Milk production in Cameroon: *A Review*

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Abstract

For centuries, milk production in Cameroon has been characterized by the traditional system using local zebu cows (Gudali, White Fulani, Red Fulani). However, this production has been insufficient reaching only an average of 3 litres per cow per day. Per capita annual consumption was 10 kg in 1984. Since then improvement in production has been possible thanks to importations of high yielding breeds such as Holstein Friesian, Jersey and others. This gave room to other semi intensive and intensive production systems in such a way that in 1998 per capita production was 12.8kg. This is still far below 34 kg per person for Africa and 294 kg per person for Europe. In this study, research done in the area on milk production was reviewed. Constraints to increase production were summarized and proposal are made for the sustainable development of the dairy sector

Résumé

La production laitière depuis longtemps au Cameroun a été caractérisée par un système d'élevage traditionnel utilisant les animaux zébu locaux (Gudali, Red Fulani, White Fulani). Mais cette production a été jusque là insuffisante ne dépassant pas 3 litres par vache par jour de lactation. La consommation annuelle était de 10 kg par personne par an en 1984. Depuis lors des améliorations ont été faites par beaucoup plus d'importation de races laitières d'origine européenne telles que Holstein Friesian, Jersey et bien d'autres encore. Ce qui a donné naissance à d'autres systèmes d'élevage laitier semi intensifs et intensifs de telle sorte qu'en 1998 la production annuelle à été de 12.8 kg par personne. Ceci est encore en dessous de 34 kg par personne pour le continent Africain et 294 kg par personne en Europe. Dans cette étude, les travaux de recherche ont été revus, les contraintes à l'augmentation de la production laitière au Cameroun ont été relevées et des propositions faites pour une amélioration rapide et durable du secteur laitier dans le pays.

Introduction

Africa's human population is growing at a rate of 3.1% per year (Ndituru, 1993). This population growth is prompting many governments to aim at a policy of food self sufficiency. Although efforts are being made to increase agricultural production, malnutrition is still a plague in many parts of the continent. Protein and micronutrients deficiencies continue to be persistent (Delgado *et al*, 1999). Over 800 million people worldwide suffer from malnutrition and hunger not only due to low food production and unequal distribution but also because poor people lack the income to acquire adequate quantities and qualities of food (Wilson *et al*, 1995). People of Sub-Saharan Africa consume foods that consist mainly of starch and oil. Milk and milk products, if sufficiently available, could efficiently correct these deficiencies and be part of most Africans' diet. Besides improving nutrition and health of all members of the household, dairying also increases farmers' incomes (ILRI, 1998). However, in 1999, per capita production of whole fresh milk in Africa was only 34 kg /person compared to 294 kg / person in Europe (adapted from FAO, 2000) with very large variations of consumption among regions of the same country. Such a deficit makes milk products expensive and not available to most people. This is seen in urban areas where prices go up in the hot season because of the shortage of milk from pastoralists (Kameni *et al*, 1999). The consequence of high prices is the reduced availability of milk products for vulnerable groups (Phelan, 1994). These are children and people of low income. On the other hand the milk deficit calls for imports of milk products thus leading to a considerable drain on finances. Von Massow (1984) drew attention to the increase in the volumes and values of dairy imports into Sub-Saharan Africa even though these countries faced a serious shortage of foreign exchange. Dairy imports made up about half the total milk consumption in West and central Africa (Von Massow, 1989), increasing throughout the 1970s and early 1980s, at an annual growth rate of 10% or more. Consequently, there are sustained efforts to develop domestic milk production in Sub-Saharan Africa (Walshe *et al*, 1991). Formal research on dairy cattle started in Cameroon in the early 1970's (Tchoumboue and Jousset, 1982) on imported and local cattle. However, there is no comprehensive report available providing information on the key aspects of the research done on this topic in Cameroon to this day. In Sub-Saharan countries, because of inadequate available literature, there is always a risk of duplicating research and therefore wasting time and resources. There is also a need for information to be gathered on the subject and made available to policy makers. Consequently, this paper reviews and discusses work carried out in Cameroon in relation to dairying, suggesting ways to improving the sector and proposing lines for subsequent research.

Sites of dairy cattle production in Cameroon

The Republic of Cameroon is located in Central Africa and ranges from the equatorial forest to the Sahelian zone in Lake Tchad with a total land area of 475 440 km^2 and a human population of 14.693 million (FAO, 1999). The population is expected to reach 20.5 million in 2010 (CIRAD-EMVT, 1995) It is administratively divided into 10 provinces covering five agro ecological zones. The cattle population stands at

6 million heads. Over 90% of the estimated cattle number is to be found in four provinces, the Far North, the North, the Adamaoua and the North West Province (Kameni *et al*, 1999). The two provinces that have been particularly associated with dairy production in Cameroon are as follows:

The Adamaoua Plateau is situated at 1100 m above sea level. Weather conditions have been reported by (Pamo and Yonkeu, 1986). The climate is tropical, usually described as sudano-guinean, with a characteristic unimodal rainfall pattern. Two major seasons are prevalent, the wet season which runs from April (mean precipitations of 128.8 mm) to October (107.2 mm) and the dry season from November to March. The maximum monthly rainfall ever recorded was 325.6 mm and occurred in July. Total annual precipitation ranges from 1392 to 1982 mm per year. Mean relative humidity and temperature are 0.673 and 22.0^{o} C, respectively. Minimum and maximum temperatures are 10 and 34^{o} C, respectively. The hottest months are from November to January. Frost is rare on the highlands.

Natural vegetation is woody savannah. It is a sudano-guinean type which is interspersed with *Daniellia* and *Lophira* spp. trees. Major grasses have been described by Piot and Rippstein (1975) with predominant species being *Hyparrhenia* and *Panicum* spp.The principal improved pastures developed on station are *Brachiaria* and *Stylosanthes* spp.

The Western Highlands, another dairy producing region, is located in the mid and high altitude zone of the country which lies between latitudes 5°20’ and 7° North and longitude 9°40’ and 11°10’ East of the Equator. The surface area of the Province is 17,910 km2 covering 1/6 of the country’s land area. Altitudes range from 300 to 3000 m above sea level. The climate distincts itself with a dry season from November to mid March and a rainy season from mid March to October. Rainfall ranges between 1300-3000 mm with a mean of 2000 mm. Minimum and maximum temperatures have means of 15.50°C and 24.5°C respectively although temperatures can go above 30°C. There are three types of soils: volcanic, hydromorphic and ferralitic. The human population is estimated at 1.82 million inhabitants, being of one of the highest population densities in the country, with at least 79 inhabitants per km ^{2} and a population growth rate of 3.1% (Winrock International, 1992). The agricultural population is estimated at 72% with 160,025 farm families. Agricultural products from low to medium altitude include: oil palm, cocoa, Robusta coffee, fruit trees, cocoyam, maize, small livestock, rice, groundnuts. The high altitude (above 1400m) products include: solanum potato, Arabica coffee, vegetable and small and large ruminants (PNVRA, 2002).The province is the third major cattle producing area (500,000 cattle) after the North and the East. The main vegetation is Savannah. Pastures are dominant with *Sporobolus africanus*. But the following species can be encountered: *Pennisetum clandestinum* and *Pennisetum purpureum, Loudetia, Hyparrhenia, Urelytrum fasciculatun, Panicum phramitoides, Paspalum arbiculare*. Some improved species have also been introduced such as *Brachiaria spp, Trypsacum laxum, Stylosanthes spp* and tree legumes (Merlin *et al*, 1986; CIRAD-EMVT, 1995). The Western Highland of Cameroon is an area free of Tse Tse fly.

Traditional dairy production

In Africa, pastoralists derive up to 75% of their food needs from milk (Galvin, 1985). These pastoralists own about 50% of Africa's livestock (de Leeuw *et al*, 1995). In Cameroon, they own most of the cattle population. According to Kameni *et al* (1994), most of the available cow's milk in Cameroon is produced by the Fulani cattle men. In the Fulani tribe, cattle production is the main activity. Their life revolves around this activity and most of their income is derived from it. Crop production is marginal and is carried out by occasional labour. The cattle men practice a pastoralist type of management whereby cattle are held in the vicinity of the village or urban area during the wet season, and then taken to lower pastures during the hot months in search of better grazing (Douffissa, 1993). In this traditional system, milk is considered as a by-product of beef production using breeds such as the Gudali, Red Fulani and White Fulani (*Bos indicus)*. More than 90 % of calvings occur during the rainy season (Njoya *et al*, 1999). Milk off take starts from 1 to 3 months post-calving. Calves are usually weaned at 10.5 months. A number of lactating animals are left on the camping area while the rest of the herd is taken for grazing. Milking is all done by hand and any milk not required by the owners is either boiled and sold as liquid milk or allowed to sour naturally to provide a base for a sorghum or maize porridge (Kameni *et al*, 1999). The milk can also be used for exchange for grain. When cattle herds reside around urban centres, they represent the major, perhaps only, source of fresh milk for urban dwellers. When cattle herds reside in remote areas, only a very limited amount of milk might occasionally be sold for cash because the camping areas are usually far away from urban centers and schools. So a major constraint on the supply of milk to urban populations is the effective marketing of the supplies of milk potentially available from pastoral herds. An added complication is that the demand for milk in the urban centres is greater in the dry season than in the wet season. However, in the dry season with cows being on transhumance, pastoralists are unable to take advantage of this increased demand while in the wet season, when cattle herds may be adjacent to urban centres, demand for milk is low and prices are depressed. The opportunity to capitalise on the demand for milk, coupled to the need to promote more productive dairy systems, has led to the importation of European type dairy cattle.

Introduction of exotic dairy cows in Cameroon

The first exotic dairy cattle were imported into Cameroon in the 1930s (Tambi, 1991) by expatriates. They were of the German Brown breed (Atekwana and Maximuangu, 1981). At the end of the Second World War, these cattle were replaced with Holstein Friesian cattle and an Austrian breed (Pinzgauer) in Buea. At the same time, the Montbéliard breed was introduced in Dschang and Jakiri for crossbreeding with local cattle. In 1964, a dairy experimental station was set up at Bambui (Njwe, 1984) and in 1967 Brown Swiss heifers were imported for crossbreeding with N'Dama cattle. Montbéliard semen was imported in 1975 for crossbreeding with Gudali (*Bos indicus*) females in the northern part of the country.Immediately preceding this, the Heifer Project International (HPI) signed an agreement with the government and the importation of Jersey cattle,

Holstein Friesian cattle and semen started and continues to the present time (HPI, 1999). This same organisation has trained dairy farmers to practise a zero grazing system with Holstein Friesian cows imported from Ireland since 1994. Importations of exotic cattle resulted in the development of more specialist systems of dairying.

Semi intensive system and crop and livestock integration

These systems of dairying use crossbred cattle with improved pasture grazing and supplements such as rice bran, palm kernel cake wheat bran, soya beans etc., all in small amounts. Fencing is common as is rotational grazing.

Animals often make use of farm residues such as corn stovers, ground nuts and beans haulms, rice straw, banana forage etc. They are also supplemented with agro-industrial by products such as cottonseed cake, brewers grains and palm kernel cake and tree legumes such as *Leucaena spp* and other legumes (*Stylosanthes spp, Desmodium spp* etc.). In the Western highlands, such systems are practiced by the Tikar (native) population (Njoya *et al*, 1999).

Intensive system

Intensive systems involve on the one hand a few modern commercial farms, on the other hand the cut and carry system where animals are kept in stables and supplemented with concentrate. It is these systems which use purebred high yielding dairy cows (HPI, 1999). Small farmers suffer however from a very heavy work load because of the lack of machinery. Efficient ways of management need to be developed in order to lighten this burden.

Productivity of breeds used for milk production

Nearly all milk production studies done in the country have been geared towards cattle which supply the majority of milk. The common traditional breeds involved in dairying are the *Bos indicus* Gudali, Red Fulani and White Fulani. Their production levels are indicated in Table 1. Tawah and Rege, (1996) reviewed information on White Fulani cattle related to the breed's physical characters and production parameters. They described its distribution and husbandry practices and concluded that the breed is economically important for several communities in West and Central Africa. Although the population size of the breed is large, crossbreeding with exotic and local breeds poses a long-term threat to this breed. Abassa *et al* (1993), then Bayemi (1999) investigated growth performance records of Gudali cattle. The latter developed models related to the growth of calves and heifers as a help to selection. The Red Fulani breed is found in many countries of West and Central Africa; Nigeria, Chad, Cameroon, Niger and the Central African Republic. They are extremely hardy and adapt to a wide range of conditions particularly to arid zones (Maule, 1990).

These local breeds have been crossed with European *Bos taurus* breeds, including the Holstein Friesian, Jersey and Montbeliard (Mbah *et al*, 1987; Tawah and Mbah, 1989; Mbah *et al*, 1991; Tawah *et al* (1999a).

Tawah *et al* (1998) studied the fixed effects of genotype, parity, age at calving, season and year of birth of cows on lactation and reproductive performance. Traits analysed were lactation milk yield, lactation duration, annual milk yield, calving interval, dry period and age at first calving. They found as expected, that in Cameroon, Holstein cows produced more milk than any other breed, exotic or local. Holstein F1 crosses were also better than any other crosses in the same trait. The season of birth of cow also significantly affected the age at firs calving. This means that female calves born in times of hardship, dry season, took much longer to take in a calf. Is it not an indication for the need of breeding cows for particular calving periods if it is economically proven that this is beneficial? Tawah *et al* (1999b) also studied the genotype and environmental factors of crossbreeding the local Gudali zebu cows with either Montbeliard or Holstein bulls. Their study confirmed reports that F1 crosses are superior to their backcrosses in milk production in harsh tropics. The results further revealed that Holstein x Gudali F1 cows were better Montbeliard x Gudali F1 in milk production and reproductive performance. The performance of F2 was lower than F1 in milk production and age at first calving suggesting that they may be recommenced for the development of synthetic dairy breeds through *inter se* mating of he F1 genotypes coupled with selection. The authors recommended that Montbeliard x Gudali crosses be used for dairy-beef production systems because of their dual purpose nature while Holstein x Gudali crosses may be better suited for moderately intensive dairy production systems on the Cameroon Highlands and similar environments. Kamga *et al*, 2001 working with Holstein, Jersey and their crosses with Gudali confirmed the suitability of Holstein x Gudali crosses for milk production in Cameroon.

Domestic milk production and demand

In Cameroon, the livestock sector represents 16% of the agricultural production in terms of Gross Domestic Production (MINPAT, 1986) and is dominated by large ruminants. The country has 6 million cattle with 4% milking cows (Figure 1: FAO, 2000). The total number of cattle has been consistently increasing for over 30 years.

However, the percentage of milking cows relative to the total number of cattle has considerably decreased, particularly in the late 1970's. Milking cows considered were those which have been milked even if the milk was subsequently given to the calf. This definition does not concern milk suckled by calves (FAO, 2000). This drop may have been due to the fact that for eight years, from 1971 to 1979, the total number of cows sold to neighbouring countries was nearly three times more (53,972 heads) than the number exported during a period of 12 years after that date (18,830 heads;1980 to 1992). This exportation was done irrespective of gender.

The increase in number of lactating cows in the 1990's may have been due to the new surge towards high yielding imported cows to increase domestic production. Annual per capita of milk production in Cameroon was estimated at 5.1 kg (MINPAT, 1986) while consumption was estimated at 10kg / person / year by Von Mason (1984). Total domestic production of milk was 50.000 tons (Tambi, 1991). In 1999, per capita

production stood at 12.8kg while per capita consumption was 15.3 kg in 1998 (calculated from FAO, 2000). In fact milk production in the country has substantially increased (from 48 000 tons to 184,000 tons) although this increase is not fully reflected in the quoted figures as population has increased over this period from 10 to 14.7 million inhabitants. However, the production is far from satisfying local demand for milk and milk products. Since the devaluation of the CFA Franc by 100% in 1994, the price of imported milk and milk products has more than doubled. Teuscher *et al* (1992), estimated the level of imports of milk and milk products was 11480 tonnes, which represented about 50% of the adults per capita consumption. The low per capita consumption in subsequent years (less than half of Africa's) reflects the limits in imports of dairy products in the country, standing only at 23% of total per capita consumption. Consequently, local milk can compete with imported products. In the past, the availability of cheap products in international markets supported low consumer prices in the country. Approximately 50% of the population are urban dwellers. Figure 2 shows that although urban population is rapidly increasing, imports of milk have slowed down. This trend was confirmed by ILCA (1993). On the positive side, the present situation creates an extraordinary opportunity for dairy development. Already, many small peri-urban farmers are selling fresh milk at 200F per kg (0.3 $US). This is the retail price recommended by Pingpoh (1985) who suggested that in order to make the dairy business profitable, the price of milk be increased by over 50%, from 140 CFA (1/5 $US) to 214 CFA / kg. This reality has led some peri-urban farmers to use purebred Holstein Friesan Cows. In order to maximize profit, these animals were imported for commercial production in increasing number over the last five years. For a sound and progressive development of the sector, dairy cooperative and societies have been formed (e.g. the "Projet laitier" in Ngaoundéré, Adamaoua in the Northern part of the country and TADU dairy cooperative and Bamenda Dairy Cooperative Society in the North West). A private dairy processing company, SOTRAMILK, ensures the purchase of their liquid milk.

The urban demand of milk

A study conducted by Vabi and Tambi (1995) revealed that urban dwellers had a high preference for fresh milk with a mean household consumption of 3 kg for the high-income households, 3 kg for the low-, and 2 kg for the medium-income households. Although high-income households spent more money on fresh milk compared to the medium- and low-income households, the proportion of income spent on fresh milk was lowest for the high, followed by medium- and low-income households. The authors suggested the need to organize home-based education programmes on nutrition as a strategy for boosting the consumption of dairy products among low-income households. It is therefore surprising that Tambi (1998) classified milk and milk products in Cameroon as relative luxuries and mentioned that they were considered as substitute for meat. Meanwhile low income households spent a high proportion of their money on these products.

Constraints to milk production

Traditional dairy management, though sustainable for centuries, does not supply enough milk to meet the ever growing demand. Improvement in milk production in Cameroon is possible thanks to the introduction of European type dairy breeds. Though adapting to the environment, these exotic breeds and their crossbreeds are found to be susceptible to the challenging Cameroonian environment. Constraints to dairy production are listed in Table 2.

Milk processing

Traditionally, milking was found to be carried out once a day in the morning, mainly by women and children, often with very little hygiene and sanitation. The calf is allowed to suckle in order to induce milk let down in the zebu cows. The milk is low is microbial quality. Therefore it lasts for 3 to 4 hours at room temperature (ambient temperatures are 30 to 35^{o}C) in the northern part of the country. In the Western Highlands where temperatures are moderate (18 to 22^{o}C) the shelf life of milk is slightly longer. Traditional processing is carried out by women. Various locally made milk products can be seen in markets and shops in urban areas of Cameroon. Kameni *et al* (1999) investigated milk products found in Cameroon and classified them as those from traditional or modern processing methods (Table 3). The latter are used by processing plants Sotramilk and Projet Laitier. Another dairy plant in being built at Tadu near Kumbo. These plants are not running at full capacity but ensure that seasonal volumes of surplus milk are efficiently utilized.

Imele *et al*, 1999 determined the composition of milk from White Fulani cows (Table 4). It might be better for the same work to be carried out with other breeds.

Kameni *et al* (2002) worked on suitable temperature and time for proper pasteurization of milk under local conditions in Cameroon. They recommended that at household level, milk should be heated to at least 74 degrees Celsius for more that 10 minutes to ensure safe milk supply in the country. Kamga *et al* (1999), attempted to determine the time of maturation of cream for obtaining butter of higher quality and good yield. They suggested that cream should be matured for not more than 30 hours by farmers who have no refrigeration facilities (this period ensures better quality and yield of butter) and 7 hours by those who intend to use refrigerators. Lower temperatures led to earlier maturation of cream, better yields and quality. A number of other studies dealt with cheese. Kameni *et al* (1994 and 1998)) studied the production of cheese in Cameroon. Studies of Bafut cheese showed that a typical Bafut cheese is hard, cylindrical and of 2 kg in weight and covered with a dry, hard rind formed by moisture loss during maturation. Its properties are indicated in Table 5.

Furthermore, Kameni and Imele (1997) demonstrated that heat treating raw milk increased wet yield and recovery of total solids of local Edam-type cheese. Milk was heated to experimental temperatures up to 90 degrees Celsius and immediately cooled to 32 degrees Celsius. Milk gel setting time increased from 30mn to 165mn with corresponding experimental temperatures of 32 and 90 degrees Celsius respectively. These results

imply the need to understand detailed local processing method for cheese making in order to give proper recommendations to farmers. If the milk is not heated, the resulting cheese might be high in microbial contents. In contrast if the milk is heated above 70 degrees Celsius, coagulation time might be too long.

Technologies for local milk processing at household level might be of great importance for remote areas where marketing of liquid milk is a problem. Milk can be transformed and the products transported to urban areas. However, stress should be put on hygiene for the products to be properly accepted.

Marketing

In the dry season, market demand in Cameroon for milk products is very high but milk is scarce because cattle are on transhumance. Even when milk is available, the lack of refrigeration at farm level forces producers to make and market their products every day. The marketing system is mainly informal. In Garoua, there are large herds of cattle and a lot of milk in the rainy season. Women carry the milk products on their heads and walk around town to retail them. In Maroua where milk output is low, dairy products are expensive because of traditional form of management, and a special site has been provided for the sale of milk in the main market. In Bamenda, milk collection is done in main axes with refrigerated vans by Sotramilk. This is a dairy plant collecting in January 100 litres per day and in September-October (peak), 500liters per day. They use blend and reconstituted milk to make their products (Mbanya *et al*, 1995). In order to ensure better marketing for their milk, farmers constitute themselves in cooperatives. Tambi and Vabi (1994), surveying one of the cooperative dairy farmers said that the financial responsibility of household head (gender), input cost, and price significantly influence market supply. They stated however that price is relatively inflexible to changes in market supply.

The way ahead

Favourable factors for improved milk production were already outlined by Makek (1980). Moreover, the republic of Cameroon owns a large cattle population. Traditionally, livestock farming techniques have remained largely as they have been for centuries (Pradere, 1982). Although is seems difficult to bring much improvement in the pastoral system, it is still necessary to assist theses farmers particularly in the area of health control and milk hygiene, so that the products marketed will be safe for the public. Many regions still depend on them for the supply of milk. The Cameroonian climate is appropriate for good pasture development. Some areas, especially in the Western Highlands, are free of tse tse fly and are therefore very suitable for dairy development. Although the performance of high producing breeds imported to Cameroon is lower than their genetic potential, it is still far above that of local breeds. These animals are therefore suitable for milk production in the country.

Enough work has already been done on crossbreeding local with exotic dairy breeds as cited in the present paper. These studies have recommended upon the use of F1 progeny. But because of the lack of a stabilised breed, there is a dependence on imported bulls or semen and artificial insemination. This leads to the

lengthening of the calving interval in times of unavailability of imported semen and artificial insemination technicians. The dependence on imported semen has the advantage of farmers benefiting from genetic progress made in developed countries. However, as in the present situation, unplanned crossbreeding may lead to the disappearance of local breeds. Therefore, there is a need for research to tackle the preservation of local cattle genetic resources in the country. By characterising, selecting and breeding local purebreds for meat production in order to lead to dual purpose F1.

Little work has been done on nutrition using available local material. This is another area where research in needed. Particularly adapting research done in similar environments in other countries to Cameroonian conditions. The existence of dairy plants confirms the fact that there is a market for dairy products in the country. But usually, the price paid to farmers for fresh milk could be better if farmers where efficiently organized in sound cooperatives instead of scattered small groups.

Much research is needed to study efficient methods of transferring research results to farmers. Some extension work on dairying have been accomplished by non governmental organizations which offer a credit scheme to farmers to own dairy cattle, but the number of in-calf heifers is still very limited. There is an urgent need for the government to assist dairy farmers in this line. In fact, there seems to be serious obstacles to dairy development unless the government organizes and subsidized at least in part, the sector. Such a limited involvement of the state has helped small scale dairying to be successful in countries such as India.

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Table 1: Summary of breed performance of animals used for milk production in Cameroon

(Suggest that this should be in Landscape format, and to expand the columns)

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Breed	Bith weight (kg)	Daily gain from 13 to 41 weeks (kg)	Age at 1st Calving (days)	calving rates (%)	Calving internal (days)	Lactation length (days)	Number of Insemina ti-on per concepti on	Milk yield per day of lactation (kg)	Milk yield (kg)	Mortality from birth to 36 months (%)
Gudali(G)	22.5[a]	0.35[a]	1440	75	511	140			373	3.5
Red Fulani(RF)	21.5[a]	0.43[a]		76.9[b]		114[b]		2.4[a]	513[b] 295[a]	4.7[c]
White Fulani(WF)	22.3[a]	0.27[a]		76.1	444	175		2.8[a]	536 465[a]	4.6
Jersey(J)	16.8[a]	0.39[a]	924	79.5	419	315		8[a]	2681	8.9 to 26
Boran(B)			600[e]				2[e]		315[5]	
Holstein(H)	32.7[a]	0.44[a]	964	75.4	472	329	2.4[e]	11.5[a]	3202[a] 3471[b] 4750[e]	12.7 to 38
HXG(F1)			780	78.9	399	282			1575	6.3 to 20
HXRF(f1)			927	87.5	403	221			1551	5.8
JXWF(F1)			1077	78.8	382	189			1011	5.6 to11.5
MXG(F1)			1140	82	399	258			1380	44

[a]IEMVT (1975/76); [b]IRZ(1982,1983,1984,1985)[b];[c]Mbah *et al*(1987); [d]Tawah and Mbah (1989); [e]HPI(1999);

Figure 1: Production patterns in Cameroon

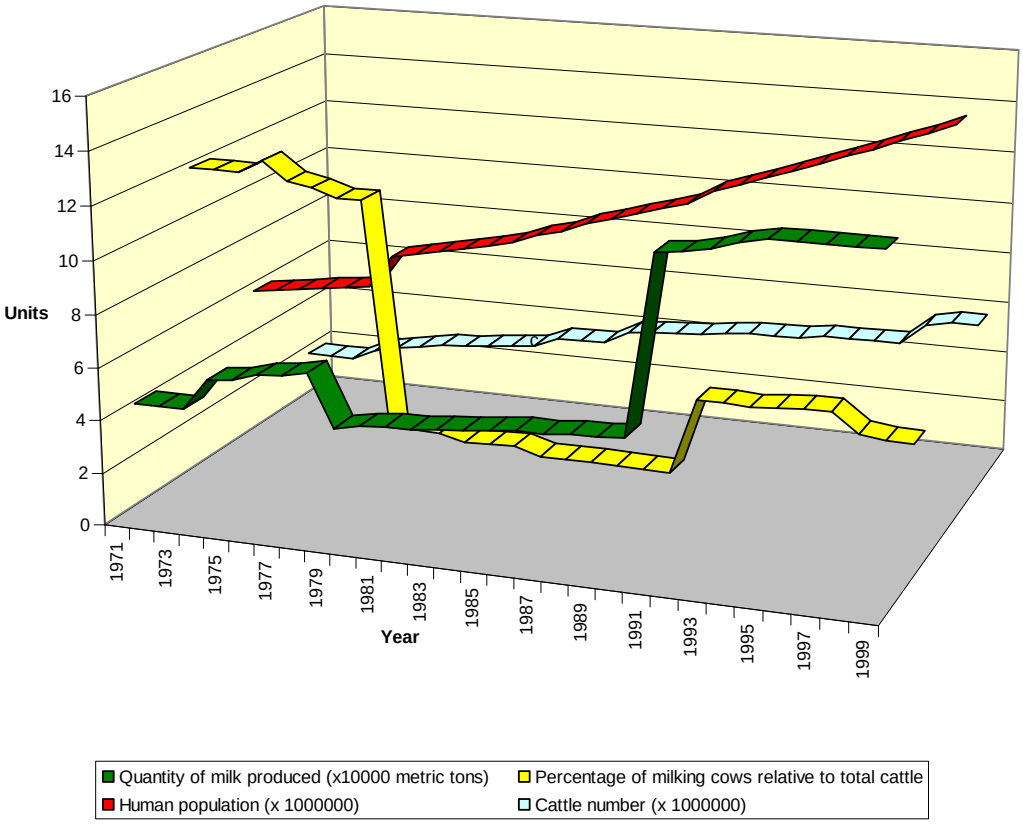

Figure 2: Dairy products imports relative to urban population

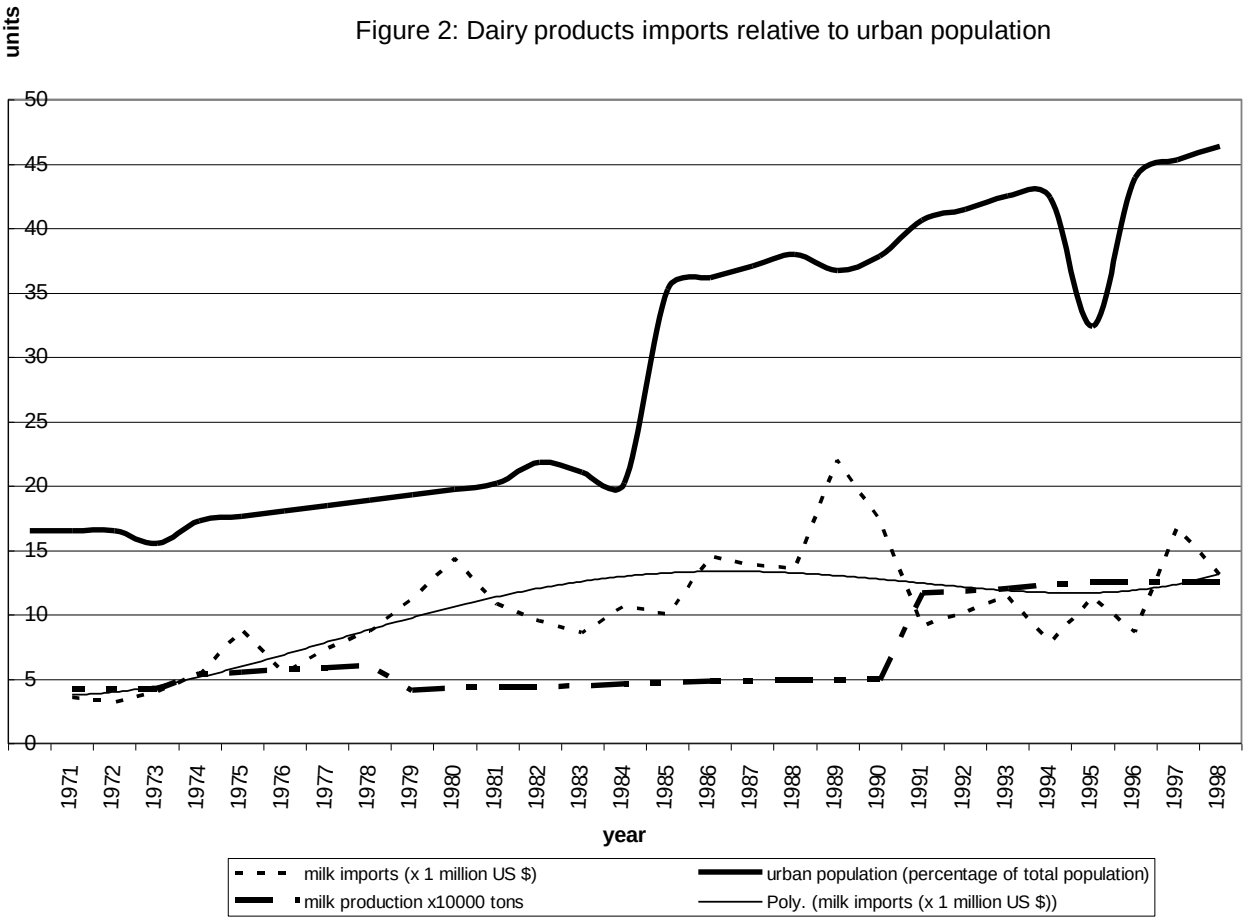

Table II: Tabulated constraints to dairy cattle in Cameroon

	CONSTRAINTS	SOURCE
NUTRITION	1. Traditional grasses are of low nutritive value and demand adequate supplementation; in February, native *Sporobolus africanus* only contains 4.5 % crude protein on a dry matter basis. 2. There is inadequate pasture management. Some areas are densely populated,leading to insufficient grazing land. Consequently many dairy farmers endeavour to cultivate grass.	Njoya *et al* (1999)
BREEDING AND MANAGEMENT	1. Unavailability of good dairy breeds. Many people wish to get involved in dairy business but either they do not find dairy heifers for purchase or more often they are very expensive to be bought on cash. Some NGOs give loans to farmers in this line, to be paid in kind with a heifer or a bull of the same breeds 3 years later. 2. There is a long calving to conception period with a mean of 185 plus or minus 105 days. Moreover, the calving interval is long meaning that there is a great need of increasing reproductive performance on farms. 3. In improved systems (semi intensive and intensive) there are problems with heat detection and low A.I. success rates.	HPI (1999) Njoya *et a*l (1999)
HEALTH	1. Ticks and tick-borne diseases are an obstacle to the introduction of exotic dairy breeds. They show a high susceptibility to Babesiosis, cowdriosis and dermatophilosis. Attempts to control ticks with acaricides have been proposed. 2. Rinderpest decimate non vaccinated animals (Is this still a problem? Most of Africa is now free from Rinderpest) 3. Brucellosis 4. Haemorrhagic septicaemia	Mbah (1982 a,b) Merlin *et al* (1986) Merlin (1987) Merlin *et al* (1987) Bayemi (1991) Ndi *et al* (1991) Douffissa (1993) Staschurski (1993) Ndi *et a*l (1998) Ngangnou (1991) Ngangnou and Zoyem (1994 and 1995) Martrenchar *et al* (1995) Martrenchar and Njanpop (1994)

	5. Gastrointestinal parasites: Toxocara, Strongyloides, Coccidia Trichuris, Moniezia, Fasciola and paramphistomes infest dairy cattle. Deworming with anthelmintic was recommended	Chollet *et al* (1994)
	6. Foot and mouth disease commonly present	Ekue *et al* (1990) Bronsvoort *et al* (2002)
	7. There are inadequate veterinary inputs by dairy farmers. Most of them keep their animals indoors, because of the fear of high tick load and worm loads. Exotic breeds though highly performing are very susceptible to parasites and heat stress. Therefore in Table 1, they show very high mortality rates.	Mbanya *et al* (1995)
	8. Because of high costs of conventional veterinary medicine. Many farmers use ethno veterinary medicine	Nfi *et al* (2001)
PROCESSING MARKETING CONSUMPTION	1. Limited quantity of milk for processing and consumption in urban areas	HPI (1999)
	2. Farmers who are a long way from urban centers cannot easily sell their milk. Consequently, cows are milked once day to sustain the family needs. At farm level, there are no cooling or storage facilities for fresh milk as well as a lack of processing facilities and technical know-how. In peri urban areas there is no collection of evening milk for processing. Therefore, the milk is mainly consumed by family and fed to pet animals and calves.	HPI (1999) Kameni *et al* (1999)

Table 3: Products made from milk in Cameroon

Dairy plant	**Traditional methods (household level)**
Sweetened yogurt	Pendidam (fermented milk)
Set yogurt (natural)	Kindirmu (Set yogurt)
Stirred fruit yogurt	Heat treated milk
Stirred plain yogurt	Lebol (butter)
Cheese	Nebam (butter oil)
Pasteurized milk	Sour milk

Table 4: Composition of White Fulani cow milk

PROPERTIES	VALUE
Butter Fat	3.89±0.17%
Protein	3.52±0.21%
Total Solids	12.69±0.43%
Solids-not-Fat	8.79±0.44%

Table 5: Mean values obtained by the analysis of 12 samples of Bafut cheese.

Properties	Mean	Range
Fat	25.0	17.5-29.5
Protein	26.1	22.2-33.6
Moisture	41.6	40.3-45.1
Fat-in-Dry-Matter	42.8	38.5-49.5
Titratable Acidity	2.1	1.8-2.6
pH	4.3	3.9-4.6
Total Volatile Substances	0.09	0.05-0.15
Free Fatty Acids	0.3	0.18-0.33
Salt	1.3	1.01-1.53
Tyrosine(mg/5ml filtrate)	0.24	0.16-0.30

NB. All figures as g/100 g of cheese as consumed, except for the index of proteolysis. The figures for volatiles Substances and Free Fatty Acids have been reported as '% lactic acid'