse tree cover on buttes with laterite pans; the dominant plants are: *Butyrospermum paradoxum*, *Burkea africana*, *Loudetiopsis scaëttae* and *Schizachyrium sanguineum*;
- densely treed savannas on plains with flat relief; these are the most widespread formations in the zone with a flora dominated by *Azelia africana*, *Terminalia macroptera*, *Schizachyrium sanguineum* and *Hyparrhenia cyaneus*;
- treed savannas with *Isobertia doka* and *Andropogon ascinodis* on gentle slopes.
- lastly grassy savanna on bowal (shallow, clay-loam soils, locally hydromorphic during the rains) with *Loudetia togoensis* and *Diheteropogon hagerupii*; savannas of temporarily flooded areas with *Imperata cylindrica* and *Schizachyrium brevifolium*; grasslands of land flooded for long periods with *Oryza barthii* and *Acroceras amplexans*.

The fodder situation

Table 4 shows the overall national fodder situation. On reading the table it is evident that the Sahelian regions are overstocked whereas the Sudanian zones, notably the south Sudanian are quite understocked. This emphasises the necessity of mobility, transhumance, of the Sahelian systems to the Sudanian zone.

This table does neither take into account browse nor crop residues. The former are a high quality fodder source sought after by livestock to balance their protein requirements. The most palatable woody forages are *Acacia* spp. and *Pterocarpus lucens* in the Sahelian zone, *Pterocarpus erinaceus*, *Azelia africana*, *Khaya senegalensis*, *Gardenia ternifolia* and *Combretum* spp. in the Sudanian zone. Crop residues play an important role in the feed calendar.

Constraints to the use of natural pasture

A certain number of constraints limit the optimal use of pasture resources on both quantitative and qualitative levels; these are conflict between farmers and stock-owners, bush fires and the short duration of the growing season.

The zones with surplus fodder are in the Sudanian agro-pastoral regions. The transhumance of Sahelian stock towards these high potential areas is the origin, every year, of conflicts, some mortal,

Table 4. Fodder balance for grazing lands in the agro-ecological zones of Burkina Faso

Pasture types	Area ha	Carrying capacity ha/ UBT/an	Potential stocking UBT	Present stocking UBT	Stocking %
Sahelian	1 467 800	5.0	293 560	759 382	258.7
Sub-Sahelian	2 767 800	5.0	55 560	1 098 870	198.5
North Sudanian	6 806 600	2.5	2 722 640	2 433 820	89.4
South Sudanian	5 707 900	1.3	4 566 320	1 100 477	24.1

Source: Ministère des Ressources Animales (2000)

between pastoralists and crop farmers. Whether it be during the transhumance or at a local scale, coexistence between pastoral stock-raising and settled agriculture inevitably causes conflict between pastoralists and farmers. Damage to crops and produce are the visible causes of conflicts which also have their origins in:

- the continual calling into question of the boundaries of the pastoral land because of encroachment by farming;
- lack of fencing of orchards (cashew nuts and mangoes) etc;
- late harvest of crops left on the field;
- night grazing and poor supervision of herds;
- obstruction of traditional access routes to pasture and watering points;
- installing crops close to water points;
- cultivating land for crops in areas regularly occupied by livestock (grazing land, night paddocks etc.);
- the emergence of agropastoral stock-raising among the agricultural people which is in competition with transhumant pastoralism; that affects the farmer-herder relationship and minimises their complementarity (contracts for manuring or work) and exacerbates the competition for land and resources.

Every year uncontrolled bush fires, early and late, consume the Sudanian savannas. While early burning causes little damage, late fires destroy all the standing herbage. Various campaigns against bush fires have been in vain, except in the planned pastoral zones and protected areas.

At the level of quality the major constraint is tied to the short growing season, which varies between two and six months according to zone. Outside the season of active growth the grasslands have a very poor nutritive value, not adequate for the maintenance requirements of livestock. At that season there is no protein in the grass herbage. To balance the ration the domestic ruminants rely on fodder trees and shrubs. In all cases the forages are poor except in the active growing season.

Crop residues. These are an important fodder resource. They include the stover of such cereals as bulrush millet (*Pennisetum glaucum*), sorghum (*Sorghum bicolor*), maize (*Zea mays*) and rice straw (*Oryza sativa*) as well as the haulms of pulses, cowpeas (*Vigna unguiculata*) groundnut (*Arachis hypogaea*) and Bambara groundnut (*Voandzeia subterranea*) (Savadogo, 2000).

After harvest the stubbles are open to grazing by the herds during the cool, dry season (called *dabbunde* by the Fulani herdsman) from November to February. To use crop residues (*nyuale*) it is sometimes necessary to travel short distances and “manure contracts”. In all cases the daily distance covered by the herd is increased but that extra expenditure of energy is, according to the herders, largely compensated by the good condition of the stock and a significant improvement in milk quality (increase in fat content and better flavour) (Kagoné, 2000). In the case of farmers who keep livestock some of the straw and stover and all the legume residues are collected and stored, mainly to feed draught and fattening stock. There are some cases of sale of crop residues in the Sahelian and north Sudanian zones.

The potential quantities of available crop residues, by agro-ecological zone, are given in Table 5. These are estimated from the straw:grain ratio which are taken as 3:1 for millet and sorghum, 2:1 for maize, 1.5:1 for cowpea and groundnut and 1:1 for Bambara groundnut (Zongo, 1997 cited by Savadogo, 2000). These residues are not all reserved for livestock feed. Some are used domestically, on the farm or as fuel without counting losses due to termites and fire. Taking such losses into account, about a third of the total production is available to livestock. The season for grazing crop residues is three months.

Crop residues have an acceptable feeding value at a time when the pastures are very poor, notably in protein. Table 6 synthesised by Savadogo (2000) gives their nutritive values. The haulms of pulses are, of course, richest in protein

Table 5. Availability of crop residues and carrying capacity by agro-ecological zone under extensive management

Agro-ecological zone	Crop residues 10 ⁶ kg dry matter				Carrying capacity UBT
	Cereals	Pulses	Total	Useable	
Sahel	499	11	510	170	301 954
Sub-Sahel	873	99	972	324	575 488
North Sudan	3 931	431	4 362	1 454	2 582 591
South Sudan	1 872	170	2 042	681	1 209 591
Total	7 175	711	7 886	2 629	4 669 624

(Adapted from Savadogo, 2000)

and have a higher energy value than cereal stover. The table brings out the poor digestibility of cereal residues. It would be advisable, therefore, to improve the chemical characteristics of cereal residues by, for example, urea treatment or supplementing them with multi-nutrient blocks (Chenost and Kayouli, 1997). It is important to address the improvement of utilization of crop residues since their availability is increasing year by year to the detriment of natural grazing.

Fodder crops

Improving the availability and quality of forage has been a preoccupation for those responsible for animal husbandry since the 1950s in Burkina Faso. Several research and extension campaigns have been carried out such as:

- The Extended Technical Aid Programme of FAO – in 1950 about twenty grasses and legumes were tested in the livestock stations of Samadéni, Banakaga and the grounds of the livestock service at Bobo-Dioulasso;
- A trial programme on grasses and legumes was undertaken in 1965 on the Makoye station in the Sahel;
- The fodder crop programme of the Institut de Recherches Agronomiques Tropicales (IRAT) began its introduction trials in 1961 on the stations of Saris (north Sudanian) and Fako-Ba (south Sudanian);
- Trials on fodders were carried out between 1971 and 1985 at the Kou valley and Sorou by the Centre d'Expérimentation sur le Riz et les Cultures Irriguées (CERCI);
- Trials were done at Bané by the Autorité de l'Aménagement des Vallées des Voltas (AVV) sur des espèces fourragères améliorantes à Bane (south-east);
- The sub-regional CILSS-FAO programme « Développement des cultures fourragères et améliorantes » covered the Sahelian zones of Burkina-Faso, Mali and Niger.

More recently the Institute for the Environment and Agricultural Research, the International Centre for Livestock Research-Development in the Sub-Humid Zone and the Programme for Supporting Pastoral Development have tested or extended fodder crops at the national or regional level.

Table 6. Nutritive value of crop residues

Residue	OM (% DM)	CP (% OM)	ME (MJ/kgMO)	Digestible OM
<i>Haulms of pulses</i>				
Cowpea	88–92	13.9–21.7	9.2–11.7	58–74
Groundnut	85–90	8.5–25.3	8.7–10.8	55–68
Bambara nut	84–92	5.5–10.1	7.9–9.5	50–60
<i>Stovers and straw</i>				
Maize	87–95	4.6–6.5	6.3–8.7	40–55
Bulrush millet	89–93	4.8–9.3	4.6–10.0	29–63
Rice	77–86	2.3–8.6	6.7–9.0	42–57
Sorghum	90–94	2.8–7.0	6.8–10.3	43–65

OM = organic matter ; DM = dry matter ; CP = crude protein ; EM = metabolisable energy estimated from the digestible organic matter (1 g of DOM équivalent to 15.8 kJ EM).
Source: Savadogo (2000).

Table 7. Forages adapted to different agro-ecological zones

Agro-ecological zone	Grasses	Legumes
Sahel (< 400 mm)	<i>Andropogon gayanus</i> <i>Cenchrus ciliaris</i> cv <i>Biloela</i> <i>Cenchrus ciliaris</i> cv <i>Gayndah</i> <i>Pennisetum pedicellatum</i>	<i>Alysicarpus ovalifolius</i> <i>Macroptilium atropurpureum</i> <i>Macroptilium lathyroides</i> <i>Stylosanthes hamata</i> <i>Vigna unguiculata</i>
Sub-Sahel (400–600 mm)	<i>Andropogon gayanus</i> <i>Pennisetum pedicellatum</i> <i>Sorgho fourrager</i> R10 <i>Zea mays</i> GC4 (fodder maize)	<i>Alysicarpus ovalifolius</i> <i>Lablab niger</i> <i>Macroptilium atropurpureum</i> <i>Mucuna</i> sp. Fodder cowpea IAR7 Fodder cowpea IT80D994
North-Sudan (600–900 mm)	<i>Andropogon gayanus</i> <i>Panicum maximum</i> C1 <i>Pennisetum pedicellatum</i> <i>Rottboelia exaltata</i> Fodder sorghum R10	<i>Aeschynomene histrix</i> <i>Crotalaria intermedia</i> <i>Crotalaria juncea</i> <i>Lablab niger</i> <i>Mucuna</i> sp. <i>Mucuna pruriens</i> cv <i>utilis</i> Fodder cowpea IAR7 <i>Stylosanthes gracilis</i> <i>Stylosanthes guianensis</i> CIAT 136
South-Sudan (> 900 mm)	<i>Andropogon gayanus</i> <i>Brachiaria ruziziensis</i> <i>Cenchrus ciliaris</i> cv <i>Biloela</i> <i>Chloris gayana</i> <i>Echinochloa stagnina</i> <i>Melinis minutiflora</i> <i>Panicum maximum</i> C1 <i>Pennisetum purpureum</i> , cv <i>Napier</i> <i>Sorgho fourrager</i> cv « Rio » <i>Zea mays</i> GC4	<i>Aeschynomene histrix</i> <i>Cajanus cajan</i> <i>Centrosema</i> spp. <i>Lablab niger</i> <i>Neonotonia wightii</i> <i>Macroptilium atropurpureum</i> <i>Macroptilium lathyroides</i> <i>Mucuna</i> sp. <i>Phaseolus aureus</i> <i>Stylosanthes hamata</i> cv <i>Verano</i> <i>Stylosanthes guianensis</i> CIAT 136

Of the forages tested from 1950 to date, those adapted to the eco-climatic conditions of Burkina Faso are shown in Table 7. Despite these interesting results, the development of fodder growing is very timid. Only dolichos (*Lablab niger*), dual-purpose cowpea and velvet bean (*Mucuna* sp.) have been well enough accepted by the producers. Despite everything the area sown to fodder crops remains very small, under a ha for those farms which grow it. In the planned pastoral zone of Nouhau, Sanon (1987) found a mean size of individual fodder plots between 0.25 and 0.5 ha, with a yield of 3.5 tonnes/ha.

There are three major kinds of obstacle to taking up fodder growing: the problem of land rights, the problem of time in the agricultural calendar and the problem of seed supply. The scarcity of land favours cereal growing not perennial forages. In an uncertain climate like the sahelian and sub-sahelian zones the producers risk avoidance strategy must give priority, if not exclusive attention, to food crops. This is why farmers in these regions accept dual-purpose cowpea more readily than purely fodder crops.

The agricultural calendar for fodders is almost the same as that of cereals; there is, therefore, a clash of demand for labour and the fodder loses out.

Finally the poor availability of seeds is the main constraint to developing sown fodders. The demand is far greater than the supply and the price of imported seed is prohibitive. The thrust of any fodder programme must master seed production. Such a programme should target peri-urban dairy and fattening systems, agropastoral systems with some dairy cattle, fattening stock or those having draught animals in planned pastoral zones.

6. OPPORTUNITIES FOR IMPROVEMENT OF FODDER RESOURCES

Planning pastoral zones. The Government strategy is to sedentarise transhumant herders, make pastoral stock raising more secure, improve herd productivity and manage natural pasture rationally. This approach had its origins in the ecological crises which have taken place in the Sahel since the nineteen sixties when great droughts killed more than 30% of the national herd and ruined many herders (Meyer, 1989).

An appraisal of 25 years of planning pastoral zones shows certain advances but inadequate insofar as security of tenure and pasture management are concerned. The work has mainly consisted in physical demarcation of zones, installation of stock-raisers, installation of infrastructure for water supply, disease control, tracks, fire-breaks and farmsteads. These works permit the utilization of the pastoral land and its fodder resources.

Development of laws guiding pastoralism. Insecurity of land tenure is the major constraint facing pastoral stock-rearing in Burkina Faso (Ministère des Ressources Animales, 2000). This is shown by:

- an advance of the agricultural frontier by over 3% annually (especially in the bottom lands), thus depriving the herds of dry season grazing land and water points;
- a reduction in the total area of pasture;
- blocking stock routes;
- more frequent conflicts between stock-keepers and farmers.

Faced with such a situation the Ministry of Animal Resources has undertaken, with assistance from UNDP and FAO, a process of developing a law to orient pastoralism. That law aims to establish the principals and judicial modalities which will favour sustainable, peaceful, integration of agro-silvo-pastoral activities.

Operations on mowing and conserving natural fodders. Since 1988 the Ministry of Animal Resources has developed and put into operation a vast programme on the conservation of natural herbage. This operation which is on a national scale aims to popularise the techniques of turning and sun-drying, baling and storage in hay-sheds of both natural and cultivated forage. This contributes to saving some forage from the bush fires and to providing stock with quality fodder. It also allows stock-owners to

manage their fodder stocks rationally thanks to their being able to quantify them and make more accurate estimates.

During the campaigns of 1999 and 2000 the amount of forage stored within the framework of that operation was, respectively, 7 900 and 4 500 tonnes of hay. Regarding these insignificant quantities it can be said that there is room for progress and that the extension effort should continue.

Growing fodder legumes with cereals. Despite the positive results of trials and specific extension programmes, fodder crops *sensu stricto* have hardly been taken up by farmers for reasons given above.

To get round the land and labour problems trials are being carried out on mixing fodder legumes with cereal crops. So the Netherlands development agency in collaboration with the Direction Régionale des Ressources Animales des Hauts Bassins, has been testing maize-dolichos (Traoré and Coulibaly, 1999).

7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

Institut du Développement Rural / Université Polytechnique de Bobo-Dioulasso

It is responsible for training the upper levels of rural development staff, engineers in agriculture, animal husbandry and forestry. It also carries out research on several aspects, including fodder.

Contact: Prof. Chantal Kaboré-Zoungrana. Animal nutrition specialist who is working on the chemical composition and nutritive value of herbaceous and woody fodders.

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Centre International de Recherche-Développement sur l'Élevage en Zone Subhumide (CIRDES).

01 BP 454 Bobo-Dioulasso 01, Burkina Faso. Tél. (226)97 22 87

The CIRDES is a sub-regional research organisation dealing with combating trypanosomiasis, including trypanotolerance and the destruction of vectors. It thus contributes to clearing the Sudanian pastures of tsetse fly. That centre also works on fodders.

Contact: Augustin Kanwe, biochemist, nutritionist.

Institut de l'Environnement et de Recherches Agricoles (IN.E.R.A.). 03 BP 7192 Ouagadougou 03, Burkina Faso. The INERA is the national institution which undertakes livestock research. Its animal production department does, among others, research on pastoralism and fodder resources, (natural pastures, fodder crops, crop residues).

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Ir Hadja Oumou Sanon, works on pasture survey and seed production of fodder crops.

Development organizations

Direction des Aménagements Pastoraux et du Foncier (DAPF). In charge of policy and monitoring of matters concerning transhumance, pastoral planning and development.

Contact<: Ir Salifo Tiemtoré, Directeur. 01 BP 03 BP 7126 Ouagadougou 03, Burkina Faso ; Tél. (226) 31 74 45 / 31 10 76 ; Fax (226) 31 84 75.

Direction de la Production et des Industries Animales (DPIA).

This directorate has amongst its activities intensification of fodder production to complement intensified livestock production systems (peri-urban dairying, fattening cattle and sheep). It encourages fodder growing and conservation of both sown and natural forage.

Contact<: Ir Michel Ouédraogo, Directeur, 03 BP 7126 Ouagadougou 03, Burkina Faso.

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Programme d'Appui aux Aménagements Pastoraux (PAAP)

This programme, financed by the Government and the seventh FED, has for its aim the improvement of pasture development by the elaboration of norms and technical reference systems. It also contributes to fodder crop extension and support to seed distribution.

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