CHAPTER 3

3. Surveys

3.1. Participatory rural appraisal of dairy farms in the North West Province of Cameroon

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3.1.1. Abstract

A Participatory rural appraisal (PRA) was conducted in dairy farms of the North West Region of Cameroon. The aim of the PRA was to have a better understanding of the prevailing dairy systems, identify problems, and set priorities for research and development that can contribute to improved systems of production. A multidisciplinary team of researchers and extension agents was constituted. It was made up of scientists of the following fields: cattle management, forage science, agro economy, veterinary, dairy technology, nutrition and extension. The research team visited farmers' groups and divided itself into subgroups for farm and village walks during which direct observations were also noted. The extension agent of the locality, key informant, gave additional information overlooked by farmers. Interviews were also carried out with other stakeholders of the dairy sector. The research team met the day following the visit to agree on a common report. Results show that five small scale dairy production systems are found in the region: transhumance, improved extensive, semi intensive, zero grazing and peri-urban. Agriculture is well integrated to dairying. Main constraints include in order of importance: poor marketing opportunities and long distances to market, limited grazing land and poor supplementation of cattle, limited health control, inadequate knowledge in processing, conservation and storage of milk, poor reproductive management and prolonged calving interval, lack of water in the dry season, poor housing, poor organization of group, limited number of dairy cows and poor record keeping. In market oriented farms, reproduction and feeding were the most important constraints. Main factors influencing dairy production are: milk collection, fresh milk price, consumer demand, genotype and management. These results suggest that much can be done to improve production by extending improved packages to dairy farmers.

Key words: Cameroon, cattle, dairy systems, milk, participatory rural appraisal

3.1.2. Introduction

Cameroon human population is growing at a rate of 5% per year (MINEPIA, 2002). There is unceasing worry to feed this population. Annual per capita of milk production in Cameroon was estimated at 5.1kg (MINPAT, 1986) while consumption was estimated at 10kg / person / year by Von Masow (1984). Total domestic production of milk was 50,000 tonnes (Tambi, 1991). In 1999, per capita production stood at 12.8kg while per capita consumption was 15.3kg in 1998 (calculated from FAO, 2000). Milk production in the country has substantially increased in the last 15 years from 48,000 tonnes to 184,000 tonnes. However, the production is far from satisfying local demand for milk and milk products. This gap in domestic demand is being over the years covered by large imports. Teuscher *et al* (1992) estimated that the level of imports of milk and milk products was 11480 tonnes, which represented about 50% of the adult per capita consumption. However, due to the devaluation of the CFA Franc currency used in the country by 100% in 1994, per capita consumption in subsequent years dropped to less than half of Africa's which is 34kg/person/year (294kg/person/year in Europe) reflecting the limits in imports of dairy products in the country, standing only at 23% of total per capita consumption. Imported products are expensive for common Cameroonians. Consequently, products from local milk can more efficiently compete with imported ones. This paves the way for a huge development in local milk production. This development will be effective if there is a detailed knowledge of the dairy production environment in the country. Interventions will be easily measured, felt and seen if they were applied in selected farms and economic effect of interventions monitored.

More than fifteen years ago (Douffissa, 1988), three cattle systems were defined in Cameroon: traditional, semi intensive and intensive. However, the economical, political and environmental conditions have drastically changed in the country. There is limited

knowledge of current milk production systems in Cameroon. What are their constraints and limitations? What stakeholders and factors influence dairy production? What is the marketing channel? What perceptions have dairy farmers in this activity and what suggestions can be given to improve dairy production in the country? What is the economic reference point of selected farms that could be used for measuring results of subsequent interventions? The following research was conceived to attempt answers to the above questions.

3.1.3. Material and methods

3.1.3.1. Dairy cattle production regions 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, 2000). The population is expected to reach 20.5 million in 2010 (Njoya *et al*, 1999). It is administratively divided into 10 regions 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 regions, the Far North, the North, the Adamaoua and the North West Province (Kameni *et al*, 1999). The two regions that have been particularly associated with dairy production in Cameroon are the Adamaoua Plateau and the North West region. The study was carried out in this region.

3.1.3.2. Participatory rural appraisal (PRA)

The Participatory rural appraisal was used as a tool to identify constraints (Bandhari, 2003) and suggest interventions geared towards promoting the sustainable development of dairy production in the North West Region of the Western Highlands Cameroon.

3.1.3.3. Selection of study area

This site was chosen because it is the most appropriate environment for dairy improvement in the country. Not only it is free of Tse Tse fly, but the region is linked to the two major towns, Douala and Yaoundé by a good road network. Temperatures are the lowest in the country therefore suitable for high yielding breeds. Milk production in this area is government priority. A dairy technology laboratory has been set in the area to improve milk processing. Furthermore, the Heifer Project International has established its head quarters in the region to closely help farmers in dairy management. On the other

hand, milk produced in the northern part of the country is mostly through pastoralists who are not very open to change in cattle management. The North West region is therefore very suitable for improvement in dairy production and was chosen consequently.

3.1.3.4. Research team and PRA method

A multidisciplinary research team was constituted with scientists of different fields as follows: a cattle and forage scientist, an agro economist, a dairy technologist, a veterinarian, an extension agent and various technicians. One researcher, a lady helped to establish links with women in communities were foreign men were not allowed to individually question women. Farmers were choosen on their willingness for long term cooperation with the research team and easy access. The team first decided on the site and farmers' group to be visited. Contact was established with the group through phone numbers or government 'zonal extension workers'. A date and time were arranged at the convenience of the farmers' group. Some food or local drinks were prepared to make the discussion free and informal. A PRA topical guideline was prepared as a semi-structured interview consisting of the following points: introduction on purpose of the meeting and visit; presentation of the team; presentation of individual farmers present; questions on cropping, cattle management, milk processing and marketing, labour, constraints and prioritization, other activities, expectations, other comments. Finally a dictation machine (tape recorder) was discretely used during group discussions to avoid writing down every piece of information. The questionnaire was translated in the very common pidgin language by a researcher, native of the area. It was pre-tested at one locality (Sabga) and readjusted for shortening the time taken for group discussions, order of questioning and few more questions were added. Sometimes there was a need to translate part of the discussion into/from local dialects. This was either done by a research team member or a member of the dairy group.

At arrival at the site the research team was welcomed by the extension agent who introduced it to the group. The team explained the purpose of the visit and initiated the discussion. The team sat in an indiscriminate manner, and mingled with farmers to create more confidence among both parties. Although a leader guided the discussion, any other scientist could intervene at any moment to ask for appropriate information that could have been overlooked. The zonal extension agent, key informant, also took part in the discussion. He gave additional information that the farmers were unable to provide. Care was taken to avoid people monopolizing the discussion because of their wealth status or leadership role.

The group discussion proper took place in one of the farmers' houses or in a common group house. It lasted a maximum of two hours. After the discussion a field visit to various farms was organized. In some cases the research team divided itself into sub groups of 2-3 people; in other instances the whole team visited farms. Much information was also gathered from questions asked to farmers during the village walk. Transects and direct observations were done during the field walk. Body maps were drawn by 36 farmers to diagnose health problems in two groups. Visits usually ended with a meal taken with farmers. However, there were further questions asked to the key informant to collect additional information or crosscheck farmers' answers. The visit lasted a day in each group. In some villages (Sabga, Jakiri, and Tadu) because of gender-separated way of life, women were interviewed from men in separate visits. A total of 137 farmers were individually interviewed representing about 25% of dairy farmers registered in 32 dairy groups and three dairy cooperatives. Interviews were also carried out with other stakeholders of the dairy sector such as Non-governmental Organizations, industries and government officers. The research team met the day following the visit to gather information and write a report.

Secondary data used in this work involved annual reports of IRZ (1984, 1985, 1986); results of previous surveys involving dairy production in the region (HPI, 1999; Kameni *et al*, 1999); current statistics from dairy cooperatives and non governmental organisations.

3.1.3.5. Data analysis of PRA information

As suggested by Pretty (1994), the validity of the data was ensured by: forming a research team with members having differences in scientific disciplines, ethnicity, age, religion and gender. Main points noted in a group were read to the participants at the end of gathering and corrected. During the research report writing, there was crosschecking of information collected by each member of the multidisciplinary team. The results were submitted to review in a scientific presentation to colleagues and to peer review. Results were subsequently compared to secondary data.

Three methods were used for constraints ranking: first, farmers agreed among themselves and a spokesman expressed the major constraint by order of importance. Where this agreement failed, farmers were asked to close their eyes and put their hands up when a constraint was listed. Eyes were closed to reduce influence from other farmers. The numbers of farmers voting for a particular constraint was subsequently counted. Lastly, Ashby's method (1986) was used to rank constraints in the whole region. Simple statistics were used to calculate percentages.

3.1.4. Results

3.1.4.1. Seasonal calendar of activities of dairy farmers

Farming activities of dairy farmers of the Western Highlands can be divided as indicated in Figure 3.1.1.

Activities such as milking, forage cut and carry for purebreds Holstein or Jersey, milk processing and marketing are permanent throughout the year, while farming and transhumance depend on the two seasons, wet and dry. These activities are similar for the whole region.

3.1.4.2. Cattle feeding

Much milk produced in the Western Highlands of Cameroon is from native cattle. These cattle are usually grazing native pastures of *Sporobolus africanus, Pennisetum purporeum* and *Melinis multiflora*. However, pastures have also been improved with planted grasses, legumes and multipurpose trees (MPT). These are for grasses: *Brachiaria spp, Trypsacum laxum, Kikuyu (Pennisetum clandestinum)*. Trees are being planted as live fences and are: *Caliandra spp*, *Leucaena leucocephala*, *Jacaranda spp* and *Acacia spp*. Cattle are also fed on by-products, waste food and fruits such as sugar cane leaves, potato leaves, guavas, ripe bananas, pumpkins and waste cooked corn (fufu). Crop residues include: corn stovers, banana pseudo stems and leaves, ground nuts and beans haulms.

The following ingredients are commonly used in supplementation: Maize, rice bran, wheat bran, palm kernel cake, cotton seed cake, whole soya beans, bone ash, limestone and table salt. The proportion of farmers using different feedstuffs in the peri-urban areas of Bamenda and Fundong is shown in Table III.1.1.

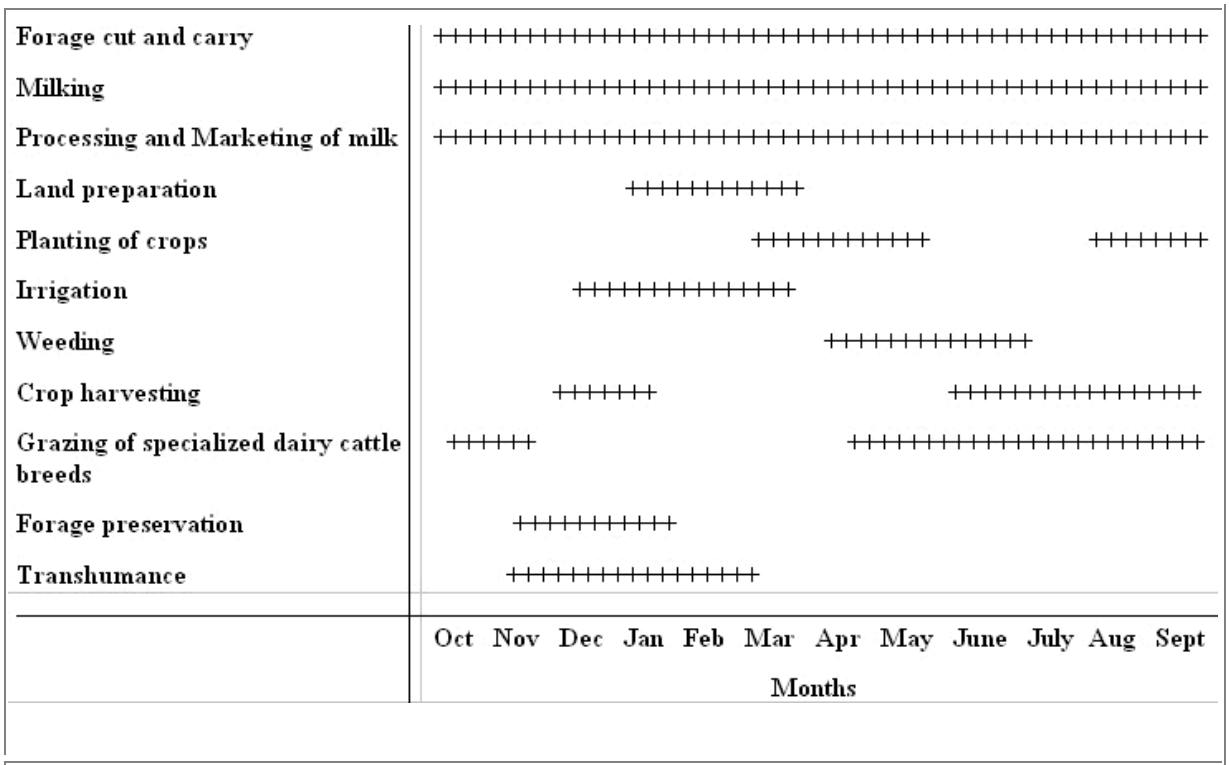

Figure 3.1.1. Farming activities carried out by dairy farmers of the Western Highlands of Cameroon

Table III.1.1. Proportion of farmers using different feedstuffs in homemade concentrates

Ingredient	**% of farmers using in feed mixture**	**Source of feed**
Maize	79.0	Purchase or farm harvested
Wheat bran	67.4	Purchased
Cotton seed cake	53.5	Purchased
Whole soya beans flour	48.8	Farm harvested
Rice bran	46.5	Purchased
Palm kernel cake	41.8	Purchased
Soya bran cake	13.9	Purchased

Principal energy providing ingredients are maize and wheat bran while protein mostly comes from cotton seed cake or whole soya bean flour. Traditional farmers use table salt as sole supplement to cattle in the areas of Sabga, Jakiri and Bamdzeng. Concentrate is fed to dairy cows during milking.

3.1.4.3. Cattle breeding

Traditional producers have been using for a long time natural mating from visually-selected bulls bought, exchanged or loaned from other farmers. With the aim of upgrading the traditional stock, artificial insemination (AI) is being used in Jakiri, Tadu and Bamdzeng. AI is also used in Holstein cows in Fundong (Meli and Mukweh), Nkwen and Santa. In the Bamenda surroundings where there is a high failure of AI, purebred Holstein bulls are used for natural mating. In Sabga and Jakiri, farmers use crossbred bulls for breeding therefore obtaining ¼ Holstein crosses in the progeny.

Dairy cows are bred as from two months post-partum. The calving interval lies between 12 and 18 months. Improved breeds reach active sexual maturity at 24 months while local breeds are sexually active as from 36 months of age.

3.1.4.4. Calf management

Calves from purebred dams are weaned at 4 months of age while in traditional herds weaning is between 7 and 12 months. Weaning is done by separating calves from cows for 3 weeks or by rubbing a mixture of rotten colostrum and dung in mother's udder, thus repulsing the calf. Calves from local breed suckle dams for one month before milking starts. Purebred calves are first given colostrum; then are bucket fed in elevated pens as from three days post-partum as follows: less than one month 5-6 litres of milk/calf/day; 1

to 2 months, 3-4 litres/calf/day; 2-3months, 2-3 litres/calf/day and 3-4 months, 1litre of milk/calf/day. Forage is introduced between 2 and 4 weeks of calving.

3.1.4.5. Milking

In traditional herds, cows to be milked are chosen with the following criteria: calmness and high milk production, older cows are preferred to young ones. In general milking is done in the morning between 6 and 8 am and in the evening between 4 and 6 pm. Purebred Holsteins are milked twice a day. In Tadu milking sometimes goes up to 3 times a day. Milking of local breeds is still done with poor hygiene consisting of few seconds suckling by calf to favour milk let down. Milking is then done with calf presence. Dairy farmers owning purebred Holstein clean the udder with warm water and rub it with Vaseline before and after milking. Milking is done manually and milk is collected in buckets after tying the cow's hind legs.

3.1.4.6. Cattle production

Breed production is summarized in Table III.1.2. The impact of pure Holstein Friesian is increasing in the region, particularly in peri-urban areas of Bamenda in Mezam and Fundong in Boyo (Figure 3.1.2). Many women are also involved in rearing this breed. Figure 3.1.3 indicates the quantity of milk collected by Sotramilk (see below). Much milk is produced in the rainy season when forage is abundant. Figure 3.1.4 shows that the sources of milk products in the country are either imported or locally produced.

Table III.1.2. Daily quantities of milk produced in the traditional system (lactation length 7 to 10 months)

Breed	**Dry season (maximum litres/cow/ day)**	**Rainy season (maximum litres/cow/day)**
White Fulani	1	2
Red Fulani	2	4
Gudali	2	4
Brahman crosses	2	4
Holstein crosses	8	15
Holstein Friesian	-	25

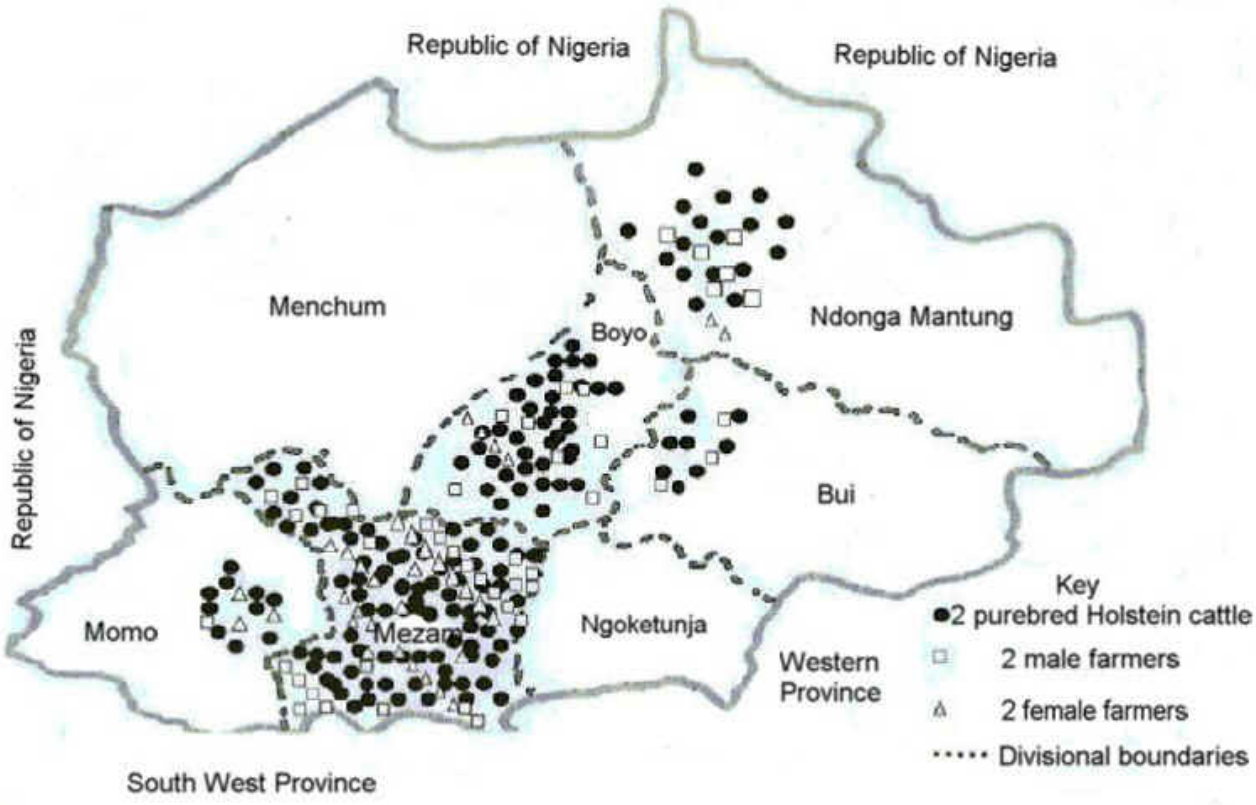

Figure 3.1.2. Regional distribution of Holstein Friesian cattle in the North West Region of Cameroon

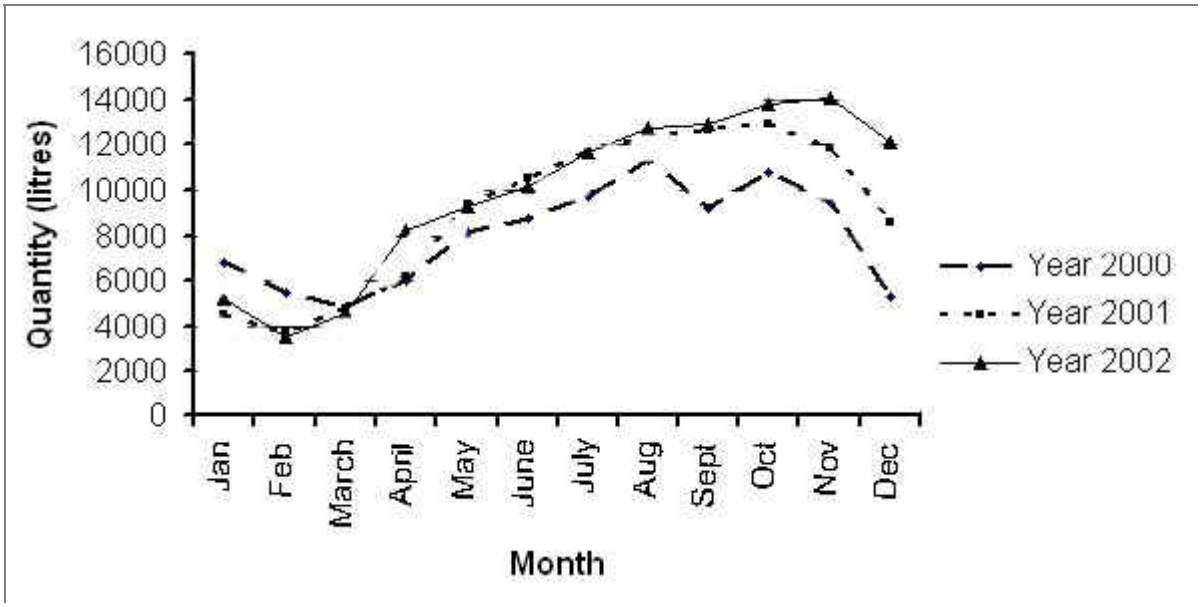

Figure 3.1.3. Monthly milk supply to SOTRAMILK

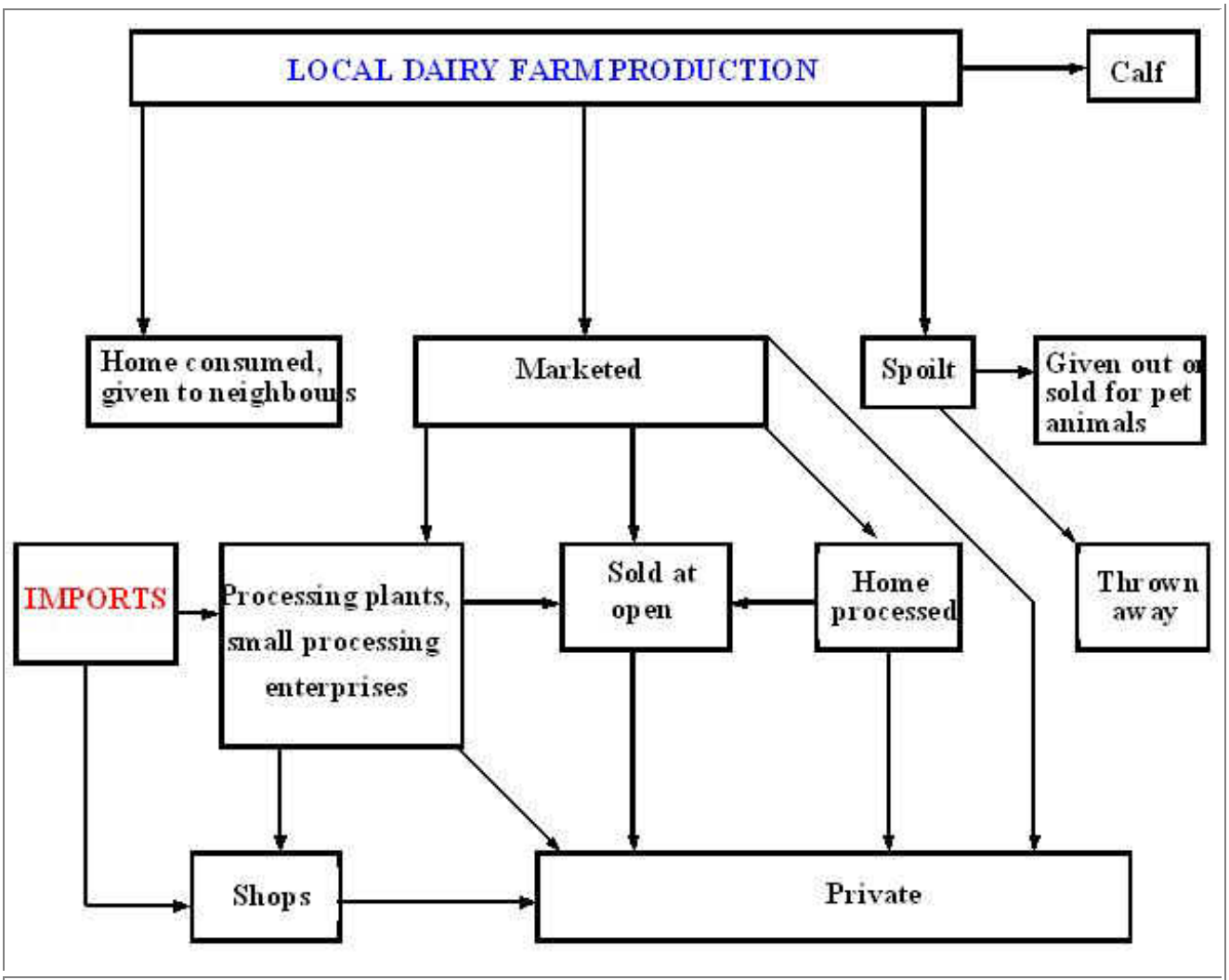

Figure 3.1.4. Milk marketing channels in Cameroon

Table III.1.3. Average cost of milk and milk products (1$ = 650FCFA; 1000FCFA = $ 1.5)

Dairy products made from milk	Average cost in dry season, FCFA	Average cost in rainy season, FCFA	Average village price, FCFA	Average town price, FCFA
Local products				
Liquid milk price per litre*	250	200	200	300
Pendidam (sour skimmed milk), price per litre	300	250	100	200
Kindirmu (sour whole milk), price per litre	500			
Butter	100 per 200ml	1500 per 900g	100 per 200ml	100
Butter	100 per 200ml	1500 per 900g	100 per200ml	100
Butter oil, price per litre	3500	3000	2000	2000
Yoghurt, price per litre	1500	1500		
Cheese, price perkg	6000	6000		
Imported available milk products or made from imported milk				
Sterilized milk can screamed	1000			
Power milk	1900 per 800g	1900 per 500g		
Butter	845 per 200g	500 per 200g		
Yoghurt	250 per 125ml	250 per 125ml		
Cheese, price perkg	10000	1000		
Concentrated, price perkg	1500	1500		

** SOTRAMILK buying from farmers at 160 per litre.*

Milk not taken by calves is either home consumed, spoilt or marketed. No cooperative collects milk. Milk and milk products are marketed either directly by producers or are collected by processing companies. In the peri-urban area of Bamenda, milk marketing is more formal through Sotramilk. In other areas, milk marketing is informal. Milk is either bought at the farm by individuals or farmers carry it to the market place. In this case the price is higher than what is offered by the processing plants. This pattern also happens in the northern part of the country with much activity where former processing plants closed up because of lack of sufficient milk supply. Costs of products are indicated in Table III.1.3.

Home processed products and milk sold in the open market are still much a part of the marketing channel. If better quality products are to be supplied to consumers, there is a need for methods on processing and hygiene to be extended to farmers. On average, 20 to 50% of milk is home consumed in places where marketing is a problem. In Meli (Fundong), sour milk (spoilt) is sold to dog owners. After milking, women and children can take up to 2 hours to get to the market place, and wait for up to 4 hours for the milk to be sold before going back to the homestead.

3.1.4.7. Housing and manure

In traditional management, cattle graze on a free-range system with nights spent in open pastures. In the peri-urban management, there are sleeping paddocks and sleeping sheds constructed with wood and the roof made of either zinc material or local grass. In the last system cows are milked in sheds cemented with concrete. In the zero grazing system, some farmers had very poor sheds letting mature cows eat grass from the roof, thus destroying it.

Manure is a very important activity in the cut and carry (zero grazing) farms and in peri-urban areas where gardening and agriculture are much rewarded. This manure is collected with spades and kept in pits before being dried, used or sold. There is little hazard from manure as the quantity is small.

3.1.4.8. Labour and gender

Generally, the whole family is involved in cattle caring. In the more pastoralist communities, adult men take cattle for grazing while women and children do the milking, processing and milk marketing. School children milk cows before going to school in the morning. The peak period for labour demand is the dry season (January to March) when the farming season starts. At this time, labour is hired to take cattle for transhumance at a cost of 15 000 FCFA per month. Labour is paid for farm preparation at 10000 to 20000 FCFA for a one eighth hectare farm or 600FCFA per man day. When men are married to many wives, at least one of them is in charge of farming and gardening. In the Fulani pastoralist communities, men own cattle but the milk belongs to the women. In Mukweh, some labour is paid with liquid milk. In Sabga peak labour demand in the rainy season is for training of first-calf cows for milking.

Individual interviews revealed that men constituted only 16.8% of dairy operators compared to 83.2% of women. 71% of respondents fell within the age range of 24 to 50 years while 29% was above 50 years. Furthermore 49% of farmers had not received training in dairy production. The gender representation of dairy farmers in the North West Region is illustrated in Figure 3.1.5.

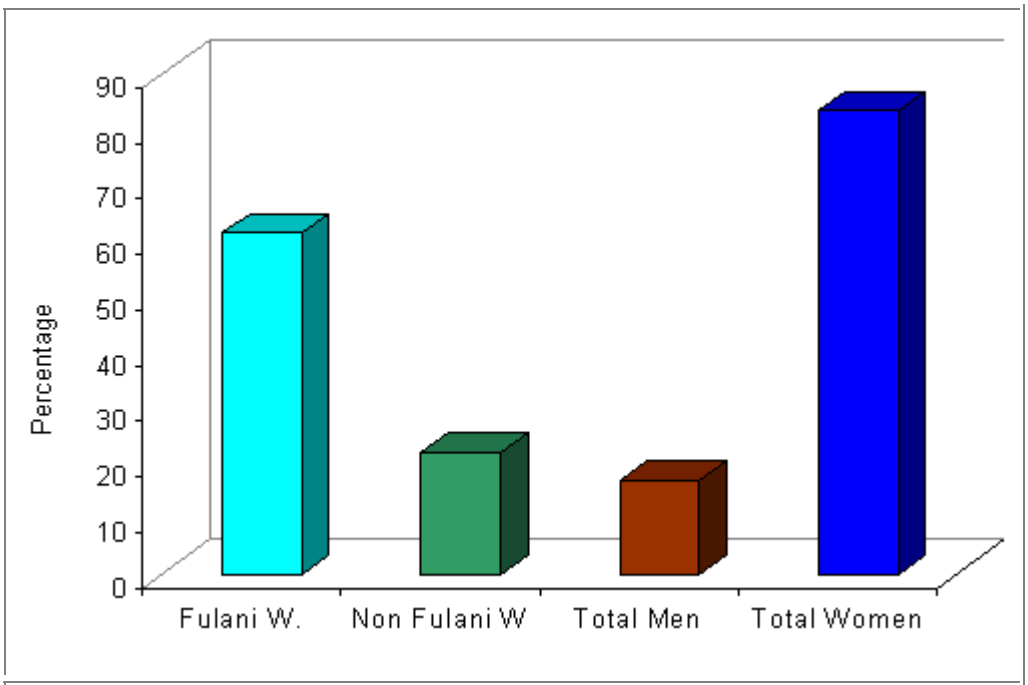

Figure 3.1.5. Gender representation of dairy farmers

The high percentage of the Fulani women clearly shows that they are more involved in dairy activities than the None Fulani women. Thus, the role of the women in dairy production is of prime importance. They need motivation and more education in this sector. If the milk production sector fails, then the livelihood of the Fulani women will be the most affected.

3.1.4.9. Health

Major dairy cattle diseases in the Western highland are in order of importance ticks and tick born diseases: babesiosis, anaplasmosis, dermatophilosis, cowdriosis; mastitis in milking cows; diarrhea; foot and mouth disease (FMD); black quarter; ephemeral fever and ear infection. Veterinary services are provided by non-governmental organizations or private veterinarians. Vaccination is done yearly against black quarter, haemorrhagic septicaemia, and contagious bovine pleuropneumonia. Only few farmers spray their dairy animals. Hand de-ticking is more common. It is the fear of ticks that prevents some farmers from sending crossbred cattle in low and hot lands on transhumance during the dry season. Many traditional farmers make use of ethno-veterinary medicine (Sabaga, Jakiri, and Bamdzeng).

3.1.4.10. Marketing

3.1.4.10.1. Stakeholders

Main stakeholders for dairy production in the Western Highland of Cameroon are: the non-government organization Heifer Project International (HPI), the processing company Sotramilk, the Tadu dairy cooperative, the Ministry of Livestock and Fisheries, feed companies and the Institute of Agricultural Research for Development.

3.1.4.10.2. HPI

This non-governmental organization (NGO) is based in the United States of America. In Cameroon it is a representation of the intensive form of management. In 1974, in collaboration with the institute of animal research (IRZ), HPI provided the initial shipment of purebred Holstein and Jersey dairy cattle to Bambui research station. Recently, more purebred in-calf heifers are being provided directly to farmers.

3.1.4.10.3. Sotramilk

It is a plant aided by a Dutch non-governmental organization which started operating in 1995 with the aim of boosting local milk production. It operates by buying milk from neighbouring farmers in a radius of 10 km. The factory has a capacity for processing 12000 litres of milk a day. But it collects only a maximum of 300 litres per day in the dry season and 600 litres per day in the rainy season. Therefore this fresh milk is usually combined with imported powder milk to make various products such as: Gudali and Edam cheese, and natural and fruit yoghurt (cherry, pineapple). Milk collection is limited because of bad roads. However farmers who do arrange for their milk to be delivered to the factory are compensated for transport.

3.1.4.10.4. Tadu Dairy Cooperative Society (TDCS)

TDCS is a cooperative organization established in 1992 following an intensive training provided by Land 'O' Lakes, Inc. and the United States Agency for International Development (USAID). The main service provided to the members is artificial insemination with Holstein and Brahman semen. TDCS was initially made up of over 200 pastoralists. Up to 1000 to 3000 liters of milk could be collected daily during the dry and rainy season respectively. However the road network is very bad and the market is limited

to the neigbouring Kumbo town. Consequently TDCS is planning to build a processing plant.

3.1.4.10.5. Feed companies

There are many feed companies in provincial towns. The following are ingredients commonly found in these shops: cotton seed cake, wheat bran, rice bran, soya bean cake, fish meal, palm kernel cake, bone ash, limestone meal, blood meal (Table III.I.4). Maize is usually sold for human consumption although it is also bought by animal producers.

3.1.4.11. Use of money from sales of milk

In Fulani communities (pastoralist tendency), milk belongs to the women and so money from milk sales is not used for cattle but for personal needs, household needs and children school fees. In native communities, this money can also be used for cattle. Some people suggested that if they had more money from milk, they would send their children to secondary school and university or open other businesses.

3.1.4.12. Farmers' access to services and information

Farmers acquire information and services mainly through NGOs and the government programme of agricultural extension services. Although internet services are available in the regional head quarters, not many farmers are formally educated to be interested to this source of information. What is needed is to provide adequate information to these organizations for it to be well used by farmers. Therefore if the relationship of research continues to be good with these stakeholders, there will be a good flow of information. Most of the veterinary services are provided by HPI as far as Holstein cows are concerned. Otherwise, private veterinarians offer payable consultations.

Table III.1.4. Prices of feed ingredients found in shops in Bamenda (1000FCFA= $ 1.5)

Ingredient	Average price, FCFA /kg	Availability
Cotton seed cake	140	Good but price depends on good roads from place of production in northern part of the country
Palm kernel cake	60	Very good
Fish meal	600	Poor
Soya beans cake	500	Poor
Whole soya beans	300	Good
Wheat bran	75	Very good
Rice bran	50	Seasonal
Bone meal	200	Good
Limestone	200	Good
Blood meal	400	Scarce
Maize	200	Very good but price goes up in late dry season to early rainy season

3.1.4.13. Other activities

Dairy farmers commonly keep other farm animals such as scavenging chickens, goats, sheep and horses. Non-Muslims keep pigs. All farmers visited plant crops, and grow maize, potatoes, sweat potatoes, coco yams, beans or coffee. Some farmers are also involved in activities such as cattle trading, small businesses and apiculture. Some Fundong dairy farmers own fishponds.

3.1.4.14. Constraints

Major constraints of dairy production in the region were ranked by order of importance as follows:

a. **Marketing: Poor marketing opportunities and long distances to market**

The processing company Sotramilk has a limited sphere of milk collection because of high collection costs. Also, farmers supplying milk to the factory complain of the price of fresh milk being low.

Farmers' suggestions to alleviate constraint: Break the monopoly of Sotramilk or let the company raise prices; let the government provide financial support to farmers.

Recommendation from research team: to this constraint, farmers were advised to arrange milk collection in groups and transportation to Sotramilk.

Farmers of Fundong and Bafut who have adopted this system no longer suffer from a marketing problem.

Milk transport is one of the most important problems faced by farmers. In the traditional system with large herds, individual cows have a low daily production but farmers can milk a large number of animals to have a good quantity of milk per herd. Unfortunately,

these farms are far from the market and roads are bad thus milk easily spoils during transportation. The Lacto-peroxydase system could be used to prolong the shelf life of milk. Farmers could also be provided with technologies for processing milk into cheese if the market is available.

When considering the peri urban production system, the most important constraint was the lack of improved breeds for milk production (Holstein Friesian).

b. Feeding: limited grazing land and poor supplementation of cattle

Because of encroachment of pastures by crop farmers, dairy farmers found themselves with limited grazing lands. They also lack knowledge of good feed compounding. Some areas (Mukweh in Fundong) had their improved pastures permanently invaded by stray goats from neighbours. In Tadu most pastures are seriously invaded by bracken fern. There was consequently an inadequate feeding during the dry season in most parts of the region. Moreover, farmers find the cost of concentrate high and the cut and carry system tedious.

Farmers suggested as a solution to land conflicts that the government secure communal grazing lands.

Recommendation from research team: Make concentrates more available at low cost by formulating in a linear programme cheap rations using local available products. Research should also find a way of making grass cutting less tedious for farmers employing zero grazing (cut-and-carry) management. This could be done by devising a local chopper adapted to the farm size and which could be acquired by dairy groups.

Previously, dairy rations formulated by researchers in the regions, though efficient, were not very profitable because of inclusion of high cost ingredients. This constraint can be

alleviated by extending improved and cheaper rations to farmers, and providing them with extension leaflets in feeding methods for dairy cows.

c. Limited health control

In some places, drugs and veterinary services were not always available.

Recommendation from the research team: Farmers should invest more money in health control and should organize themselves within dairy groups for veterinary care in order to lower cost. Private veterinarians are available for consultation.

The government no longer provides free veterinary services to farmers as the sector has been liberalized. It is good to make farmers understand the economic loss they incur with poor health control. The Economic Opportunity Survey will be helpful in this area. Previously, veterinary researchers worked to identify diseases and pathogens hindering cattle productivity. No economic evaluation of the impact of disease has been done in the region.

d. Inadequate knowledge in processing, conservation and storage of milk

Many farmers complained of their milk getting bad in a short time.

Recommendation from the research team: Train farmers in hygiene, processing and preservation methods. The lacto-peroxydase system, tested in the Sabga, Santa and Bali region, can extend the shelf life of milk to an additional 6 hours or more if the milk is kept in cold water. This constraint will be alleviated by extending processing and conservation methods.

e. Breeding: poor reproductive management and prolonged calving interval

In traditional management where fencing is rare, bulls breed cows without control. This was the case in Jakiri and Mbamzeng. On the other hand, farmers using AI did not always have semen or purebred bulls available to them. There was also a great failure of conception in inseminated cows.

Recommendations: Improve the breeding program. This constraint though 5th in general ranking, comes among the first in the peri urban system which is the most market-oriented. Farmers complained of lacking good dairy animals. The causes of the poor reproductive performance need to be investigated and advice given to farmers. There is also a need to emphasize good breeding management through extension leaflets.

Artificial insemination has proven to be less sustainable because of the high cost of liquid nitrogen and conception failure due to the AI technician not getting 'heat' information early enough or getting to the farm at an appropriate time. Therefore, it is advisable that dairy groups acquire bulls. It is also possible in areas where the main problem is high cost of liquid nitrogen that chilled semen be used for insemination.

f. Farming management

Lack of water in the dry season.

Recommendation: Farmers could pay people to carry water when they use a zero grazing scheme.

g. Poor Housing

Many milking stables were in a bad state and fencing was poor.

Recommendation: Provide extension services for housing and fencing.

h. Poor organization of group

Recommendation: Reorganize groups to be more dynamic.

i. Others: *limited number of dairy cows and poor record keeping*

3.1.4.15. Dairy production systems

Dairy cattle management systems of the region are summarized in Table III.1.5. In the region, five main dairy production systems have been identified. Recommendations from stakeholders are indicated in Table III.1.6.

Table III.1.5. Some characteristics of the dairy production systems.

Production system	**zero grazing**	**Peri-urban**	**Semi intensive**	**Transhumance**	**Improved extensive**
Breed	*High yielding exotic	*Exotic or/and crossbreeds		*Local	*Crossbreeds
Confinement	Total stall feeding. Improved grass. Some supplementation	Stall feeding. Rotational grazing. Improved grass. Cheap agro industrial by- products	*Rotational grazing some supplementation	Communal grazing. *Transhumance of non lactating adult cattle	*Communal grazing
Cropping activities	*Owners primarily involved in cropping activities	Integrated to dairying	Integrated to dairying	Limited	Limited
Marketing	*Not always available	*Very good Market oriented	*Not always available	Difficult	Difficult
Number of cattle	< 5	< 10	<50	hundreds	hundreds
Dominant tribe Gender	Native men or women	Native men or women	Native men	Fulani men	Fulani men
Main constraint	Poor market	Poor reproductive performance. Lack of good dairy breeds. Heavy work load in cutting and chopping grass.	Limited knowledge in feeding management	Lack of sufficient grazing land	Lack of sufficient grazing land
Main herd purpose	Dairy/Manure	Dairy/ Manure/ Beef	Dairy / beef	Beef/dairy	Beef/dairy
Health care	average	Good	Good	Poor	Good
Consequence	Ownership of cattle is due to incentives from NGOs	Farmers very opened to accepting extension packages and investing in dairy cows	Farmers drive production to market demands (meat or milk)	Traditional way of management could disappear or seriously reduced due to land disputes	Open to limited improvement of management. Could adapt to changing environment if they could have more crossbreeds and continue to manage them well
Exemple of site	Meli; Fundong	Nkwen	Bafut	Sabga	Jakiri; Bamdzeng

** Main characteristic*

Table III.1.6. General recommendations from processing plant agents, from regional government livestock office, from non-governmental organizations and from cooperatives

Source of recommendation	**To Farmers**	**To Extension Services**	**To Sotramilk**	**To Research**	**To Government investing bodies**
SOTRAMILK	Improve cattle feeding	Show the importance of milk to families		Conduct seminars on feeding in order for farmers to grasp the need to improving feeding	Create a dairy technology School. Provide subventions to farmers like in some other African countries
Government livestock department	Must drive management towards intensification because of land conflicts resulting from reduction in communal pastures	Show the necessity of concentrate to farmers. Show need of agro industrial by-products	Stimulate producers	Be involved in extension	Be also involved in dairy cattle production. Must not only put emphasis on small livestock species
Non-Governmental organizations Farmers' cooperatives	Improve in milk preservation		1. Share profits with farmers by increasing price of milk 2. Standardise measurement of farmers milk, either in litre orkg. 3. Measure milk on with farmers and issue receipts to farmers at collection point. 4. Also collect evening milk.	1. Investigate low calving rate and relationship to plane of nutrition. 2. Number of improved breed animals limited; so set up nucleus herd for multiplication. 3. Produce extension leaflets in all aspects of dairy management 4. Find balanced dairy rations adapted to local environment. 5. Find baseline data related to health.	1. Provide subsidies to farmers. 2. Limit licence for import of dairy products

3.1.5. Discussion

3.1.5.1. Feeding, breeds, production, marketing and health

The calendar of activities of the region shows that after the harvesting season, crop residues can be fed to stall-fed cattle in the dry season or as the practice is in mixed communities (pastoratists/crop farmers), cattle can be sent to graze standing crop residues such as maize stovers. In Kenya, Stall *at al* (2001) found that crop residues (maize stovers) used for dairy cattle had gone up while the use of concentrate and roadside grasses was reduced. Chopping grass for Holstein cows is tedious in the zero grazing system. These farms could have a tremendous help if research could design a small scale chopper to be used by farmers' groups.

All dairy systems in the North West Region are involved in cropping activities; although in varying degrees as described in Figure 3.1.6.

It is expected that farmers more involved in cropping will feed more crop residues to cattle. Therefore, they may not have severe feeding shortages in the dry season. On the other hand the fear is that these farmers rely more on the residues at the expense of grass. It is therefore necessary to keep encouraging crop farmers to cultivate improved grass and legumes.

The information on ingredients used in concentrate shows that most farmers use maize and whole soya bean flour in the feed. But this seems expensive as there are by-products such as wheat bran and cotton seed cake which can more economically be used. Palm kernel cake is cheap but is not widely used as farmers complain of a drop in milk yield when including it in high proportions in home-made concentrate.

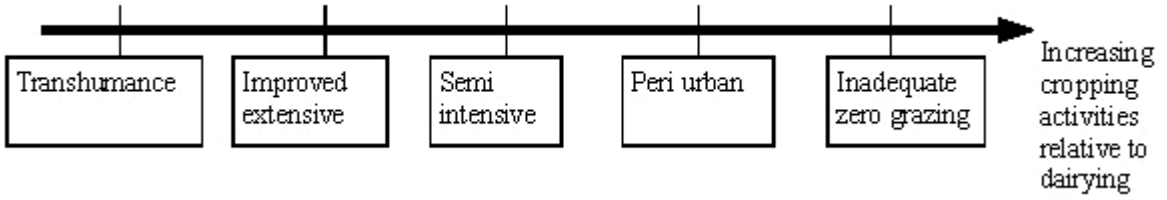

Figure 3.1.6. Integration of dairy systems with cropping activities that favours the feeding of crop residues

This by-product is not very palatable (McDonald *et al*, 1988) and has residual oil content which can impair microbial activity of the rumen. Therefore, the recommendation of using a linear program to formulate dairy rations seems appropriate.

The only high yielding pure milk breed found in the region was Holstein. In the past, the smaller size Jersey was also present. Farmers of the Western Highlands of Cameroon prefer Holstein Friesian which is also good for beef production. The increasing use of the Holstein Friesian breed indicates that in market oriented farms, farmers prefer high yielding animals to improve milk production per cow. This confirms their willingness to adopt new technologies. A company or organization set up to produce these animals will be of great help to the farmers. In Kenya (Stall *et al*, 2001), although the predominant dairy breed is Holstein (42%), there are also other exotic milk breeds: Ayrshire (18%); Guernsey (12%), Jersey (3%); the local breeds representing 25% of milking animals. In Cameroon, production from crosses is fairly good. These animals are well adapted to the semi intensive and to the improved extensive management. Twice daily milking was found to increase milk production by over 30% compared to once-daily milking but the market in many places is not good. That is why many farmers do not do milk more than once daily.

Main factors influencing milk production have been outlined in Figure 3.1.7. Fresh milk price can be increased by reduced importation. This is in fact what has happened since 1994 because of the devaluation of the CFA currency. The milk price can also be put up by processing plants.

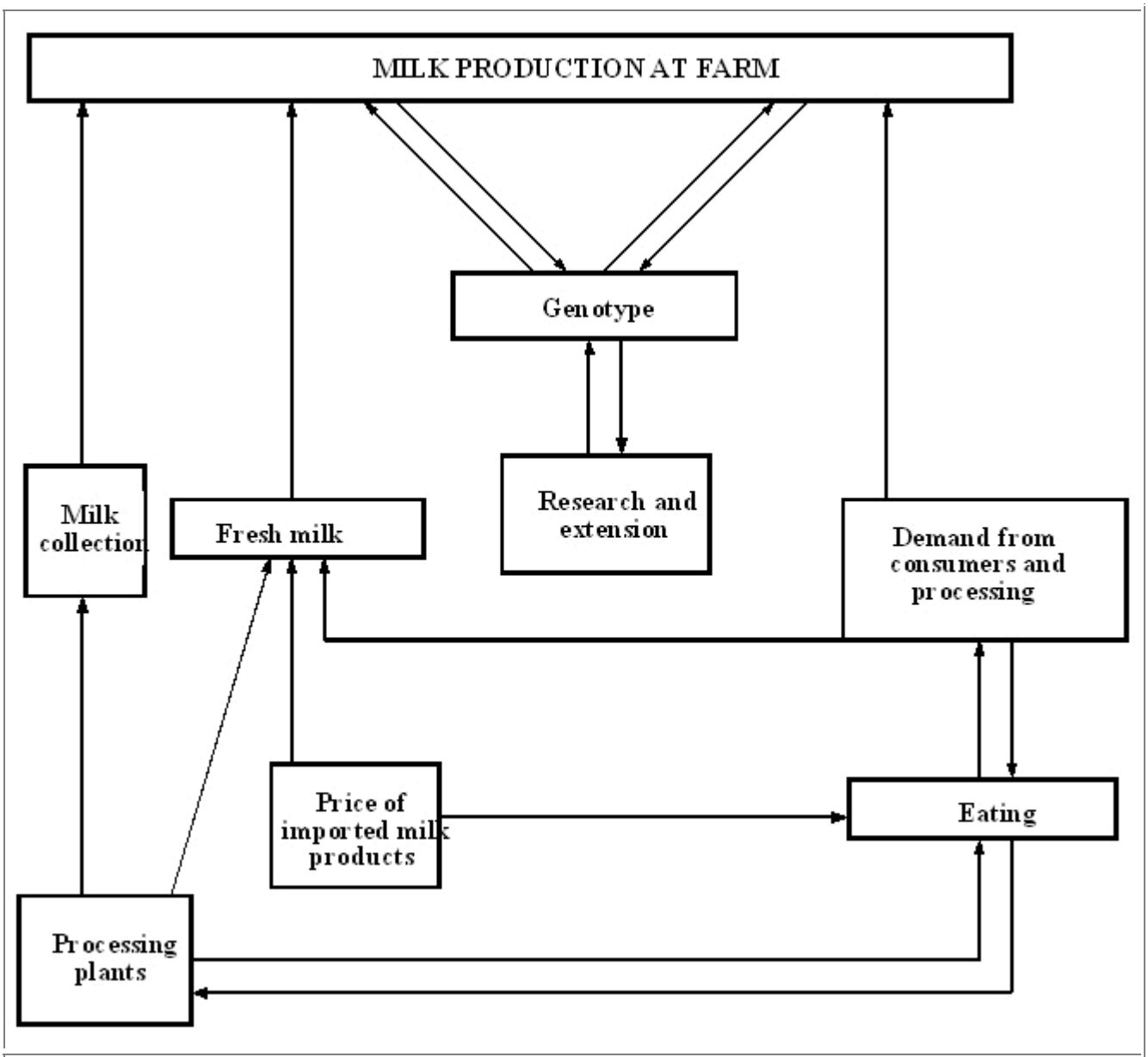

Figure 3.1.7. Main factors influencing milk production in Cameroon

Lastly in open markets, a high consumer demand increases price. When the milk price is up, farmers can modify their management by improving it. They can also reduce culling rates of female dairy animals. Others can purchase high yielding animals which will help them make more money. In contrast, when price is low, culling rates go high in favour of meat and management is poor. Processing plants sometimes modify eating habits of Cameroonians by creating new products. When consumer demand for fresh milk and milk products is high, milk production can increase because many people purchase products directly from farmers. As in the first case, the need of increased production at farm level positively influences type of breed kept and management. Research and extension bodies intervene mainly in breeds, breeding and management. At the moment, there is no possibility of over production which could negatively influence price. This confirms the findings of Tambi and Vabi (1994) that price is relatively inflexible to changes in market supply. The demand for milk is very high in urban areas and there is good prospect for farmers if production increases. Research and extension consequently have a lot to do in improving management, especially in the peri-urban system.

The pattern of milk supplies to the processing plant indicates that there is less milk available in the dry season. Consequently the plant must import powder milk at that period to meet a high demand in milk products. However, the plant could encourage farmers to keep up with the production in the dry season by paying a higher price of milk. The informal marketing could be improved by farmers' groups organizing themselves to preserve milk and market it together.

As far as consumption is concerned, many people do not know the importance of milk in human nutrition. Fresh milk is not also common in eating habits of non pastoralist Cameroonians. If many farmers do not sell their milk, it is simply because of the lack of market. In Kenya (ibid) 37% of dairy farmers' households refuse to sell their milk. In

Cameroon, most dairy operators are women. This is an indication that women constitute a stronger force in milk production and marketing than the men do. This agrees with the findings of Kameni (1994). This also occurs in Zanzibar, Tanzania where 75% of them are women (Biwi, 1992). This fact is a good prospect for women's welfare in rural Cameroon. If dairy production increases, women will be the first beneficiaries. They need motivation and more education in this sector. Otherwise, their livelihood will be most affected.

In health aspects, worm infestation was not listed as a problem. Perhaps because much ethonovetenary drugs are used to control worms (Nfi *et al*, 1999). It is also possible that worm infestation causes much morbidity thus reducing milk yield. It would be better for farmers to make sure that worms are controlled even if cows do not clinically suffer. Most important diseases were found to be tick-born; meanwhile in Nigerian dairy commercial farms, it is mastitis (Onwuka *et al*, 1995). In the semi-intensive system, specialized dairy breeds are sent for grazing at the time tick infestation is high in pasture (Bayemi *et al*, 1999). Therefore there is a need to control this challenge with pour-on acaricides so that exotic breeds or crossbreeds are not put at risk.

3.1.5.2. Systems

Nell (1992) described 5 dairy production systems in Sub Saharian Africa: pastoral, agro pastoral, mixed farming, intensive and peri urban. These systems are found in Cameroon in various stages. However, the intensive system if understood as leading to industrial milk production was not found in the western Highlands where most farmers practice dairying at a small scale level. Previously only three dairy systems were found in Cameroon: pastoral, semi intensive and intensive (Kameni *et al*, 1999). Over the years, with the growing extension of high yielding dairy breeds, the zero grazing system has been encouraged. In the past, this intensive system was not encouraged as there was a fear

that farmers would not be able to care for heavier animals such as Holstein. In fact, this is what happens in some of the zero grazing farms where farmers, because of the lack of market, neglect these animals. However, in the peri-urban area, many farmers adopt good management and would like to increase the number of Holstein cows in their farms. Dairying has also specialized in the peri-urban areas where marketing is good. More crop farmers get involved in dairying. In Tunisia, the total confinement system is practiced by farmers without pastures (Lahmar *et al*, 2003). But in Cameroon, many such farmers cultivate improved grass in a cut-and-carry system.

In Tanzania (MOAC, 1998), four systems are found in small scale dairying: two intensive urban systems and two semi intensive urban, with manure being very valuable alongside milk or meat. Farmers in that country also use crosses in the intensive system while in the North West of Cameroon, crosses are only used in the semi-intensive. The semi zero grazing found in Uganda (ILRI, 1996) or Kenya was not found in this study.

3.1.5.3. Constraints

In Uganda, the primary constraint was seasonal fluctuation in quantity and quality of feed resources. This is similar to Kenya and Tanzania. This must be related to the fact that dairying is more developed in those countries and dairy cooperatives well established. In Cameroon, the first constraint was market related when considering the whole region. A lot more needs to be done to channel the milk produced in rural areas to urban centers and educate more people in the use of milk in their diets. This can be done by processing plants, cooperatives or NGOs. However in the semi intensive and zero grazing peri urban systems where the problem of marketing is reduced, farmers complain of the lack of good dairy breeds. This shows their desire to improve production. Their willingness to invest in the purchase of high yielding dairy cows is an indication that small scale dairy business is profitable. In Zimbabwe (Francis and Sibanda, 2001), the first constraint was poor

reproductive performance followed by inadequate amount and low quality forage. This pattern is similar to the peri-urban systems of the North West Region.

Main constraints of dairy production in this region could be tackled through extension of appropriate methods adapted to each system. In fact, recommendations from farmers show that government, research and extension services are keys to the solution to many of these problems

3.1.5.4. Conclusion

- Five dairy production systems were found in the North West Region of Cameroon: transhumance, improved extensive, semi-intensive, peri-urban, and zero-grazing.
- Constraints hindering production in these systems are by order of importance related marketing opportunities and long distances to market, feeding, limited health control, storage and processing, reproduction and management.
- In market-oriented farms, main constraints are poor reproduction and inadequate feeding.
- Main factors influencing production are milk processing plant, fresh milk price and management. The marketing channel involves processing plants and open markets.
- Recommendations were geared towards government bodies and research working more to helping farmers to resolving constraints. However, processing plants were also advised to finding ways of establishing more confidence with farmers in the measurement of their milk.
- The fact that women are the gender more involved in milk production and benefiting more of the marketing is a good prospect for their welfare if production improves.

- The most urgent interventions to follow in market oriented farms seems to be tackling constraints of failure in reproduction and heavy work load in chopping grass. This is coupled with the extension of improved methods feeding and breeding methods.

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3.2. Economic opportunity survey of small scale dairy farms of the North West Province of Cameroon

Published in Tropical Animal Health and Production

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3.2.1. Abstract

An economic opportunity survey (EOS) was conducted on dairy farms in the North West Region of Cameroon. Results showed that median (range) number of cows in milk per farm was 0.6 (0-4) and six (3-12) in the zero grazing and transhumance systems, respectively. Medians (range) of three (0-24) and four (3-10) litres of milk were sold per farm per day, corresponding to 30% and 60% of milk produced. 24% and 13% of total cattle per herd were milking cows in the zero grazing and transhumance systems respectively. Median milk production per cow on one day was two (0-25) and two (1-3) litres. Median calf production interval was 14.5 (12-25) and. 21.5 (14-29) months. More milk produced per day represented the best economic opportunity in both systems while reduced age at first calving and longer lactation length were the next in both. Wastage of milk through spoilage from poor hygiene and lack of cooling was a major problem. Holstein cows, which were in the zero grazing system, had unexpectedly short lactations. Constraints identified led to the setting up of interventions of training and advice for farmers and of better nutrition.

Key Words: Cattle, Cameroon, economic opportunity, milk, small-scale dairy farm.

3.2.2. Introduction

Improving milk production is a key issue for the livestock industries of many countries, whether it is expressed in terms of quantity as in most developing countries or in terms of quality as in the European Union. In 1999, the per capita milk production of Cameroon was only 12.8kg, while the average value for Africa as a whole was 34kg. At the same time, milk consumption per capita in Cameroon was 15.3kg (FAO, 2000). Because of this deficit, milk products are imported in the country to cover it up. This importation sends hard currency out of the country that could otherwise be used in the development. Furthermore, milk products can often be imported at prices far lower than that for milk produced within the country, rendering local farmers more vulnerable to loss of markets. Nevertheless, in Cameroon, local milk competes quite efficiently with imported milk (Bayemi *et al.*, 2005a). Therefore, an effort is being made by the government and Non-governmental Organizations to increase local milk production and, as a result, economic returns.

In a dairy herd, many factors influence economic returns. These factors may be related to the animal itself, to the management or to financial inputs. Similarly, some constraints cost the farmer much more than others. If these main constraints could be identified and overcome, economic returns would be expected to improve substantially. Such components of production are called economic opportunities (Nordlund *et al*, 2007). The objective of this research was to evaluate the state of small-scale dairy farms in Cameroon and to determine the most important economic opportunities, with the eventual goal of addressing such opportunities in an integrated manner.

3.2.3. Materials and methods

3.2.3.1. Area of study

The North West Region of Cameroon is located in the mid to high altitude zone of the country that lies between latitudes 5°20' and 7°00' North and longitudes 9°40' and 11°10' East. Altitudes range from 300 to 3000 metres above sea level. The climate is characterized by two distinct seasons: Dry from November to mid March and rainy from mid March to October. Annual rainfall varies between 1300-3000 mm, with a mean of 2000 mm. Daily minimum and maximum temperatures have means of 15.5°C and 24.5°C, respectively, although temperatures can exceed 30°C. The human population is estimated at 1.82 million inhabitants with an annual growth rate of 3.1% (Winrock International, 1992). The proportion of the population involved in agriculture is estimated to be 72%. Agricultural products from low to medium altitudes include: oil palm, cocoa, Robusta coffee, fruit trees, cocoyam, maize, small livestock, rice, and groundnuts. The high altitude (above 1400m) products include: solanum potato, Arabica coffee, vegetables and small and large ruminants (PNVRA, 2002).

3.2.3.2. Animals

Five small-scale dairy production systems are found in the region: transhumance, improved extensive, semi-intensive, zero grazing and peri-urban (Bayemi *et al,* 2005b). In the transhumance system, cattle graze on communal lands and spend nights in open pastures. The cattle are of local breeds - Gudali and Red and White Fulani- (*Bos indicus*). In the zero grazing management systems, grass is cut, chopped and provided to animals in feeding troughs. The majority of these cattle are Holsteins or crosses (*Bos taurus* X *Bos indicus*) and are permanently housed in stables. Cows are offered concentrate diets during milking. The semi-intensive farms have sleeping paddocks or sheds constructed of wood with zinc or grass roofs. In the last two systems, cows are milked in sheds with concrete floors. Many farmers use purebred Holstein bulls for natural mating.

Major dairy cattle diseases in the region are, in order of importance (Bayemi *et al,* 2005b), ticks and tick born diseases (babesiosis, anaplasmosis, dermatophilosis, cowdriosis), mastitis in lactating cows, diarrhoea, foot and mouth disease, black quarter and ephemeral fever. Gastrointestinal parasites are also very prevalent. Non-governmental organizations or private veterinarians provide veterinary services. Vaccination is done yearly against black quarter, haemorrhagic septicaemia and contagious bovine pleuropneumonia. Only few farmers spray dairy animals against ticks; hand picking of ticks is more common.

3.2.3.3. Survey

Sixty-one farms were selected for the Economic Opportunity Survey (EOS) on the basis that they were market-oriented and easily accessible. Most of the farms (51 of 61) were zero grazing, while the other 10 were from the transhumance system. Each farmer was asked to complete a survey in June and July. The survey forms used were designed by Nordlund *et al* (2007). The responses to the questionnaire were used to establish a database consisting of four sections:

(i) Milk production on one day: Total production on the day prior to the visit divided by the number of lactating cows.

(ii) Expenses for cattle health care and feeds: Sum of purchased feeds, veterinary services and medicines during the last year.

(iii) Inventory of herd culls and deaths: Number of cattle sold or dead during the past year, average price per class of animal.

(iv) Milk and calf production (calving) per cow. This section describes current milk production per cow on one day, calving date, number of calves per lifetime, age at first calving, calf production and days-in-milk.

A fifth section was necessary for setting targets used for evaluating farm performance. The results from the survey were downloaded into an "EOS output" file, comparing individual farms with the 20% or 80% percentile (Table III.2.1) and calculating economic opportunities using the approach developed by Nordlund *et al* (2007). For figures where a higher value is desirable, e.g. lactation length, milk yield, percentage of lactating cows relative to total cattle, the 80th percentile of the data collected was used. Where lower values are better, the 20th percentile was used, e.g. calf mortality rate, age at first calving and calf production interval. The lactation length of some cows in the zero grazing reached 500 days. Such figures were discarded to consider the standard lactation length of 305 days of Holstein cows as the target. The lactation length target of transhumance cows was taken from maximum values (Bayemi *et al*, 2005a) and so 225 days was used.

Table III.2.1. Targets used in two dairy production systems in North Western Cameroon to assess economic opportunities for gain.

	Transhumance	**Zero grazing**
Percentage of milk and milk products sold of milk produced[a]	60%	80%
Calf mortality rate (past 12 months)[b]	0%	0%
Average age at first calving - data for first and second lactation cows only - (months)[b]	31	27
Calf production interval (months)[b]	17	12
Average lactation length (days)	225	305
Lactating cows as a% of total cows[a]	60%	
Lactating cows as% of all cattle[a]	30%	50%
Milk production per cow on one day (litres)[a]	3	15

[a]80th percentile of data collected used as target
[b]20th percentile of data collected used as target

Farmers occasionally ignored forage consumption on the input forms. In these cases, forage intake was roughly estimated relative to live weight (McDonald *et al,* 1988), assuming that access was unlimited, and forage dry matter in the season that the survey was conducted. In the transhumance system forage cost was estimated from the salary used to pay herdsmen for taking animals for grazing. In the zero grazing system, the cost was calculated from expenditures on planting, weeding, cutting, fertilizing and chopping of grass.

3.2.4. Results

Table III.2.2 shows that the transhumance system used more family labour than did the zero grazing system and had no need to hire workers from off the farm, despite the greater need for labour. Only a limited land area is used for pasture improvement. Nine out of the 10 transhumance farmers owned no land at all with the other one owning 130 hectares. Farmers employing the transhumance system consumed slightly more milk per family than farmers practicing the zero grazing system. This is probably an inevitable finding because 22 out of 51 zero grazed farms were producing no milk at all at the time (Table III.2.2). Therefore milk is not traditionally part of their diet, whereas it is for the transhumance pastoralists. The highest producing farms of the zero grazing system sold 80% of their milk. Only one farm in the transhumance system gave milk separately to calves. In this system, calves usually take residual milk and they are taken off the cow in the evening. Calves here are weaned between seven and 12 months while the calves of zero grazing cows are weaned at four months.

Six farms in the zero grazing system were milking their cows once a day in the morning with cows producing an average of four litres per cow on one day and having an average lactation length of 173 days. This compared to eight litres per cow on one day in the remaining 23 farms, where cows were in milk, and on twice a day milking, where the average lactation length was 296 days.

Table III.2.2. Median of cattle, labour, land and milk usages per farm in two dairy production systems in North Western Cameroon.

	Zero grazing system		Transhumance system	
	Median (range)	**Number of farms**	**Median (range)**	**Number of farms**
Number of cattle per herd	4 (1-22)	51	47 (16-80)	10
Number of lactating cows per herd	0.6 (0-4)	51	6 (3-12)	10
Family labour per farm (men/year)	3 (0-15)	51	8.5 (6-10)	10
Hired Labour per farm (men/year)	0 (0-2)	51	0	10
Total land owned (ha)	3 (0-8)	51	0 (0-130)	10
Improved Pasture per farm (ha)	2 (0-33)	51	0.75 (0.5-1)	10
Lactating cows as % of total cows	1 (0-100)	44	37 (10-60)	10
Total milk produced (litres on-one-day) [a]	5 (0-30)	51	7 (4-55)	10
Milk sold/produced [a]	0.3 (0-1) [a]	29	0.60 (0.2-0.8)	10
Sold milk (litres/day) [a]	3 (0-24) [a]	27	4 (3-10)	10
Family used milk (litres/day)	1 (0-5) [a]	29	3 (1-7)	10
Fed to calves (litres/day)	0 (0-5) [a]	26	Not applicable	-
Other uses of milk (litres/day)	0 (0-3) [a]	3	None	-

[a]22 out of 51 zero grazed farms were producing no milk at the time of the survey. Data with superscript [a] are only from those producing milk at the time.

Few farms in either system processed their milk prior to selling it. However, two farmers of the transhumance system processed large quantities of milk, each having more than 10 times the output of the largest zero grazing herd that processed milk. The common products made were yoghurt, traditional sour milk and butter oil.

A significant proportion of milk appeared to be wasted through spoilage, with an average of one litre per farm per day a considered estimate by researchers.

Health care and feeding costs were quite variable (Table III.2.3). Some farmers used ethno-veterinary medicine and therefore spent no money on health care. The total health care cost per farm was higher in the transhumance system because farmers paid for treatment for hundreds of cattle yet only a few cows are used for milking. Some individual zero grazing farms had high health costs and because of smaller herd size spent the most per cow on health. When transhumance farmers gave concentrates, the total cost was high (147%) compared to the income from milk sold. This was mainly due to salt feeding to many non-lactating animals. Although salt is not technically a concentrate, it was taken into account because it was part of the money spent for feeding.

Figure 3.2.1 presents statistics regarding cattle inventories in the two systems studied. As mentioned previously, on average the herds in the transhumance system include a high proportion of non-lactating cows: 13% lactating against 24% in zero grazed herds. Although transhumance requires the cash flow from milk sales to support more costs for animal maintenance, it also allows for more selling of live animals: 15%, 16% and 4% of sold calves, bulls and cows compared to 0%, 5% and 1% respectively in the zero grazing.

Table III.2.3. Median (range) health care and feeding costs per farm in 61 farms in North Western Cameroon.

	Zero grazing system 51 farms	Transhumance system 10 farms
Total health care costs per farm per year ($)	18 (0-320)	110 (70-360)
Concentrate fed per cow per day (kg)	4 (0-10)	3 (2-4)[a]
Concentrate unit price ($/kg)	0.21 (0.1-0.33)	0.20 (0.2-0.7)
Total concentrate cost per cow per day ($)	1.06 (0-3.34)[b]	0.70 (0.4-2.8)
Total feeding cost per cow per day ($)	2.08 (0.5-2.14)	0.70 (0.4-2.8)

[a]Salt included as a concentrate
[b]Some zero grazing cows did not receive any concentrate

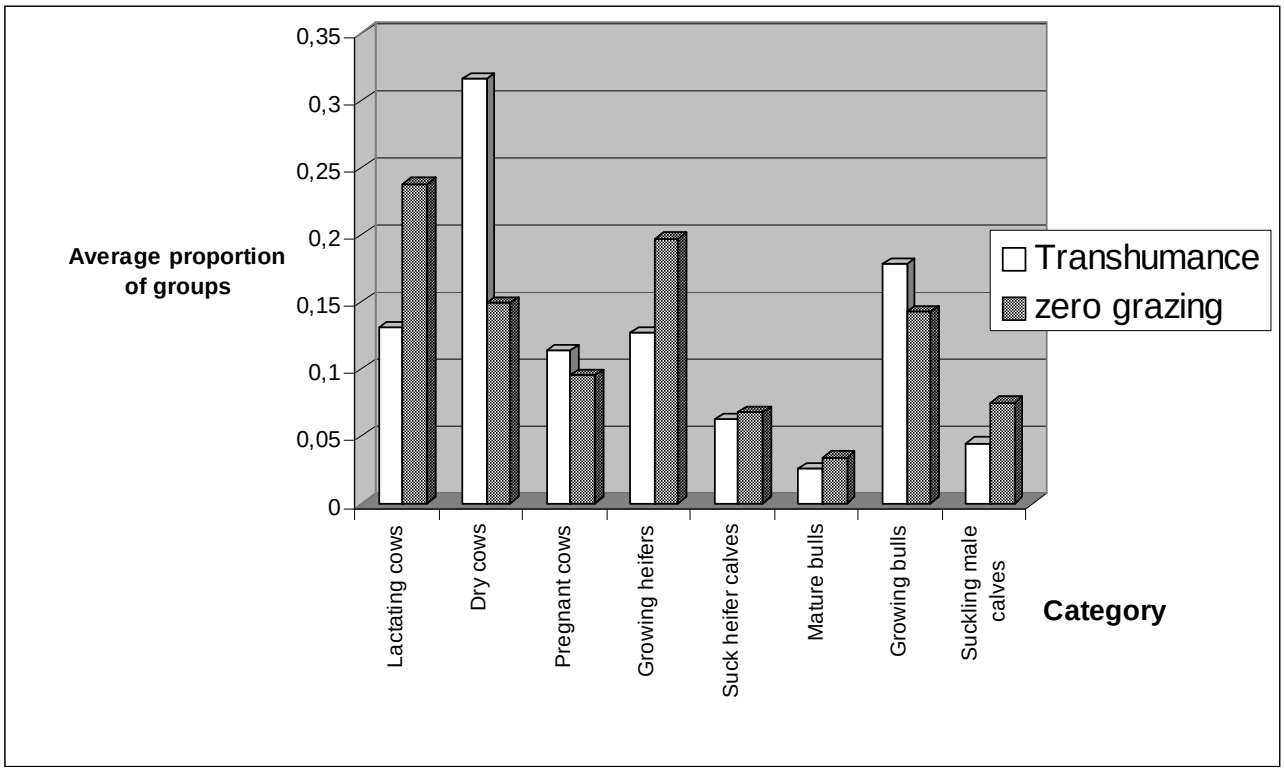

Figure 3.2.1. Herd structures in two small holder dairy production systems in North Western Cameroon

The transhumance system is effectively dual-purpose and more cows and bulls are sold, mostly for meat. In this system, beef production is more important for the farmer as it gives an average of $6000 yearly income per farm against $100 yearly income from milk. Consequently, women are usually in charge of milk production. In the zero grazing system, milk production gives an average of $600 yearly income to farmers against $350 from beef sales. Milk sales provide daily cash income helping farmers to support daily household needs.

Table III.2.4. compares the two farming systems for a number of parameters. The median milk production per lactating cow on-one-day was similar in both systems. The range was much greater in zero grazing herds. Twenty two were producing no milk on the day data was collected but a few cows were producing far more milk than any in the transhumance herds. The median age at first calving was also similar between the two systems but the data is less complete in zero grazing herds and the ranges show that some are very high. Calf production interval data is also similarly incomplete and widely ranging but appears longer in transhumance systems. Lactation lengths appear slightly shorter in transhumance herds.

Calf mortality was 12% per farm in the zero grazing while no calf was recorded dead in transhumance herds. It is quite likely that no calf died in the ten herds surveyed in the traditional system though this is not the case in all herds. Table III.2.5. shows average economic opportunities per herd in the two systems. In both, milk production offers the highest opportunity and could contribute much to increase income. Lactation length is also important, more so in transhumance herds where the large number of non-lactating cows influences the calculated result. Many farmers in zero grazing did not give enough information on health and breeding as they were not used to record keeping and thus only a limited number of them contributed to the investigation and the respective data in table III.2.5.

Table III.2.4. Some production parameters in smallholder dairy farms in North Western Cameroon

	Zero grazing system		**Transhumance system**	
	Median (Range)	Number of farms	Median (Range)	Number of farms
Milk per cow on-one-day (litres)	2 (0-25)	51	2 (1-3)	10
Age at first calving (months)	34 (25-68)	21	35 (25-43)	10
Calf production interval (months)	14.5 (12-25)	15	21.5 (14-29)	8
Lactation length (days)	223 (149-394)	16	213 (81-287)	9

Table III.2.5. Average economic opportunities in dollars ($) per farm in two systems of smallholder dairy farms in an Economic Opportunity Survey in North Western Cameroon

Opportunity	Zero grazing system	Transhumance system
Calf survival	12	0
Age at first calving	253	278
Calf production interval	32	11
Lactation length	103	738
Milk production	1302	890
Health care cost/cows	29	8

Due to the nature of the calculations in the EOS system (Nordlund *et al*, 2007) potential economic benefit from greater annual milk production is not included in the calculation for the effect of change in calf production interval.

3.2.5. Discussion

3.2.5.1. Labour, land and marketing

In the North West Region of Cameroon, the Fulani tribe has traditionally kept cattle and farmed them in a transhumance system. This activity is part of their way of life and the whole family is involved in herding. Most herdsmen who may be hired are often considered as members of the household. Although members of the family will take care of the cows in the zero grazing system, labour will also be hired, at least for tasks like grass cutting and chopping or cleaning.

Farmers involved in zero grazing systems are mostly those who used to be (or are still partly) involved in crop farming. The fact that they have been willing to reduce production of most crops and allocate large portions of their land to the raising of forages for dairy cattle suggests that they yield greater and/or more stable economic returns from dairying than from crop farming. This movement from crop to dairy production continues to gain popularity in the peri-urban areas of Bamenda (HPI, 1999). A similar trend has been observed in Kenya, where growing fodder in the cut-and-carry system decreases the land available for other types of agriculture (Staal *et al*, 2001). Data collected in this study (Table III.2.2) confirm that livestock keepers of the transhumance system graze their cattle in communal lands, because the private land available to them is very limited.

In addition to the on-farm constraints to dairy production, such as low production per cow and less than optimal reproduction, the lack of a consistent avenue for milk marketing is also restricting the expansion of milk production. This was the primary constraint found during the Participatory Rural Appraisal study (Bayemi *et al*, 2005b). There is no doubt that, if the market were available, more milk would be sold. Much is still needed to be done to increase the volume of milk sold by farmers.

One problem contributing to hurting commercial milk sales seems to be low keeping quality because of a general lack of access to systems for cooling milk to prevent early spoilage. The estimated average milk spoilage of one litre per farm per day is about 17% wastage of the milk produced. This is a significant loss with an economic opportunity of $12 per month or one third of a monthly salary of a herdsman. One traditional cooling method observed is to put pasteurised milk in a jar and deep it in cool water that is replaced every 6 hours. Such a method can keep the milk for 24 hours in the Western Highlands of Cameroon. But this depends on environmental temperatures that can go up to 40^{o}C. There is a need for educating farmers in milking hygiene to improve the milk quality. Without cool storage, milk must be consumed by the farmers' families or shared with neighbours or it will go bad. The lack of cooling systems is part of a vicious cycle that requires financial investment to break it. A Tanzanian experience shows that the higher the price per litre of milk, the less milk is kept for home consumption (MOAC, 1998). However, small scale farmers cannot afford to purchase the equipment needed to maintain a high quality of milk and obtain the higher prices. They are not always near enough to each other to cooperate and the quantity of milk produced per farm does not often justify big investment.

Dairy farmers owning purebred Holstein clean the udder with warm water and rub it with Vaseline before and after milking to ensure the tenderness of the udder for hand milking and reduce bacterial count in milk. Milking is done manually and milk is collected in buckets after tying the cow's hind legs. Teat dipping and mastitis testing are not practiced.

3.2.5.2. Diseases

Ticks and tick born diseases are the most important diseases threatening dairy production (Merlin *et al,* 1986). Holstein cattle are particularly susceptible to babesiosis, anaplasmosis,

dermatophilosis and cowdriosis in this region. Luckily, animals of zero grazing farms are not much exposed to ticks, so cows do not often suffer from these diseases. In general, farms concerned in this study did not have any alarming health concerns, as shown by the PRA study (Bayemi *et al*, 2005b), and so health control did not present a good opportunity for economic gain (Table III.2.5). However, farmers should not neglect health control lest to lose valuable animals, especially in the zero grazing system.

3.2.5.3. Feeding

The amount of concentrates provided to traditional transhumance cattle was rather high, relative to the milk produced. A significant part of this was salt and many non-milk producing animals received this. As much as 18kg of salt per 30 cows per month may be given as the only 'concentrate' to traditional cows.

The Participatory Rural Appraisal (Bayemi *et al,* 2005b) revealed that low reproduction was a constraint to dairy production. The apparently high level of concentrate feeding – if not nearly all salt – does not look to be having a suitable effect. Many farmers did not include any adequate protein supplement in home made concentrate. Farmers used wheat or rice bran, maize, salt and bone meal. Njoya and Trenkle (1992) have already shown that inadequate protein supplementation was a limiting factor of grazing cattle production in Cameroon. The feed supplement used by transhumance farmers was then reformulated to include a higher percentage of cotton seed cake during the intervention phase of the project.

3.2.5.4. Lactation period and average age at first calving

Figure 3.2.1 shows the details of the distribution of cattle of different ages and sexes in the two systems. The zero grazing herds had approximately double the proportion of lactating cows and half the dry cows of the transhumance herds. These differences reflect the contrasts

between the systems. The primary objective of the zero grazing system is milk production, whereas meat production is most important in the transhumance system. A high proportion of concentrate in the latter system is therefore used for beef production. In addition, the Holstein cattle breed is the most popular in the zero grazing system and less suitable for beef production. The average herd composition found in this study in zero grazing is similar to that reported for small scale dairy herds in Kenya (Staal *et al*, 2001). However no farmer in either system had only females among the adult animals (Figure 3.2.1). This result indicates that farmers in the small scale zero grazing systems, as well as the traditional transhumance, not only reared replacement heifers but also kept bulls for sale.

The poorer production parameters of farmers in zero grazing practising one milking per day suggested that twice a day milking could be a good intervention to boost milk production in those farms. The reasons for the one milking in the morning are that there is no market for evening milk and the absence of cooling facilities does not allow it to be kept and sold in a satisfactory condition the next morning. In which case interventions helping farmers in milk processing or better milk preservation will open the way to two milkings in those farms.

The median age at first calving was similar to that found in the Hilly zone of Bangladesh (Shamsuddin *et al*, 2006). This parameter is highly influenced by the way heifers are fed prior to puberty. O'Kelly *et al* (1988) found that growth-retarded calves reach puberty later, but other factors are also important. In the zero grazing system, nutrition may be sufficient to allow heifers to come into oestrus at two years of age (28% of farmers had cows that calved at 25 months of age – Table III.2.4 – but 20% of farms had cows calving at more that four years old) but farmers may fail to detect oestrus accurately too. Inefficient heat detection is usually a limiting factor of reproduction in small scale farms and a human management factor is almost always involved in differences in efficiency of heat detection (Cavestany and Galina,

2000). These farmers may need more training on the importance of and the proper approaches to oestrus detection. Furthermore, the use of a communal bull is widespread in some of the areas studied and its lack of immediate availability can be restrictive on efficient fertility.

Median lactation length (Table III.2.4) was not significantly different between the two systems ($P>0.05$). This result was surprising because farmers with high producing breeds such as Holsteins should see lactation periods considerably beyond the length typical for local cattle. Probably lactation length in the zero grazing herds was limited due to poor feeding and disease. Tawah *et al*, (1998) have already shown that Holstein cows have longer lactation lengths than traditional zebu cows. As the median health cost in zero grazed herds does not seem high (Table II.2.3), the unexpectedly short lactation lengths in the Holsteins may be more a consequence of poor nutrition than poor health, unless health care is not being effectively applied. Recommendations to farmers, based on the poor body condition scoring visually appraised, were given primarily to improve the feeding standards of their cows. Improved feeding, one of the interventions of the project, should increase milk yields, lactation length and reproduction efficiency. The outcome of these interventions should allow a considered assessment of whether pure-bred Holsteins can be managed in this type of zero grazing system in Cameroon to produce milk closer to their potential. Even if they can, there remains interest whether their lifetime productivity – possibly limited due to early death from disease – can match that of indigenous cattle or cross-breeds with Holsteins. It is important that information on mortality rates and longevity in Holsteins are assessed. Only when this has been done can the best advice be given to farmers in Cameroon on the use of pure-bred Holsteins, crosses or better managed selected local cattle for the required increase in national milk production.

The calf production interval in the zero grazed herds (Table III.2.4) was similar to the Saline Zone (15 months) of Bangladesh (Shamsuddin *et al*, 2006). The Economic Opportunity (EO) is relatively low (Table III.2.5.) because the EOS calculation does not take into account any benefit from the effect of a shorter interval between calvings on annual milk production per cow. But of course milk production depends on calving and so small-scale zero grazing dairy farmers recognise the value of striving to get their cows in oestrus and in calf again as soon as possible. Traditional transhumance farmers take a more relaxed and traditional view but education about the potential benefits of more positive reproductive management may be worthwhile. Better fertility efficiency could allow for smaller herd sizes for the same levels of production of both milk and meat. This might reduce pressure on communal grazing areas. Reproductive management was then part of the interventions.

3.2.5.5. Opportunities and interventions

The Participatory Rural Appraisal carried out (Bayemi *et al*, 2005b) before this study showed that, after poor marketing opportunities, inadequate feeding of lactating cows was the second most important constraint on dairy production in Cameroon. This EOS shows that milk production-per-cow is the most important limiting factor in terms of financial return when considering both systems as a whole, followed by lactation length and then age at first calving (Table II.2.5). Economic opportunities for lactation length in the transhumance system are very high because the calculation takes into account the total number of non lactating cows present in the herd. In this parameter non-milking cows contribute to the economic loss of the farmer. The economic opportunity result suggests that Holstein and traditional cows are both exploited below their potential. Milk-production-per-cow could probably be improved by offering more forage to lactating cows. Most zero grazed Holstein cows of this region are undernourished (Bayemi *et al*, 2005b) and restricted cows in zero grazing systems are not usually offered enough forage (Msangi *et al*, 2004). Hay is not common in the region and

silage is not produced at all. Therefore farmers cut grass using cutlasses and carry it to the shed. This is time consuming and labour intensive. In this system, concentrate is a supplement and, if not offered especially if free access to forage is limited, lactating cows may be in a severe negative energy balance (Williams, 1990). Such undernourishment is detrimental to production, reproduction and health.

Traditional breeds, if fed more and better digestible forage, will probably produce more milk (Ndambi, 2006). If potential was realized from better feeding, then within-breed selection could be tried to boost the potential for milk production in this system. Transhumance farmers were encouraged to purchase hay. They will be able to afford it if milk marketing is good, which is not presently the case with most farmers of the North West , due to a recent bankruptcy of the main milk plant. Only farmers successful in the informal market are following these recommendations. Milk production per cow can usually be increased by improving the quality of the concentrate supplement. Interventions were planned to do this too.

Constraints brought out by the PRA and EOS led to the setting up of interventions geared towards improving milk sales and milk production per cow. Interventions primarily consisted of advice, education and training, through synchronization of oestrus and AI were carried out by the research team. Most interventions were carried out with the zero grazing herds able to keep good records. These were: 1) Looking at ways to help farmers increase forage consumption by pasture improvement; putting them in contact with hay producers; formulating a new concentrate mixture. 2) Supplementation with concentrates of better yielding zero grazed cows according to stage of lactation. 3) Training farmers in milk processing to cheese and yoghurt in order to improve the shelf life of milk. 4) Linking farmers to better health care services and milk buyers. 5) Introducing artificial insemination using

fresh semen (AI). 6) Initiating two milkings a day where appropriate. These interventions were to be applied in an integrated method - any problem faced by a farmer could be addressed, whether it be in the area of marketing, health, management or reproduction.

Transhumance farmers are pastoralists and their herds cannot be easily monitored all year round because of seasonal movements of cattle. They were however encouraged to use AI because they are requesting to have some crossbred Holstein cows. This would be beneficial particularly to women and children because often the cow belongs to the men and the milk to the women. Transhumance farmers were also trained in reproductive management and milk processing.

Partial budgeting is being used to assess the financial benefits of these interventions and to provide evidence to show to other farmers to encourage them to follow suit.

3.2.5.6. References

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