



## **CHAPTER 5**

### **5. Cattle health**

## **5.1. Prevalence of *Brucella abortus* antibodies in serum of Holstein cattle in Cameroon**

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### 5.1.1. Abstract

Holstein cattle (298) of a small scale dairy production systems were screened for *Brucella abortus* antibodies in 21 villages in the Western Highlands of Cameroon by ELISA. The screening was done using Brucella-Ab C-ELISA kit. Age of animals was divided into the following groups: less than one year, one to less than three years, three to five years and more than five years. The Chi-square analysis in SAS was used to test differences of *Brucella* prevalence amongst age groups, sex and locations. Results show a general seroprevalence of 8.4%. The rate of brucellosis infection was higher in females compared to males ( $P=0.0143$ ) considering the whole population tested. But when comparison was done relative to each sex, results were similar. Of the 192 cows tested, 14 were infected giving a within-sex seroprevalence of 7.3% while 6/74 bulls were infected with a seroprevalence of 8% (some positive animals had no labelled sex). There was no evidence ( $P=0.11$ ) of difference in the seroprevalence of age groups although animals above one year and below three years accounted for nearly half of the infected animals. 64% of infected animals were found in three locations ( $P=0.015$ ): Kutaba (32%), Bamendankwe (16%) and Finge (16%). A specific control programme should be organized in these locations and an effort should be made to determine the causes of the spread of the infection. Owing to the fact that animals screened are from the high milk yielding Holstein breed, it is recommended that measures should be taken to ensure the eradication of the disease within the population and sound control measures adopted to avoid a further spread of the disease to larger cattle populations in the region. Infected animals should be slaughtered systematically. All farmers should be advised to boil milk before consumption. Vaccination against *Brucella abortus* and regular *Brucella* testing should be instituted.

**Key words:** *Brucella*, Cameroon, ELISA, Holstein, small scale dairy

## 5.1.2. Introduction

Brucellosis is a major zoonosis that occurs worldwide. It is caused by small nonmotile coccobacilli of the genus *Brucella*. Although the reported incidence and prevalence of the disease vary widely from country to country, bovine brucellosis caused mainly by *B. abortus* is still the most widespread form. Even though many countries have tried to eradicate *B. abortus* from cattle, it appears that bovine *B. melitensis* infection is emerging as an increasingly serious public health problem. Although it is anticipated that brucellosis is present in the major animal producing areas, the current status of brucellosis in Cameroon is not clear and it is becoming a major concern to veterinarians and physicians alike. According to OIE, official measures are in place in Cameroon to control bovine brucellosis through movement control of cattle at the borders and within the country but since 1996 no outbreaks have been reported to OIE. This however is not indicative of the absence of the disease but rather of an underestimation of the brucellosis in Cameroon (Shey-Njila *et al*, 2005).

Peri-urban small scale dairy farms in the Western Highlands of Cameroon use Holstein cows in a zero grazing system. The milk produced is home consumed, sold in informal markets or collected by a processing plant. However, the health status of this milk is unknown. There is a need to assess its quality in terms of health hazards and ensure the safety of consumers. The main objectives of this work therefore were to carry out a sero-epidemiology of Holstein cattle in the Western Highlands in order to establish their brucellosis status, create public awareness of the epidemiology of brucellosis in Cameroon and make concrete proposals to the appropriate authorities for adequate control measures to be put in place.

### 5.1.3. Materials and methods

298 Holstein cattle were screened from 21 locations representative of villages where purebred Holstein cows are kept. However, only 266 animals were fit for the analysis. Cows used in the Heifer International Cameroon scheme are quite separated from each other because farms are isolated. These animals were not vaccinated against *Brucella*. Age was divided into the following groups: less than one year, one to less than three years, three to five years and more than five years. Blood samples were collected within two weeks in June 2006. The samples were immediately put on ice. At the laboratory, the samples were centrifuged at 1500 rpm for 15 min and the serum kept in a freezer until the day of analysis.

#### 5.1.3.1. Principle of the test

The screening was done using Brucella-Ab C-ELISA kit (SVANOVA, Sweden, 2005). The competitive Enzyme Linked Immunosorbent Assay (C-ELISA) for detection of serum antibodies to *Brucella abortus* and *melitensis* is a multi-species assay allowing detection of *Brucella* specific antibodies in both domestic and wildlife species. In cattle, this assay can distinguish between *Brucella* infected animals, *Brucella* strain 19 vaccinated and animals infected with cross-reacting gram-negative bacteria. Briefly, the samples are exposed to *Brucella abortus* smooth lipopolysaccharide (S-LPS) coated wells on microtiter plates together with a mouse monoclonal antibody (mAb) specific for an epitope on the o-polysaccharide portion of the S-LPS antigen. After an incubation period the microplate is washed and goat anti-mouse IgG antibody conjugate with horseradish peroxidase is added which binds to the mAb's. Unbound materials are removed by rinsing before the addition of substrate solution. The chromogen tetramethyl-benzidine with H<sub>2</sub>O<sub>2</sub> as substrate leads to a colour change which is read within 15 minutes with an ELISA reader at 450nm. Samples were tested in duplicates.

### 5.1.3.2. Statistical analysis

The Chi-square analysis in SAS was used to test differences of *Brucella* prevalence amongst age groups, sex and locations.

### 5.1.4. Results and discussion

Results suggest that the rate of brucellosis infection was higher in females compared to males ( $P= 0.0143$ ) considering the whole population tested. But when comparison was done relative to each sex, results were similar. Of the 192 cows tested, 14 were infected giving a within-sex seroprevalence of 7.3% while 6/74 bulls were infected with a seroprevalence of 8%. In Nigeria, Ocholi et al (1996) also found no difference between sexes although the overall seroprevalence was 6.6%. There was no evidence ( $P=0.11$ ) of differences in seroprevalence of different age groups although animals above one year and below three years accounted for nearly half of the infected animals Table V.1.1.

Results obtained in this study show a seroprevalence of bovine brucellosis of 8.4% in the sera tested. This prevalence is within 4.88 to 9.64% reported by Shey-Njila in 2004 in a survey conducted at the abattoir of Dschang, Cameroon. Similarly, the samples collected at the abattoir of Yaounde in Cameroon, indicated a seroprevalence of bovine brucellosis of between 7.2 and 8.8% (Shey-Njila *et al*, 2005). These authors said that brucellosis was still enzootic in zebu cattle in areas where the cattle came from. Already in 1986 a survey carried out at the Institute of Animal Research at Bambui, Cameroon showed a prevalence of over 20% in cattle reared at ranches and 4% in those from traditional systems (IRZ, 1985 and 1986). In the northern part of Cameroon, Bornarel *et al* (1987) found a brucellosis seroprevalence of 12.5%. Several other studies reported seroprevalences ranging from 7 to 31% (Domenech *et al*, 1980, 1982a, 1982b, 1985; Bornarel *et al*, 1987, Akakpo *et al*, 1987). Lefèvre (1991) concluded that in Cameroon, the prevalence of bovine brucellosis exceeds 5%

In neighbouring Tchad *Brucella* seroprevalence was found to be 7% (Schelling *et al*, 2003) while in Mali the prevalence was 22% (Tounkara, 1994).

Animals selected for this work were Holstein cows in an intensive system. The *Brucella* seroprevalence in this population was similar to other reports on brucellosis in Cameroon. In Eritrea, Omer *et al* (2000) also found that 8.2% of cattle infected with *Brucella* were kept in an intensive system. Cows used in the Heifer International Cameroon scheme are quite separated from each other since the farms are quite isolated. But it may be possible that milk used to feed calves in an infected herd could be sold to other dairy farmers for the feeding of calves. Otherwise, it could be possible that proximity with other farm animals (sheep, goats, dogs and pigs) serves as reservoirs for these herds. It will be interesting then to also screen the prevalence of *Brucella* in other farm animals. Furthermore the ‘passing-on-the-gift’ scheme used in this Non-governmental Organization, whereby farmers receiving a Heifer pay-back with another heifer which will be given to another farmer may also contribute to spreading the infection. In case a cow is infected, the heifer calf will carry the infection to the neighbouring farm. A proportion of animals may also have been infected because of the common bull scheme whereby farmers take cows for breeding to the village bull although in this study, mature breeding bulls were not infected.



**Table V.1:** Frequency and percentage of infected animals by age groups

Age (years)	Sex	Frequency (Infected/Tested)
$\leq 1$	Females	1/9
	Males	2/13
1 and $\leq 3$	Females	4/51
	Males	4/36
3 and $\leq 5$	Females	6/56
	Males	0/20
$> 5$	Females	3/76
	Males	0/5

NB 32 Animals did not have any labelled sex and 3 of such animals were infected.



The study also showed that *Brucella* infection varied with location ( $P=0.015$ ) with 3 out of 21 locations accounting for 64% percent of infected animals namely Kutaba (32%), Bamendankwe (16%) and Finge (16%). These results indicate that a specific control programme should be organized at these locations. Schelling *et al*, (2003) working in Tchad found that 3.8% of people working with livestock were infected with *Brucella*. This is an alarmingly high value which emphasizes that the dairy farmers selected for this study should take special measures to avoid infection by *Brucella*.

It is recommended that measures should be taken to ensure the eradication of the disease within the population and a sound testing and control system instituted to prevent the further spread of the disease to the larger cattle populations in the zone. 1) All farmers should be advised to boil milk before consumption. 2) Another test should be done to confirm positive animals, after which all infected animals should be slaughtered. 3) Care should be taken in areas of high prevalence to determined the possible causes of the spread of the infection. 4) Vaccination against *Brucella* should be instituted. This will be done every three years for the same animals as the vaccine lasts for that period of time. The vaccinated animals should be ear tagged or marked. However, care should be taken not to vaccinate pregnant animals. 5) To ensure a sound population of Holstein cows within the HPI scheme, this ELISA test should be repeated yearly since it is a more sensitive test compared to the Rose Bengal, standard agglutination and Coombs test in the diagnosis of brucellosis (Saz *et al*, 1987). 6) Artificial insemination with healthy semen should be imperative for the Heifer International scheme to avoid contamination of these valuable animals from infected bulls.

## 5.1.5. References

- Akakpo, A.J., Bornarel, P., 1987.** Epidémiologie des brucelloses animales en Afrique tropicale:Enquête clinique, sérologique et bactériologique. Rev. Sci. Techn. Off. Int. Epiz. 6: 981-1027.
- Bornarel, P., Akakpo, A.J., Tuekam, 1987.** Epidemiology of bovine brucellosis in tropical Africa. 3. Serological survey in Cameroon. Rev. Méd. Vét.. 138: 55-58.
- Domenech, J., Lucet, P., Coudert, M., 1982a.** Bovine brucellosis in central Africa. V. Description of a simplified survey technique. Rev. Elev. Méd. Vét. Pays Trop. 35: 125-129.
- Domenech, J., Lucet, P., Vallat, B., Stewart, C., Bonnet, J.B., Bertaudiere, L., 1980.** Bovine brucellosis in central Africa. II. Clinical and epidemiological survey: regional characteristics and problems of semi-intensive husbandry. Rev. Elev. Méd. Vét. Pays Trop. 33: 277-284.
- Domenech, J., Lucet, P., Vallat, B., Stewart, C., Bonnet, J.B., Hentic, A., 1982b.** Brucellosis in cattle in central Africa. III. Statistical results of surveys in Chad and Cameroon. Rev. Elev. Méd. Vét. Pays Trop. 35: 15-22.
- Domenech, J., Trap D., Gaumont R., 1985.** Study of the reproductive disorders of cattle in central Africa: survey for chlamydiosis and Q fever. Rev. Elev. Méd. Vét. Pays Trop. 38: 138-143.
- IRZ, 185.** Rapport annuel de l'Institut de Recherches Zootechniques, Bambui Cameroon.
- IRZ, 186.** Rapport annuel de l'Institut de Recherches Zootechniques, Bambui Cameroon.
- Lefèvre, P.C., 1991.** Atlas des maladies infectieuses des ruminants. IEMVT-CIRAD, Maisons-Alfort. 95p.
- Ocholi, R.A., Ezeokoli, C.D., Akerejola, O.O., Saror, D.I., 1996.** Use of the enzyme-linked immunosorbent assay for screening cattle for *Brucella* antibodies in Nigeria. Vet Q. 1996 Mar; 18(1):22-4.

- Omer, M. K. , Skjerve, E. , Holstad, G. , Woldehiwet, Z., Macmillan, A. P., 2000.** Prevalence of antibodies to *Brucella* spp. in cattle, sheep, goats, horses and camels in the State of Eritrea; influence of husbandry systems. *Epidemiology and Infection* 125: 447-453. Cambridge University Press.
- Saz, J.V., Beltran, M., Diaz, A., Agulla, A., Merino, F.J., Villasante, P.A., Velasco, A.C., 1987.** Enzyme-linked immunosorbent assay for diagnosis of brucellosis. *Eur J Clin Microbiol.* 6(1):71-4.
- Schelling, E., Diguimbaye, C., Daoud, S., Nicolet, J., Boerlin, P., Tanner, M., Zinsstag, J., 2003.** Brucellosis and Q-fever seroprevalences of nomadic pastoralists and their livestock in Chad. *Prev Vet Med.* 2003 Dec 12; 61(4):279-93.
- Shey Njila O., 2004.** A sero-epidemiological study of bovine brucellosis in the region of Dschang (West, Cameroon). MSc. Thesis ITM Antwerp, Belgium.
- Shey-Njila O., Awah-Ndukum, J., Bayemi P. H., Nyah E., Zoli P. A., Geerts S., 2005.** Brucellosis in cameroon: current status and challenges for the future. The role of biotechnology in animal agriculture to address poverty in Africa: Opportunities and challenges. Arusha, Tanzania, 23-26 Septembre.
- SVANOVA, 2005.** Brucella-Ab, C-ELISA SVANOVIR™. ELISA test for the detection of *Brucella* antibodies in serum samples discriminating between infected and vaccinated cattle. Manual.
- Toukara, K., Maiga, S., Traore, A., Seck, B.M., Akakpo, A.J., 1994.** Epidemiology of bovine brucellosis in Mali: serologic investigation and initial isolation of strains of *Brucella abortus*. *Rev Sci Tech.* 1994 Sep;13(3):777-86.

## CHAPTER 6

### **6. Impact of management interventions in small-scale dairy farms of the Western Highlands of Cameroon**

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## 6.1. Abstract

A study was carried out to evaluate the impact of interventions to solve constraints in smallholder dairy farms of the Western Highlands of Cameroon. The interventions consisted of improved breeding through introduction of artificial insemination, better feed supplementation, farmers training in milk processing and better veterinary services. Results show that there was a decrease in average monthly expenditures of 18% relative to the month before interventions started. Much of the expenditures were related to feed (38% of all costs). There was an overall increase in farm income. Close to 2/3 of the income were derived from milk products from home processed milk and culled animals. Only 7% income came from milk sold to the processing plant. The partial budget shows that before interventions, farmers lost \$4.5/cow/month but gained \$38/cow/month because of the interventions. The return was 2.32 and included opportunity income for milk home consumed and shared. When this opportunity income was ignored, the return stood at 1.93. The positive impact of interventions led to poverty alleviation and some farmers acquired more cows. A spill over effect is that more crop farmers are willing to be engaged at least partially in dairy farming. It will be good if many more farmers could benefit from these interventions.

**Key words:** Cameroon, interventions, partial budget, smallholder dairy

## 6.2. Introduction

In Cameroon, the livestock sector represents 16% of the agricultural production in terms of Gross Domestic Production, providing 118 billion FCFA a year to the country. This represents 30% of the revenue of the rural population. The livestock sector is dominated by ruminants and the country has 5 million cattle with 4% being dairy (FAO, 2004). Between 1990 and 2004, the increase in human population growth was +2.2% per annum, while self-sufficiency in terms of milk production has decreased by -7.3% points within that period. Consequently the current ratio of imports / national consumption is 24% (Ndambi and Bayemi, 2006).

In order to improve local milk production, a first step involves understanding the local dairy production environment. A Participatory Rural Appraisal (PRA) was then devised to address the following questions: What are their constraints and limitations? What stakeholders and factors influence dairy production? What are the typical marketing channels? What are the perceptions of dairy farmers regarding dairying and what suggestions can be made to improve dairy production in the country? What are acceptable economic reference points that can be used to evaluate the outcomes of management interventions (Bayemi *et al*, 2005b)? A second step involved an Economic Opportunity Survey to evaluate the state of small-scale dairy farms and to determine the most important economic opportunities, with the eventual goal of addressing such opportunities in a holistic manner (Bayemi *et al*, 2007d).

It was found that the main constraints to dairy production in Cameroon 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 and management. Milk production per cow was shown to be the most important factor that influenced the economic viability of the system.

In order to address these constraints, interventions were set up to improve milk sales and increase milk production per cow with the hypothesis that these will improve the financial income.

## **6.3. Materials and methods**

### **6.3.1. Choice of area**

The North West Region of Cameroon is in the mid to high altitude zone, 5°20' - 7°00' N and 9°40'-11°10' E. Altitude varies between 300 - 3000 m, and annual rainfall is 1300 - 3000 mm, with a mean of 2000 mm. The dry season lasts from November to mid-March, and the rainy season from mid-March to October. Air temperature can exceed 30°C, while mean daily minimum and maximum temperatures vary between 15.5°C and 24.5°C, respectively. The human population is estimated at 1.82 million (Winrock International, 1992).

This site of the study was chosen because it was the most appropriate environment for dairy production in the country. This area is free of Tse Tse fly and it is close to the two major towns, Douala and Yaoundé with a good road network. Temperatures are the lowest in the country and therefore suitable for high yielding dairy breeds. In addition, milk production in this area is a government priority. A dairy technology laboratory was established in the area to improve milk processing. Furthermore, the Heifer Project International, an international Non-governmental Organization (NGO) has established its head quarters in the region to closely help farmers in dairy management. The Western Highland region is therefore very suitable for the improvement of dairy production and was thus chosen.

### **6.3.2. Selection of farmers**

Dairy farmers who participated in the study were selected by means of the Economic Opportunity Survey (Nordlund *et al*, 2007) and on the basis of commitment to long-term collaboration in the research project. They were from the peri-urban area of Bamenda city.



### 6.3.3. Production and management systems

Twenty two farms selected were from the zero grazing system where grass was cut, chopped and provided to animals in feeding troughs. The majority of these cattle were Holsteins. Two farms were from the semi intensive system herding Holstein crosses (*Bos taurus* x *Bos indicus*). Cows were offered concentrate diets during milking. The semi-intensive farms had sleeping paddocks or sheds constructed of wood with zinc or grass roofs. Cows were milked in the 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 a few farmers spray dairy cattle against ticks, but hand picking of ticks is more common.

### 6.3.4. Interventions

Constraints identified by the PRA and EOS led to the setting up of interventions geared towards improving milk sales and milk production per cow. This was done by: 1) Encouraging farmers to be involved in the zero grazing system and keep the Holstein breed. Spreading this breed was done by introducing artificial insemination using chilled semen 2) Devising ways to help farmers increase forage consumption by pasture improvement, putting them in contact with hay producers and formulating a new feed concentrate 3) Advising farmers to supplement better yielding cows based on stage of lactation 4) Training farmers in milk processing to cheese and yoghurt in order to improve the shelf life of milk and therefore

better sales 5) Linking farmers with better health care services. These interventions were applied in an integrated way. Any problem faced by a farmer could be solved whether it be in the area of marketing, health, management or reproduction.

#### **6.3.5. Data collection**

Twenty four farmers were given three different cards to record farm information. Cards were of different colours therefore helping the farmer to easily recognize them. Red cards were used to record daily farm expenses. These expenses included the following aspects namely, feed cost, veterinary medicine, hired labour, material for repairs, breeding / artificial insemination, pasture improvement, land renting, milking or processing material, and others. The green cards included monthly income: quantity of milk sold to processing plants and cost, milk sold in informal market and cost, home consumption of milk, milk fed to calves, milk used for home processing, manure sold, culled animals, bull leasing and forage material sold. The blue card included milk production per cow and could combine monthly production in the farm. Each farm was visited once per week by a team of technicians.

#### **6.3.6. Analysis**

Data were collected over a two-year period. The month immediately before the start of the program was used as the baseline. Not all farmers recorded data every month; all available monthly averages were included in the analysis. A partial budget method was used to calculate the benefit of the interventions.

### **6.4. Result and discussion**

#### **6.4.1. Expenditures**

The interventions resulted in decreased expenditures (Table VI.1). Much of the reduction in costs was in the areas of repairs, hired labour, feed cost and ‘others’. Farmers could efficiently use the labour as the records now helped them to see what was spent in these lines. A feed

was formulated so as to reduce its cost while retaining its efficacy. Other expenditures related to transport were also drastically reduced. Farmers were now able to make concentrate at home. Most farmers used cooperative owned bulls and did not previously incur a cost to breeding. On the other hand, the need for veterinary services was shown to farmers. This led to an increase in veterinary care costs of up to 65% relative to the situation before the interventions. An increase in veterinary care is related to an increase in the awareness of good general management for the cows. It was found that much of the expenditures were related to feed (38% of all costs). This shows that even in intensive small scale dairying, feed cost accounts for most of the expenditures. Consequently it is good to continue using local agro industrial by-products in feed formulations. These are: cotton seed cake, rice, corn and wheat bran, palm kernel cake, brewers grain and bone flour. Overall monthly expenditures per farm with or without interventions were higher than those reported by Tambi and Vabi (1994) and Pingpoh (1985) of \$15 and \$17 respectively (taking \$1 US at 500 FCFA). This may be an indication of an increase in investment that may reflect the expansion of dairy in the area.

#### **6.4.2. Income**

Income data is shown in Table VI.2. There was an overall increase in income. In South Africa, interventions led to an increase in income of nearly 120% in the first year and 220% in subsequent years (Braker *et al*, 2002). Increased income from milk was mainly due to the fact that some farmers started selling milk to the processing plant. The research team organized farmers to use common transport to deliver milk to the processing plant. Much of the income is also derived from sold animals. In the Western Highlands of Cameroon, large numbers of animals are often a sign of prestige to farmers. They keep bulls and unproductive cows therefore wasting time and resources. Culling these animals led to a substantial improvement of income. Dairy farmers are also mingled with crop farmers. The latter did purchase manure from cattle as fertilizer for arable crops. Income from milk processing also improved, particularly because of training offered to farmers in cheese and yoghurt processing. There

was a huge reduction of home consumed or shared milk. Due to the fact that farmers now processed more milk or delivered it to the processing plant, less was left for home consumption and sharing. Vabi and Tambi (1996) already found that improvements in the standard of hygiene and techniques of transforming fresh milk into other dairy products were acceptable strategies for intervention in the peri-urban milk producing areas of the North West Region of Cameroon. Finally farmers concerned in this study started to sell forage material, *Brachiaria spp* seeds and *Trypsacum laxum* cuttings. Before interventions, some of them did not even know that they could improve their pastures. They used naturally grown *Pennisetum purpureum*.

As regards total income, close to 2/3 were derived from milk products due to processing and culled animals. Only 7% income comes from milk sold to the processing plant. This is because of bad roads and poor management of the plant. This is similar to the Kenyan experience where 6% milk is sold to Kenya Cooperative Creameries (Stall *et al*, 2001). It is therefore necessary to expand milk processing training to other farmers not previously involved in interventions reported in this work.

**Table VI.1.** Expenditures due to interventions (\$ per cow per month)

	Feed cost	Vet cost	Hired labour	Repairs	Breeding	Pasture	Land rent	Processing materials	Others	Total
Interventions expenditures										
Per cow per month (\$)	15.81	5	7.83	5.97	0.21	3.24	0.14	0.88	2.03	41.10
Expenditures relative to total costs	38.47	12	19	14.53	0.5	7.87	0.34	2.15	4.93	100
Percentage reduction or increase in expenditures relative to month before interventions started	-21.4	65	-30	-57	100	-18	100	-1.75	-85	-18 <sup>a</sup>

<sup>a</sup> total percentage relative to first month

**Table VI.2.** Income due to interventions (\$ per cow per month)

	Milk sold to plant	Milk sold to informal costumers	Milk consumed or shared	Milk to calves	Income from milk processing	Manure sold	Sold animals	Bull leasing	Forage material	Total
<b>Interventions income</b>										
Per cow per month (\$)	6.8	4.5	14	0.82	33	0.4	35	0.4	0.08	95
<b>Percentage relative to total income</b>										
	7	5	15	1	34	0.45	37	0.45	0.1	100
<b>Percentage reduction or increase in income relative to month before interventions started</b>										
	88	-104	-1082	-15	19	49.5	80	-17	100	11

### **6.4.3. Partial budget**

Before interventions, farmers lost money. This led some of them not to buy feed for the cows. Those much interested in cash income neglected their farms and dairy cooperatives withdrew animals loaned to the negligent farmers. There is little incentive for improved management when farmers do not see a regular income or do not see any benefit in their business. Those who continue in this case expect their benefit from sales of offspring. Before interventions, farmers lost \$4.5/cow/month but gained \$38/cow/month because of the interventions. The return was 2.32 and included opportunity income for milk home consumed and shared. When this opportunity income (milk home consumed, shared or given to calves) was ignored, the return stood at 1.93. Interventions in addressing cattle diseases have proven to have a positive economic impact. The findings after controlling contagious Bovine pleuropneumonia in twelve sub-saharan African countries revealed that interventions were economically beneficial as all the benefit-cost ratios were positive in respective countries ranging from 1.61 in Ghana to 2.56 in Kenya (Tambi *et al*, 2006). The increasing rate of urbanization evident in Cameroon appears to depress the dietary role of cereals, roots and tubers in favour of the increasing importance of milk and dairy products (Tambi, 1998). The consumption patterns will probably continue in this trend therefore paving the way for much development of dairy production.

The cost of milk given to calves, home consumed or shared was estimated. This was reflected as an income because of the benefit derived by calves, family or neighbours, which led to a substantial profit and return (Table VI.3).

### **6.4.4. Impact of the interventions**

A PRA carried out to evaluate the impact of interventions showed that farmers saw the positive effects of the project in their dairy farms. They were now able to know through expenditures and income records, the profitability of their farms. They were happy that

breeding and health interventions were able to reduce the calf production interval. In such an area where malnutrition is rampant, families owning dairy cows saw a reduction in the frequency of human diseases. A survey revealed that 71% of people stated 'health and nutrition' as important reasons for drinking milk (Goldman *et al*, 1984). These aspects contributed to poverty alleviation. In Uganda and Kenya a scheme of introduction and improvement of small scale dairy production systems also alleviated the pressure of families struggling with poverty (International Agricultural Development, 1999). As in Kenya (Kidane, 1993), one dairy cow of a good breed can be enough to ensure a good income for smallholder farmers. The positive impact of interventions in Cameroon has enabled some farmers to acquire more cows. A spill over effect was that more crop farmers are now willing to be engaged at least partially in dairy farming. Farmers were keen to see the project continue. It will be good if many more farmers could also benefit from these interventions.





**Table VI.3.** Partial budgeting form (with milk shared, home consumed milk, and milk fed to calves opportunity cost)

<b>INCREASED INCOME (per cow per month (liters))</b>		<b>INCREASED COSTS (per cow per month (liters))</b>	
Additional Income generated from the program		Costs as a result of the program	
Milk sold (program)+opportunity costs	\$95.00	Farm costs (program)	\$41.00
MINUS		MINUS	
Milk sold (pre-program)	\$85.40	Farm costs (pre-program)	\$48.50
Difference in Income	\$9.60	Difference in Costs	-\$7.50
		Income minus Costs(profit)	\$54.00
		Net profit	\$17.10
		Income divided by Costs(return)	2.32
		Net return	0.56

## 6.5. References

- Bayemi, P.H., Bryant, M.J., Perera, B.M.A.O., Mbanya, N.J., Cavestany, D., Webb, E.C., 2005a.** Milk production in Cameroon: A Review. Livestock research for rural development. [www.cipav.org.co/lrrd/lrrd17/6/cont1706](http://www.cipav.org.co/lrrd/lrrd17/6/cont1706).
- Bayemi, P.H., Bryant, M.J., Pingpoh, D., Imele, H., Mbanya, J., Tanya, V., Cavestany, D., Awoh, J., Ngoucheme, A., Sali, D., Ekoue, F., Njakoi, H., Webb, E.C., 2005b.** Participatory Rural Appraisal of Dairy Farms in the North West Province of Cameroon. Livestock research for rural development. [www.cipav.org.co/lrrd/lrrd17/6/cont1706](http://www.cipav.org.co/lrrd/lrrd17/6/cont1706).
- Bayemi, P.H., Webb, E.C., Naoussi, P., Manjeli, Y., 2007.** Economic Opportunity Survey of Small Scale dairy farms of the North West province of Cameroon. *Tropical Animal Health and Production*, 39:583-592
- Braker, M.J.E., Udo, H.M.J., Webb, E.C., 2002.** Impacts of intervention objectives within subsistence farming systems in South Africa. *South African Journal of Animal Science*, 32(3).
- FAO, 2004.** Production yearbooks.
- Goldman, M., Pingpoh, D., Totale, E., 1984.** Milk consumers survey. Institute of Animal Research Bambui Centre, Working Document.
- Kidane, H., 1993.** Economic constraints of small holder milk production in Kenya: A linear programming approach. *Borneo Review* 4(2), p170.
- Ndambi, A., Bayemi, P.H., 2006.** Cameroon-Dairy Sector and Chain Profile. In. Hemme *et al.* (2006). IFCN Dairy Report 2006. International Farm Comparison Network, IFCN Dairy Research Center, Kiel, Germany, p102.
- Nordlund, K.V., Goodger, W.J., Bennett, T.B., Shamsuddin, M., Klos, R.F., 2007.** Methods for Conducting an Economic Survey in Small-Holding Dairy Farms, *Trop Anim Health Prod* 39:557–566.

- Pingpoh, D.P., 1985.** Determination of the selling price of milk produced by the farmers of the Bamdnda Dairy Cooperative Society. *Reviews of Science and Technology*,1, 113.
- Staal, S.J., Owango, M., Muriuki, H., Kenyanjui, M., Lukuyu, B., Njoroge, L., Njubi, D., Baltenweck, I., Musembi, F., Bwana, O., Muriuki, K., Gichungu, G., Omore, A., Thorpe, W., 2001.** Dairy systems characterisation of the greater Nairobi milk Shed. SDP Research report. Smallholder Dairy (R&D) project, Nairobi, Kenya.
- Tambi, E., 1998.** Testing for habit formation in food commodity consumption patterns in Cameroon. *Journal of International Food and Agribusiness Marketing*, Vol 10(1), p26.
- Tambi, E., Onesmus, M., Ndi, C., 2006.** An estimation of the economic impact of Contagious Bovine Pleuropneumonia (CBPP) in Africa. *Revue des Sciences et Techniques Officielles des Epizooties*.
- Tambi, E., Vabi, M.B., 1994.** Analysis of factors influencing dairy market involvement in Bamenda, North West Province, Cameroon. *Agribusiness*, Vol 10 (4), p299.
- Vabi, M.B., Tambi, E., 1996.** Household consumption patterns of dairy products in Bamenda urban town; North West Province, Cameroon. *Journal of International Food and Agribusiness Marketing*, Vol 7(2), p76.
- Winrock International, 1992.** *Animal Agriculture in Sub-Saharan Africa*, 162 pp, University of California, Davis, CA: Institute of Agricultural Development.