CHEMONICS INTERNATIONAL INC.

REPORT ON A VISIT TO THE CONTROL LABORATORY AT THE PYRETHRUM PROCESSING PLANT (SOPYRWA) RUHENGERI, RWANDA

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June 2002

Submitted by:
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Under the:
Assistance à la Dynamisation de l'Agribusiness au Rwanda
(ADAR) Project
Contract # PCE-1-807-00003-00 (RAISE), TO #807

For:
USAID/Rwanda, SO3

RAPPORT

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EXECUTIVE SUMMARY

The diagnostic mission for the production of hygienic milk for export in Rwanda was carried out for Chemonics International under its USAID financed Agribusiness Development Assistance in Rwanda (ADAR) project. The results of the mission will be for the benefit the Integrated Agricultural Initiative, a consulting and management company intending to venture into the production of U.H.T. milk for export regionally.

The main objective of the mission was to assess all the methods used in the collection of hygienic milk throughout the milk chain starting from the farm level until it reaches the consumer.
Methods used to collect data included an informal survey, individual interviews of government officials, farmers and farm workers, milk vendors, milk plant operators and marketing agents including milk hawkers and shop keepers and attendants.
Generally there are two sources of raw milk in Rwanda. The first is from the traditional sector in the rural areas and the second is the commercial small scale and large-scale sector mainly in the urban and peri-urban areas of the country specifically around Kigali City.

Milk handling and collection practices were observed to be average on commercial farms but very poor in the rural areas. Cooling of milk as a preservation technique while non-existent in the rural areas is quite organized in Kigali City where milk vending is big business. Milk transport and handling generally was observed to be very poor and chaotic in both sectors. Quality assurance procedures where they exist are extremely poor both at the local and national levels. Due to these logistical constraints the volume and quality of milk available on the market is low a factor which might constrain the production of U.H.T unless urgent measure to rectify this situation are initiated. Technically it is possible to produce reconstituted U.H.T. milk using powdered milk and small amounts of good quality raw milk. This might be the best alternative available to IAI in the short term. In the long term milk powder then could gradually be replaced by raw milk as production and milk collection is improved.

Recommendations on the appropriate management and technical practices to improve the production of hygienic milk are given at the end of each section. In addition, recommendations by the stakeholders in the milk industry including farmer representatives at given out at the end of the mission briefing seminar are also included in this report.

1. BACKGROUND

The Government of Rwanda's policy on the revitalization of Agriculture including the livestock sub-sector focuses on the "empowerment of local populations to fight poverty by participating in planning and management of their development process. To achieve these development objectives, the government must address several institutional issues in order to define a sustainable and cost-effective approach to assure that a broad range of farmers have access to basic agricultural services. These services include production and marketing information, training to improve individual, farmer groups or associations and organizational management capacity, such as skills in financial management and planning as well as credit, input and output marketing services. Milk quality and marketing are very important factors of production of processed milk and has an indirect effect on farmer's economic well-being as it may affect the milk pricing mechanisims. It is within this context that Chemonics International initiated this mission.

The mission fits very well into the objectives of Chemonics's International project known as Agribusiness Development Assistance in Rwanda ADAR project under the USAID/Rwanda Strategic Objective Number Three SO3 project, which are:

1) To add value to key commodities targeted for export
2) To build efficiency and expand employment within commodity chains
3) To upgrade managerial and technical capability in agribusiness enterprises
4) To improve products quality and expand access to markets
5) To develop financing options to support agribusiness growth

1.1. The Mission's purpose

The diagnostic mission for the production of hygienic milk for export in Rwanda was undertaken for the benefit of the Integrated Agricultural Initiative S.a.r.l (IAI), a new company in Rwanda to prepare itself for the production of quality UHT milk for export into the COMESA market of which Rwanda is a member. IAI runs Nyabisindu milk plant mainly for the production of yogurt milk for the local market and Songa dairy farm for th production of raw milk. The latter farm has a capacity of 250 herds of cattle but the current herd strength stands at 225 including 68 pregnant pedigree Holstein Friesian heifers recently imported from South Africa. IAI's goal is to diversify into UHT milk production by utilizing potential milk from other parts of the country targeting internal and external markets.

Before venturing into UHT, IAI thought it should first pay attention to issues like methods of collecting quality milk from the farm level through the milk chain until it reaches the consumer. In modern economies, the target consumer is the town dweller, often-far way from the point of milk production. Milk hygiene, collection, transport, preservation, processing and distribution are integral aspects of the industry.

Milk and milk products quality relates to its chemical, microbiological, physical, and organoleptic properties, as well as to its safety. Cow's milk is among the most perishable of all foods, due to its fluid form and excellent nutritive composition. To protect milk's quality, this food should be handled and processed under rigid sanitary conditions, to ensure low bacterial count, good flavor and appearance, satisfactory keeping quality, high nutritive value, and freedom from disease-producing organisms and foreign constituents. The responsibility for ensuring milk's quality is shared by public health officials, the dairy industry, and consumers. Attention must therefore, be given not only to methods of milk production but also to methods of collecting milk from farmers and delivering fresh milk and milk products to consumers.

1.2. Mission Objective

To assess the existing hygienic conditions and potential improvements within the milk chain from production to marketing.

1.3. Mission tasks

The following were the specific tasks of the mission.

i. Analysis of operations during milk collection
ii. Analysis of operations during milk processing
iii. Analysis of management operations
v. To Analyze management operations and personnel training needs

2. METHODOLOGY

Several methodologies were used in obtaining information on the current state of affairs in the livestock sector in Rwanda and on how milk hygiene in the milk chain could be enhanced or improved.

2.1. Literature search

Secondary data on the livestock industry in Rwanda was collected from various sources including the Internet, Government documents and libraries. Information was also collected from individuals knowledgeable on the current status of the livestock industry in Rwanda

2.2. Single visit surveys

The quality and safety of market milk begins with the milk producer. Therefore, new technologies and practices by the milk producer are the major factors in improved milk quality and safety. The mission therefore, begun at the farm level. Surveys and interviews were done in purposefully selected smallholder and large-scale farms including Songa dairy farm owned by IAI company and on smallholder farms around Nyabisindu milk plant in Nyanza prefecture **,**Gitarama province.

Similar surveys were also carried out in the districts of Muvumba , Murambi Rukara,Kabare Bugaragara, Gabiro, Kahi and municipality of Umutara in the Umutara province. This province serves as an important milk shed area for Kigali city. Lastly surveys were carried out on commercial medium dairy farms in the urban and peri-urban area of Kigali city and Kigali Ngali provinces.

2.3. Interviews with individual farmers and Government officers

Discussions and Interviews were held with the following individuals, farmer representatives and government officials during the mission.

- *Chemonics International local office staff*
    1. Mr. Geoffrey Livingston, Chief of Party
    2. Mr. Maurice Wiener, Deputy Chief of Party
    3. Mr. Jean-Bosco Seminega, Enterprise Development Specialist

- *Ministry of Agriculture Animal Resources and Forestry*
    1. Mr. Venuste Rushalaza, Coordinator Rural Sector Support Program
    2. Daniel Rukazambuga, Technical Officer Rural Sector Support Program

3. Dr. John Musemakweli, Coodinator Dairy Cattle development Support Project
4. Dr. Joram Sebatwale, Director National Veterinary Laboratory
5. Dr. Tito Migabo, Director Rwanda Bureau of Standards

- *Integrated Agricultural Initiative*

1. Mr. Innocent Rutamu, Director of Production
2. Mr.Theogene Rutagambwa, Production Manager Nyabisindu Milk plant
3. Mr. John Paul Ruzindana, Chief Technician, Nyabisindu Milk Plant
4. The farm Manager Songa dairy farm
5. Ms Francoise Bakashema , Marketing Manager IAI

- *Rwanda Livestock Farmers Association*

Mr.Ndekezi Sebujisho, Chairman Rwanda farmers Association.

2.4. Personal observations

These complimented all the other methods mentioned above and relied on the consultant's own experience

3. RESULTS

3.1. The Country

Rwanda is a rural country with a land area of 26,340 square kilometers at an altitude ranging from 1000-4500m above sea level. It is a landlocked country (Figure 1) and has few natural resources and minimal industry. It is the most densely populated country in Africa with a population estimated to be above 8m people.

The Republic of Rwanda comprises twelve (12) Provinces and one hundred and sixteen (116) Districts and Municipalities. It is basically an agricultural country with agriculture contributing 40% of the GDP and employing 90% of the population. Primary exports are coffee and tea. Regardless of the 1994 genocide, which decimated Rwanda's fragile economic base and eroding the country's ability to attract private and external investment, Rwanda has made significant progress in stabilizing and rehabilitating its economy. GDP has rebounded, and inflation has been curbed.

Fig. 1. The map of Rwanda

3.2. The Livestock sub-sector

Livestock production is one of the major agricultural activities in Rwanda. Livestock plays a very important role in the socio-economic activities of Rwanda. It contributed 5.3 % of country's GDP in 1997 and serves as both a food reserve for humans, a source of manure, income, and savings and has other non-monetary but important social functions especially for cattle including prestige and payment of bride price.

Livestock production and productivity in Rwanda is however, constrained by tremendous pressures created by reduced availability of land per capita and availability of inputs like feeds and animals with good genetic base for milk production. Livestock production and productivity needs to be improved through the introduction of improved breeds of cattle, breeding practices based on a scientifically planned breeding policy, good extension and farmer training and organized marketing system etc. In other words what is needed is better utilization of the available land for livestock and human resources through the introduction training and application of improved animal production technologies at all levels from production, processing and marketing.

3.2.1.Systems of livestock production in Rwanda.

The livestock population in Rwanda is estimated at 808,000 cattle, 703073 goats, 287672 sheep, 214970 pigs, 20430770 poultry and 229399 rabbits (MINAGRI, 2002).
Commercial milk production in Rwanda is basically from cattle and there are three major milk production systems in Rwanda similar to most sub-Saharan African countries (Shem and Fujihara, 2002). A brief review of the existing livestock system will bring a better understanding of the livestock sector and the potentials and limitation for the production of quality milk.

3.2.1.1. The extensive system.

Under this system there are three categories of livestock keepers:

a) Pure pastoralists found mainly in the Umutara. Cattle ownership under this range from as low as 1 to 50 herds of cattle per household. This sector contains 40% of country's cattle population. Most of the smallholder livestock farmers in this system keep local Ankole breeds of cattle or their crosses with exotic breeds.

b) The agropastoralists in the densely populated areas who normally graze their cattle on communal lands. These own an average of 2 cows per household comprising 25% of the country's cattle population.

Plate 1. The Ankole breed under the extensive Savannah grazing lands of Umtara Province

a) The cattle keepers of the mountainous rest and other surrounding areas who also graze their cattle on communal lands. These own an average of 1 to 15 cows per household comprising 20% of the country's cattle population.

The dominant breed of cattle in this system is the Ankole cattle (Plate 1), a hardy, meat animal but low milk producer.

3.2.1.2. The semi-intensive system.

Stockbreeders under this system keep crossbred cattle (Ankole x Sahiwal) managed under minimal housing, health and feeding conditions. The average herd size ranges from 10 to 25 cattle. This comprises about 10% of the national herd.

3.2.1.3.The intensive systems

Under the intensive management system, farmers keep mainly imported purebred or grade Jersey, Sahiwal. Holtein Friesian,Brown Swiss and crossbreds of these breeds with Zebu cattle. Farmers under this system keep 1 to 150 herds of cattle with an average herd size of 20 cows per farm under the zero grazing management system. Most of these dairy farms are found in the urban and peri-urban area of Kigali and along the Kigali Rwamagana highway.

These farms are generally well managed as most owners have the capital and can afford to hire or pay for the services of qualified staff to manage the animals. With improvement in management and improved breeding, this sector has potential and could form the basis for the rapid development of the dairy industry in Rwanda. This system contains about 5% of the country's cattle population but with the highest scope for expansion compared to the other systems.

3.2.2. Milk production and Consumption

According to the available information, Rwanda produces about 56,000 tons of milk in from cattle, 630 tons from goats, 300 tons from sheep, which satisfies only 17% of the population needs (MINAGRI, 2002). On the other hand the estimated total milk requirements for the country is 500,000 tons per annum **0.2 litres per caput**. There is therefore a deficit of 450,000 tons per year. This shortfall was up to 1999 covered by importation of raw and processed milk (40,000 tones from Uganda). In addition substantial amounts of milk powder are also imported into the country (Rutamu, 2002 – personal communication). In more recent years the Government took measures to prohibit the importation of raw milk at the same time encouraged the importation of improved breeds of cattle from Europe and recently South Africa. Although statistics are not available these measures have led to an increase in milk volume on the market. However, the volume of imported milk powder and other milk products is still high.

4. ANALYSIS OF OPERATIONS DURING MILK COLLECTIONS AT FARM LEVEL

4.1. Traditional farms

4.1.1. Infrastructure

The infrastructure on the extensively managed herds was non-existent. Cows are milked in open kraals using the natural partial milking system.

4.1.2. Equipment

Milking equipment included plastic cups or containers made of aluminum and calabashes in all farms visited.

4.1.3. Milking practices

Milking practices in traditional farms were rudimentary and were all by hand. Udder wash is rarely done even if water is available. Besides the poor infrastructure and the un appropriate milking equipment cross-contamination of the milk at the farm level in the rural areas was observed to be generally very poor. Poor cow hygiene before milking and dirty udders and teats contaminate the milking equipment and the milk before it leaves the farm.

4.1.4. Milk collection and transport

In the Umutara Province, milk is collected by milk vendors in plastic containers on bicycles (Plate 2) by vendors or brought by farmers themselves at several open-air collection points (Plate 3) along the Uganda-Rwanda highway.

Plate 2. Milk transport by vendors on bicycles

At the collection points the milk is sieved using ordinary tea sieves and transferred (Plate 4) into aluminum cans under very unhygienic, hot and dusty conditions. Milk collection begins at 9.00 am and ends at between 11.30 and 12.00 am.

Plate 3. Milk collection in the open

Plate 4. Milk being transferred from plastic container into an aluminum can

Most times farmers are cheated by vendors and are always the losers. Farmers are at the messy of the milk vendors who act middlemen between the farmers and the wholesale traders as they dominate the marketing and transport activities.

Plate 5. A typical milk vendor at work sitting on a can full of milk

Milk is transported by road in aluminium cans, which are put in open trucks (plates 5 and 6). The milk reaches Kigali at around 8.00 pm. By this time milk will have been spoilt as the fermentation process in milk starts in the first hour after milking. It was reported that most of the milk is either brought back to the farmers, spilled or sold at throw away prices for making fermented milk.

Plate 6 Milk cans covered by plastics

Plate 7 Milk transport in a truck

This stage in the milk chain was observed to be the weakest link. Until this is addressed by the authorities (i.e. MINAGRI) there is no way Rwanda can produce quality milk not only for the export market but also for the internal market.

Such milk will definitely test for high acidity above pH 6.4 – 6.5 normally recommended for pasteurized milk. Worse still milk with pH of 6.4 is not suitable for U.H.T. production due to the sensitivity of the equipment and the high temperatures used in the processes. The residual bacterial load will also be to high above the allowable 1000 spore per milliliter of milk. Such milk will not be aseptically acceptable on the market and its shelf life will be reduced.

4.2. Commercial farms

On the intensively managed farms the infrastructure available includes milking parlors, holding pens, feed stores and toilets for workers. The infrastructure available was found to be satisfactory and comparable or better than to similar farms in East Africa. The quality of cows milked was very high as most of these are pure breeds imported from Europe and South Africa. Milking and milk handling practices on commercial dairy farms visited was more advanced than in traditional farms but not up to standard due to improper milking practices as described in the following sub-sections.

4.2.1. Udder preparation.

Udder cleaning and the overall environmental hygiene in all the farm visited was very poor. Only Songa dairy farm used hot water to clean the teats and udder. On other farms cow udders and teats were washed with cold tap water Drying of teats was not practices on all farms.

4.2.2. Teat priming

This activity involves the removal of a few squirts of milk from each teat quickly examine and determine if there are clots or flakes and stringiness or wateriness in milk. This was not carried out on any of the farms visited nor were strip cups and milking salve used. Milkers did and farm owners seemed not to be aware of the importance of this activity. As a result a lot of the imported high milk yielding cows had one or two blind quarters or had clear signs of clinical mastitis

4.2.3. Milking.

Hand milking is an art, which the Rwandans seem to excel. In all the farms visited this activity was carried out as recommended and udders were stripped and emptied completely.

4.2.4. Teat dipping.

This was not practiced in all the farms visited. Ideally teat dip replaces the milk film with a film of teat dip, which kills bacteria that may be on the teat skin and teat end. This helps the control mastitis.

4.2.5. Milk handling and cooling.

Milk was filtered manually in all the farms with a few exceptions where milk was poured straight from the bucket to the milk cans. Milk cooling and storing was not done in any of the farms visited as it is sold to milk vendors or is transported quickly to Kigali city where it is stored in cooling tanks either owned by farmers themselves or by their agents. Milk from Songa dairy farm was taken straight and cooled at Nyabisindu milk factory located a few kilometers away.

4.3. Personnel

Farmers and vendors need to be trained on the proper milking practices and milk handling practices Farm personnel should continuously be trained on-farm and supervised by competent herdsmen and extension officers. Specifically they need to be trained on.

- Proper handling of cows and on observation of abnormal milk
- Proper cleanliness of milking barn/stable and cow yard
- Cleanliness of milk and milk equipment
- Maintenance of proper toilet and water supply
- Handling of utensils and equipment
- Proper pre and post-milking hygiene
- Proper transfer and protection of milk during transport to the collection centres
- Proper personal hygiene

4.4. Conclusions and recommendation

Hand milking is widely practiced in all the farms visited both on traditional and on large-scale production systems. Traditional practices and the type of management systems in Rwanda and the small size of scattered farms in less-favored farming areas makes the use of milking machines difficult or impractical. However, hand milking need not be a handicap to the production of high quality milk, which will allow economic returns to production to be maximized. It is therefore important to provide a guide to good practice for farmers practicing hand milking and who wish to improve the bacteriological quality of their milk. The animals, the milkers, the milking utensils, transport containers must be clean. The animal's health (especially tuberculosis, brucellosis and mastitis) and that of the milkers should also be given due attention. At Institutional level it is recommended that MINAGRI institute the use of dairy farm inspection and quality control inspection reports and other enforceable control mechanism to check the free for all attitude among milk producers. The extension arm of the ministry should be strengthened and its outreach programs if available should be enhanced.

Milk collection and milk handling is extremely poor especially in rural areas of Umutara province. Under normal circumstances much of the milk collected could be rejected by the time it reaches the market as it is of low quality. The farmers and transporters lose money and the nation suffers because its people miss the high quality food. To avoid this, hygienic milk handling is essential at each stage; at the FARM, COOLING CENTRE AND DURING TRANSPORT. The following measures are recommended at the farm level.

4.4.1. Proper sanitation of milk cans.

Immediately cans are emptied of milk they should be cleaned as follows:

- Cold water rinse.
- Scrubbing with brush and warm detergent (any un-perfumed liquid soap will do).
- Cold water rinse.
- Sterilization (sanitization) with boiling water or steam if available or use dairy sanitizing solution such hypochlorite or commercial brand preparations in accordance with manufacturer's instructions.
- Dry cans on a drying rack. Exposure to sunlight will enhance killing off bacteria during drip-drying of cans.

4.4.2. The cows

Follow proper milking hygiene; mastitis cows should be milked last and their milk discarded. Milk from cows treated with antibiotics should not be mixed with milk from healthy cows. Observe the required 4-day withdrawal period. Milk with antibiotics will affect consumers' health as well as spoiling activity of lactic starter cultures used in cheese, yoghurt manufacture.

4.4.3. Milk transport vessels (cans and tanks)

All milk transport vessels should be cleaned in the same way as outlined for milk cans above. There should be provision for water at milk cooling centres to enable all milk suppliers' vessels or cans to be rinsed with cold water.

Plastic containers should be discouraged from being used as milk containers at any stage. This is because most plastic materials have characteristics, which make them unsuitable for milk, namely:

a) They scratch easily and thus provide hiding places for bacteria during cleaning and sanitization
b) Plastic is a poor conductor of heat and hence will hinder effective sanitization by heat
c) Plastics are sensitive to heat and may not withstand the necessary high temperatures required to achieve sterilization for many repeated operations. They may change shape during sterilization or become brittle.
d) Some plastics transmit flavors to milk either from themselves or from the surroundings.

Metal containers are recommended as milk containers; however, containers made of cooper are not suitable because of its oxidative activity on milk. Also stainless steel although is the most suitable, is heavy and very expensive. Aluminium cans are light in weight and do not affect the flavours of milk, are fairly resistant to chemical attack by washing and sanitizing agents (except NaOH). They are also cheaper compared to stainless steel can and are widely used in many developing countries.

4.4.4. Milk collection.

It is important to remember that under a hot environment milk will spoil within 3-4 hours. So any means of cooling that will lower the temperature of milk from 38? C at milking will help to prevent multiplication of bacteria. There are several options available. Ideally milk should be immediately cooled after milking, preferably to 4? C. This requires mechanical refrigeration or milk cooling tanks. These are expensive and can usually be afforded by large-scale commercial farms or by Government and donor-assisted programs. These methods depend on eveaporative cooling system but are not very efficient and cannot be very much relied on especially in very hot areas.

However, in the rural areas such as those in the highland areas of Rwanda where the water temperature can be as low as 10? C, the milk may be cooled down to 2? C using water temperature by one of the following techniques.

a. Immersing milk cans in a water trough connected to a water tap or water spring.

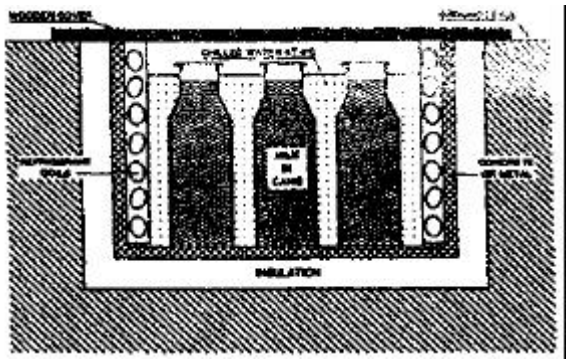

Fig. 2. Milk cooling by immersion in a trough with cool water.

b. Using a surface milk cooler

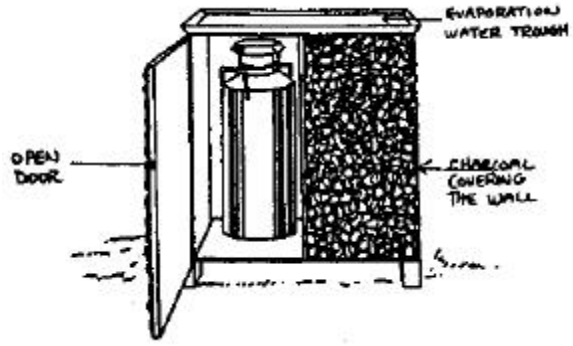

Fig. 3 Surface milk cooler

In hot areas like in the Umutara province cooling of milk below 3-5? C below ambient temperature may be achieved through use of charcoal lined evaporative cooling cabinet.

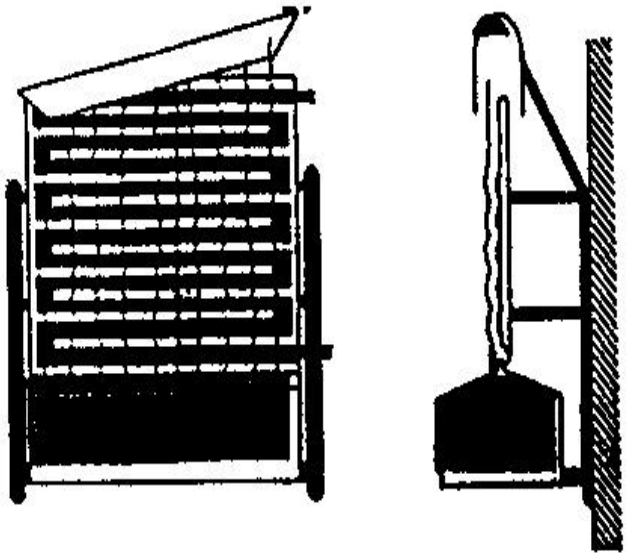

Fig. 4 evaporative charcoal lined cooler

In the case of farmers delivering milk via pick-up (collection) points as described earlier for the Umutara province it is advisable that the milk cans are placed in a shaded area (Fig.5) while awaiting pick-up by a milk transport vehicles

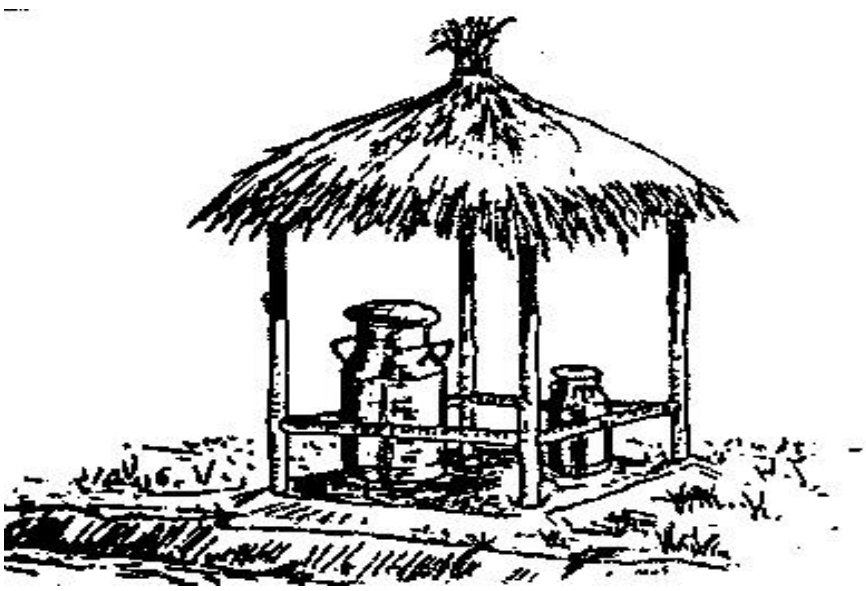

Fig. 5. Provision of shade at pick up-points is important.

5. ANALYSIS OF OPERATIONS DURING MILK COLLECTIONS AT FACTORY LEVEL.

5.1. Nyabisindu Milk Plant

The Nyabisindu dairy Plant started its operation back in 1937 and was popularly known as the King's plant. As it was King Rudahigwas's idea to start the plant with the objective of producing butter for the place and even export to neighboring kingdoms.

In 1965, UNICEF donated equipment to the plant, but full operation started in 1996 after the Germany government agreed to support the plant with new equipment, expansion of the plant, staff training and provision of subsidy funds for its running costs until September 1983. During that period to 1994 the plant's throughput was 10,000 to 12,000 litres per day. The plant was however damaged during the war and was rehabilitated in November 2000 to the present a daily capacity of 15,000 litres per day.

5.1.1. Infrastructure

Currently the plant has no milk collection centres of its own as they were destroyed or vandalized during the genocide. For example at Gatsinsino area most of the cooling equipment were stolen and the buildings are still informally occupied.

The plant has three main buildings, which include the main building where all processing activities are carried out, an office block and a godown or storage shed. Milk reception area is part of the main building used for processing milk and is situated at the front.

5.1.2. Equipment

Equipment available at the reception is very basic and includes a milk-receiving platform equipped with a sampling rack with plungers and dippers. Milk filters are also within the reception area and are used to filter the milk before it goes through to the processing area.

5.1.3. Milk collection procedures

The objectives of the plant are :

- To purchase and process milk from neighbouring farm communities
- To market the processed milk and other milk products

Previous to the genocide the plant collected or received milk from 15 communes in the three prefectures of Butare, Gikongoro and Gitarama and Songa farm. Currently the plant collects 4,000 – 5,000 litres of milk per day mainly from local farmers, Songa farm and milk vendors from as far as Gikongoro prefecture.

Milk collection is mainly from milk vendors and from Songa dairy farm. Vendors bring milk from surrounding areas and as far as Gikongoro prefecture on bicycles (Plate 8) while milk from Songa dairy farm is brought by motorized transport. Due to lack of proper milk collection and cooling facilities and the long distances covered plus the mode of transportation used, the milk is already spoilt by the time it arrives at the plant. On-spot physical observation showed that milk arriving at the reception had already separated with small or large clots of floating butter due to the churning movements of the bicycles enroute to the plant.

The main aims of milk quality control at reception are

- Assesment of freshness.
- Assesment of hygiene quality.
- Assesment of composition.

Plate 8. Milk being delivered to the factory on bicycle

Milk collection commences at 9.00 am and ends at 12.00 am. When the milk is received the following test are carried out.

- pH,
- Acidity,
- Density
- Alcohol test
- Organoleptic properties
- Butter fat

The freshness and hygienic quality tests are carried out by the plant to help in making decisions whether to accept or reject the milk and to decide on the further use of the milk. These tests are carried out immediately after the arrival of the milk at the reception area, before accepting and measuring it. Assessment of composition helps to detect fraudulent adulterations and is carried out at the reception but regular samples are also taken for the testing of chemical residuals and for somatic cell counts. Results from these test although useful are of doubtful use as the most of the milk is already spoilt before it arrives as mentioned above. They are only useful for testing milk from Songa farm and milk corrected from the immediate neighborhood. As all the milk is bulked before processing again this is an exercise in futility. In any case it helps in deciding what type of product to use and to reject the most spoilt milk. That is why the plant does rightly produce only fermented milk.

5.1.4. Maintenance

No major maintenance activity is carried out in this section.

5.1.5. Quality assurance

Quality assurance starts at the reception where the earlier mentioned are carried out. A trained laboratory technician carries out more detailed assurance test in the plant's well-equipped laboratory. The following equipments are available.

- Sterilizer
- pH mete
- A fat testing machine

The laboratory has capacity and carried out all microbiological and bacteriological tests.

5.1.6. Milk transport

The plant has no milk tankers and processed milk is transported to the market either by traders using their own transport or by using its own three-ton truck to Kigali city, which is the main market for the plant milk products.

5.1.7. Personnel

The personnel involved in milk collection are two at the reception and one laboratory technician.

5.1.8 Training needs

As far as milk collection is concerned the most important group which needs training in the area of milk quality are the vendors and the staff at reception. Cleanliness of the equipment used in collection of milk and personal hygiene should be emphasized and routinely enforced. Another group, which needs training, is the maintenance team, especially in the area of routine maintenance scheduling.

5.1.9. Conclusions and recommendation

Nyabisindu dairy plant is underutilized and can only produce fermented milks. Currently pasteurized milk is not produced due to the low volume and poor quality of the milk received. The quality assurance measures at the plant are adequate and useless as mentioned earlier regardless of the competence of the personnel involved. Delivery of milk in plastic cans contributes to the poor milk hygiene and should be discouraged. Aluminum or preferably steel cans should be introduced. Routine plant maintenance is probably poorly done, as there was no evidence of any maintenance program as is normal in most plants. This should be rectified to avoid ad hoc maintenance of the plant machinery. Periodic maintenance schedules from the Company that built the plant however, were reported to be carried out on a regular basis.

To rectify the situation the following technical measures are recommended.:

1. Milk collection centres with cooling facilities should be constructed at the sources of milk
2. Simple adaptable cooling methods like those recommended above for the Umutara province should be introduced also in the milk catchments area for Nyabisindu dairy plant
3. Farmer and milk vendors training and organization should be encouraged to ensure sustainability of the new interventions
4. If possible the lactoperoxidase LP system could be introduced for preservation of milk during transport to the factory. The system is based on the enzyme peroxidase, which is part of a natural inhibitor of bacterial growth in milk during the first three hours after milking. The LP system has very strongly bactericidal activity against bacteria known to cause milk spoilage.
5. The plant should establish a central facility for cleaning the milk delivery equipment at the plant using hot water or steam by milk vendors.

6. ANALYSIS OF OPERATIONS DURING MILK PROCESSING

Once the dairy factory has accepted the farmer's milk, it has the responsibility of ensuring that the milk is handled hygienically during processing. It must carry out quality assurance tests to ensure that the products produced conform to specified standards as to the adequacy of effect of processes applied and the keeping quality of manufacture products.

6.1. Infrastructure

The processing house is divided into:

- Reception area
- Processing area
- Cold rooms
- Laboratory

Floors of buildings are made of bard washable surface. Walls are smooth and washable to about 2 meters from floor level and were painted with light colour. Doors are the self-shutting and windows are insect proof by mosquito netting to keep flies out. All rooms were kept clean and in good repair. All product-contact surfaces were cleaned immediately before use as often as necessary, by using cleaning techniques appropriate to the equipment and processes used at the plant.

6.2. Equipment.

Basic milk processing and handling equipment available at the plant include:

- A Cooling plate
- Five Storage tanks with a capacity of 20,000 litres
- A NIMCO heat exchanger pasteurizer
- An automatic CIP cleaning machine
- A homogenizer
- Fermentation tanks for making of fermented milk
- An automatic Alfa-Laval filling and packing machine
- A cold room for storage of processed milk before shipping

6.3. Processing and related activities

This is basically a small well-equipped plant with modern processing equipment (Plate 9)

Plate.9:Processing equipment at Nyabisindu Milk factory

6.4. Disinfections

Equipment used for handling liquid milk products are cleaned and disinfected after each period of use. Disinfections of dairy equipment are carried out by means of:

- Steam - Steaming is done for 10 - l5 minutes after the condensate has attained 85? C.
- Hot water - Hot water at 8O ? C (using soft water only to prevent deposition of salts) is done for at least 20 minutes in circulation cleaning for 15 minutes at 85? C

6.5. Auxiliary sections

6.5.1. Packaging and storage of finished products.

Packaging materials are stored in a dry store away from manufacturing areas and are used in a clean and sanitary manner. Packaging is carried out in away that avoids contamination of processed products using squire tetra pack milk containers which are very well sealed to protects the processed milk product against contamination until the product reaches the consumer

Processed fermented milk is stored in a cold room under clean conditions at appropriate temperature and humidity to prevent deterioration.

6.6. Maintenance of machinery including transport vehicles

Milk tanks and equipment except those bought prior to 1968 have maintenance catalogues. Although the plant has a resident engineer in charge of all plant maintenance it was surprising there was no routine maintenance schedules. As a results it is done on an ad-hoc basis. Spare parts for the processing equipment are normally imported from the USA and The Netherlands for the packaging and pasteurizer equipment respectively. No major breakdowns yet at the plant. .

Milk transport vehicle is under the supervision of the marketing division at the company headquarters and it therefore under the factory responsibility.

6.7. Quality assurance

When milk is pasteurized at 72° C for 15 seconds in a heat exchanger continuous flow like the one they have at Nyabisindu dairy factory, all pathogen bacteria are destroyed, thereby rendering milk safe for human consumption. Simultaneously various enzymes present in milk, and which might affect its flavour, are destroyed. In order to determine whether or not milk has been adequately pasteurized, one enzyme normally present in milk**, phosphatase**, is measured. A negative phosphatase result indicates that the enzyme and any pathogenic bacteria have been destroyed during pasteurization. If it is positive, it means the pasteurization process was inadequate and the milk may not be safe for human consumption and will have a short shelf life.

This test is carried as one of the major quality assurance test by the plant..

Nyabisindu uses 90° C for 5 minutes. For the type of milk collected, this was found to be the most appropriate temperature.

6.8. Personnel

The dairy factory has enough and apparently skilled in the practical aspects of milk processing. The processing and its auxiliary sections are well run and the hygiene was quite impressive. The academic qualifications of the personnel in this section and all the other sections could not however be verified.

6.9. Training needs

It is very difficult to specifically prescribe needed training for the personnel in this section, as their basic qualifications were not verified. However, continuous on-job training and improvements in the area of milk hygiene and quality control should be emphasized and is regularly done (Plate 10).

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Plate 10. The personnel team with a trainer from Alfa Laval at the back

6.10. Conclusions and recommendation

Given the working circumstances and all the technical constraints pointed out it is concluded that the processing and auxiliary sections of the plant were doing their best and their performance was quite good. The problematic areas seem to be in the areas of maintenance and quality assurance, which seem to be not well done. Again this might be a managerial issue as the personnel to carry out these activities is available

It is recommended that equipment repairs and maintenance should preferably be carried out after processing and that whenever machines have to be fixed during production runs, adequate precautions should be taken to prevent contamination of dairy products. Quality assurance should also be enhanced/emphasized if the company is really serious to venture into the export market.

7.ANALYSIS OF OPERATIONS DURING MILK MARKETING

Marketing of the milk (mainly fermented milk) from Nyabisindu dairy plant is the responsibility of the marketing division located at the company headquarters in Kigali. Besides Yogurt from Nyabisundu dairy factory, the division markets the company's own brand of UHT by the name of VIVA, currently produced by sub-contracting to a Uganda based company which processes and packs this brand of milk in three variants of fat content. The consumer public very well accepts this brand. The aim of this business venture was to test the local market as a springboard to marketing it in the region but using Rwanda's milk. This was a very clever and innovative idea as VIVA milk although still produced at small rate can now be found not only in large areas of the country but in Burundi and Eastern Congo.

7.1. Infrastructure

The company's marketing infrastructure includes a central selling centre/outlet located within the company's headquarters. the provinces and out of the country.

7.2. Transport procedures

Milk from Nyabisindu dairy plant is transported in an insulated milk truck to the central distribution centre from where it is sold as described in the proceeding section and distributed using a moped van (Plate 11) However, the distribution system is still very weak.

Plate 11. Insulated trucks for distribution of processed milk

The company lacks refrigerated trucks for this purpose and mopeds to distribute the milk. As a result a wide range and number of customers are not reached forcing the company to rely on middlemen/women who often hike the milk price, which is detrimental to the company in the competitive market..

7.3. Storage and treatment of products at sales outlets

Available storage facilities include a cold room, a store and refrigerated facilities at the selling counter for retail purposed. A small milk bar is also located in the building. Milk is sold both to individual consumers and wholesalers. However, most of the milk is sold in bulk to wholesalers located strategically throughout the City, who in turn sell to their agents. The hygiene is at these facilities is excellent.

7.4. Personnel

The personnel in this section are under the supervision of the marketing manager and their number is sufficient.

7.5. Training needs

The training needs in this section as far as milk hygiene is concerned should focus on storage and handling of perishable goods like milk and milk products especially during the distribution activities.

7.6. Conclusions and recommendation

Milk marketing is well done regardless of the mentioned constraints. However, the distribution network was found to be very weak due to lack of appropriate facilities. The company should get out of the retail and vending activities and use contractor or agents. This will allow its personnel to concentrate on the development and supervision of the distribution system. This move besides reducing costs will reduce overhead costs in terms of salaries and storage space and their related costs as these will be transferred to the agents.

8. ANALYSIS MANAGEMENT OPERATIONS

Serious efforts have been taken by the company to improve the human resource capacity through recruitment of competent personnel and tailor made intensive on the job training schemes. These measures on improving the human resource capacity was taken to go hand in hand with the improved technical capacity of the plant equipment

8.1. Company organization and management structure

A qualified production manager with qualifications up to Msc. level in animal science manages the company. As far as the milk business is concerned, the technical staff includes the plant manager, production manager, two laboratory technicians, one microbiologist, one mechanical technician and one electrical technician, the chief accountant and the marketing manager. Under these is a number of unskilled staff with practical on-job training.

9. QUALITY ASSURANCE AT GOVERNMENT LEVEL

9.1. The Rwanda Bureau of Standards.

At the national level, quality assurance as far milk products and standards are concerned is the prerogative of the Rwanda Bureau of Standards. This is a very young institution facing a lot of constraints especially the lack of competent and trained personnel and equipment especially in the area of milk quality assurance. In summary this institution has no capacity to carry out even the basic quality assurance tests on milk and does not have milk standards for Rwanda. Rwanda bureau of standards plans to designate the quality assurance issues to the National Centre for Animal Health.

9.2. The National Centre for Animal Health.

The centre oversees the animal health care and control of zoonoses countrywide. The centre has qualified staff and very well equipped laboratories. Its bacteriology department has a very well equipped laboratory, which carries out the following activities.

- Diagnosis of bacterial diseases.
- Microbiological analyses of animal feed and food of animal origin.
- Studies on bacterial zoonoses (Brucellosis, TB, Salmonelosis) etc.
- Environmental hygiene

- Handling culture media, identification and typing of bacteria
- Carrying out of research and investigation of bacterial diseases of economic and social importance.

This centre is competent and is capable of providing the milk assurance services to the dairy industry in Rwanda.

10. LINKAGES WITH RELEVANT GOVERNMENT AGENCIES AND PROJECTS

U.H.T milk production has two main pre-requisites, volume and milk quality. As noted in this report these two factors are seriously lacking in Rwanda at the present and needs equally serious measures to tackle them. The Ministry of Agriculture, Animal resources and Forestry (MINAGRI) has initiated two important programs include the dairy Cattle Development Support Project and the Rwanda rural sector Support Project. Both projects will address the issues of milk volume *the target is to produce 265,000 tons of milk per year in two years time from now and quality through training, breeding and cattle improvements, credit and service provisions and equipment supply etc. In particular, the construction and development of milk collecting and cooling centres in the whole country will benefit from these projects. It is envisaged for example that AIA through Nyabisindu dairy plant with the assistance of the Government intends to participate fully in the construction and management of these collection centres.

11. ANALYSIS OF PERSONNEL TRAINING NEEDS

The training needs of the following groups are summarized in Figure 6.

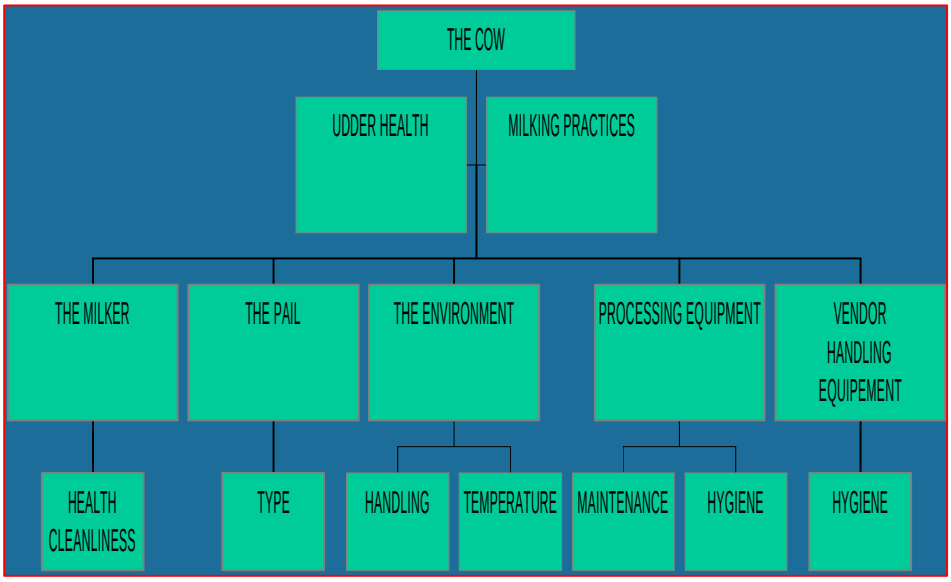

Figure 6. A chart showing training proved for the different players in the milk chain

- For farmers and farm workers.
- For milk processing staff.
- For auxiliary staff.
- For marketing staff.
- For farmer groups.

12. GENERAL RECOMMENDATIONS FROM END OF THE MISSION SEMINAR

At the end of the mission the consultant gave a seminar to farmer representatives and government officials (Section 2.3 page 9). This created a forum for synthesizing the mission's results.

From this seminar it was concluded that:

- Milk in Rwanda is produced and marketed under extremely poor hygienic conditions
- Milk marketing in the country is chaotic and needs to be organized and controlled to safeguard the health of the consumers and the economic interests of the farmers
- Rwanda needs a modern and viable commercial dairy sector to meet the milk demand of the ever-growing population
- It is potentially possible to produce U.H.T milk in Rwanda if all the milk produced is collected. The target of 12 months was found to be rather ambitious. The seminar was of the opinion that if need

be then reconstituted U.H.T milk could be produced from imported milk powder with gradual replacement with raw milk as production is increased.

- Increased efforts should be directed toward the construction and revival of unused (Plate 12) and new milk collecting and cooling centres respectively especially in the rural areas.

Plate 12. Unused milk collection cetre at Umutra municipality.

- The extension system needs to be strengthened up to village level and out of office (Plate 13) if the livestock industry is to be modernized. Outreach programs have to be revitalized.

Plate 13. From the office to the field

- Quality control and assurance measures have to be put in place and enforced throughout the milk chain
- Sustainability in of the technologies and interventions in the industry will only be achieved if farmers are well organized and empowered.

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