

# **Agricultural Analyses and Design** ***Analyses Agricoles et Conception***


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## **PROCESSING AND PACKAGING OF RWANDAN AGRICULTURAL PRODUCTS**

By

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## PREFACE

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The Agricultural Analyses and Design (AAD) activity is an eight-month design activity undertaken by the Chemonics International RAISE Consortium through funded supplied by USAID/Rwanda. USAID/ Rwanda is using this study and design effort to support its Strategic Objective Number Three (SO3) *to increase the ability of rural families in targeted communities to improve household food security*. Specifically, USAID seeks to obtain information and proposed intervention strategies, approaches and activities suitable for USAID/ Rwanda's support in achieving the second Intermediate Results under SO3 (IR3.2) of *creating and enhancing internal production / marketing chains that promote broad-based economic growth*. The purpose of AAD, therefore, is to provide USAID/ Rwanda directions and information for their use in future development and eventual funding of a project that seeks to revitalize agribusiness in Rwanda and recreate links between the rural sector and private sector traders and processors. This USAID project will achieve its objective by addressing identified constraints and opportunities within the commodity chain for increasing economic growth via agricultural production and agribusiness. The principal task of AAD is to identify these constraints and opportunities.

The Agricultural Analyses and Design activity is divided into three phases. The first phase (two months) is to identify and recommend for in-depth study to USAID/ Rwanda those commodity chains and interventions that have the most potential for creating increased economic growth, internal and external trade, opportunities for employment and increased income. The second phase (four months) will consist of a number of in-depth studies. Some studies will look at crosscutting issues such as transportation, finance and economic policy. An additional study will look at the creation of Agribusiness Support Centers. The remaining studies will be in-depth analysis of interventions related to commodity chains identified in phase one and selected for study by USAID/ Rwanda. The results of these studies will provide the basis for phase three of the activity, the synthesis of the studies done in phase two and development of a technical proposal and supportive design components for USAID/ Rwanda's use in developing a request for proposal (RFP) for a project to support IR3.2.

Dr. David Picha and Mr. Dominique Henry prepared this report in three separated visits to Rwanda. Mr. Henry visited the country from 5 to 19 February and again from 4 to 18 March 2000. Dr. Picha visited the country from 26 February to 6 March 2000.

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## EXECUTIVE SUMMARY

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Processing and packaging are major components of marketing. The study of these issues looked at general processing and packaging questions as well as specialized issues related to the meat and dairy industry and horticultural crops.

In general, the Rwandan agricultural processing and packaging industry is still quite rudimentary. There are, however, some exceptions. A modern flourmill is in operation in Ruhengeri. There is a modern dairy in Kigali that maintains high standards. A local goat cheese operation is equally well run although at a very tiny scale of production. A flower operator picks, cools and packs his product in a manner that competes in a competitive European market. In addition, the central slaughterhouse is now being rehabilitated to meet European Union standards.

Some packaging material is made in the country but, in general, it does not meet international standards. Its standard is just adequate for domestic markets.

### **1. Meat and Dairy Processing and Packaging**

The study looked at a number of milk collection operations. In all of them, the quality of the collection of raw milk was a concern. With the exception of the four milk collection centers in Umatara, there were no operating cooling tanks at rural collection or farm levels. However, some new tanks are now being installed. Much of the milk was collected in unsanitary containers, including plastic jerry cans. Milk may wait long periods before arriving at factor cooling tanks at the processing reception or urban collection centers. These long periods without refrigeration can cause serious bacterial multiplication.

Four dairies were visited. Those built before the genocide were all badly damaged. Some of these are now being rehabilitated. Standards for these dairies vary. One new dairy in Kigali operates at modern standards. A wide variety of packaging quality was observed. In the dairies being rehabilitated, many packaging machines were in poor condition. The dairies express considerable interest in the packaging of long-life milk, either sterilized or UHT. Given the limited effective demand in the country for these products and equally limited opportunities for exports, this type of product is not likely to be economically feasible at this time.

Regarding meat, animals are often purchased by brokers and sold for slaughter. Meat processing in Rwanda is very rudimentary. Most animals are slaughtered and then cut up by a butcher, often with a machete. Outside of Kigali, there are no real slaughterhouses. Except for one modern butcher in Kigali, meat is butchered by the piece, without any particular standards. The Kigali butcher cuts meat according to European standards, and also makes meat by-products (sausages and delicatessen-ready products).

A potentially interesting idea is the export of meat to the Middle East where there is large market demand. Capitalizing on this opportunity would depend on two things:

- Establishment of a consistent supply of quality meat
- Completion of the renovation of the Nyabugogo slaughterhouse.

The emerging Farmers' Livestock Cooperative may meet the first condition. Fulfillment of the second condition depends on the availability of funding.

## **2. Horticultural Processing and Packaging**

Rwanda's horticulture processing industry is very small and the packaging materials and technology used are quite rudimentary. A very limited domestic market, coupled with miniscule export volume, characterizes the status of this sector of Rwandan agriculture.

The horticulture processing industry is mostly confined to the production of several fruit juices (passion fruit, pineapple) and fruit preserves (jams, jellies).

A multitude of constraints and challenges face the Rwandan horticulture processing industry. Most importantly, there are generally not enough raw products available over an extended time period. Maintenance of raw product quality and shelf life is hindered by the lack of refrigeration and cold storage. Second, the domestic market offers very little buying power. The vast majority of Rwandans do not have the economic means to purchase high cost processed products. In order to expand market opportunities, processors must focus on export market development. Western Europe is the most logical export market destination for Rwandan products, due to its large population (over 300 million people), immense buying power, and strong demand for fruits, vegetables, and flowers.

Development of the horticulture processing industry will require substantial capital investment in equipment and in technology transfer. However, the capital available in Rwanda for starting or expanding existing fresh market or value-added horticultural export businesses is extremely limited.

A further constraint facing the horticulture processing industry is the lack of compliance to international food safety and sanitation protocols. There is no adherence to ISO quality standards, no use of HACCP (hazard analyses critical control points) programs, and no adherence to international worker safety and product safety standards.

The diversity of packaging materials found in Rwanda is very limited. In addition, the quality of the finished product would not usually meet international standards. There is currently only one company actively producing corrugated cartons. However, it focuses on fabricating cartons for consumer dry goods. The firm does not have the appropriate molds for making fresh produce cartons. The vast majority of packaging materials used for horticultural products are imported from Uganda, Kenya, or Europe. Glass jars are imported from Burundi.

Although Rwanda's horticulture processing and value-added sectors are currently extremely limited, significant opportunities exist for specific crops and products. Significant growth potential can be realized in a relatively short time frame.

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## LE SOMMAIRE EXECUTIF

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La transformation des produits et leur emballage constituent des composantes principales du marketing. L'étude de ces deux éléments s'est concentrée sur les questions générales de fabrication et d'emballage des produits, ainsi que des questions spécifiques relatives aux produits de viande, de produits laitiers ainsi que les produits horticoles. En général, l'industrie de transformation et d'emballage au Rwanda, en ce qui concerne les produits agricoles, est plus ou moins rudimentaire. Il y a certainement quelques exceptions ; une usine moderne de production de la farine est en fonctionnement à Ruhengeri, il y a une ferme moderne à Kigali même, qui maintient les niveaux standards de qualité ; une usine de production de fromage de chèvre est également bien gérée sauf que sa production reste inférieure. Un exportateur de fleurs cueille les fleurs, les conserve et les emballe selon des procédures qui peuvent concurrencer les marchés européens. Par ailleurs, l'abattoir central est en cours de réhabilitation afin de satisfaire les niveaux standards des marchés de l'Union Européenne.

Quelques matériaux d'emballage sont fabriqués dans le pays mais, en général, ils ne satisfont pas les normes internationales requises. Le niveau standard est approprié aux marchés locaux.

### **1. Préparation et emballage de la viande et de produits laitiers**

L'étude a examiné un nombre d'opérations de collecte du lait. Dans toutes ces opérations, la qualité de collecte du lait naturel était un problème. A l'exception de 4 centres de collecte du lait dans la région d'Umutara, il n'y avait pas de conteneurs frigorifiques en fonctionnement dans les centres ruraux de collecte ou au niveau des fermes, bien que quelques uns soient actuellement en voie de construction. Une grande quantité de lait était recueillie dans des conteneurs inappropriés y compris les bidons en plastiques. Le lait peut mettre assez de temps avant d'arriver aux conteneurs frigorifiques des usines laitières ou aux centres urbains de collecte. Ces périodes assez longues sans facilité de réfrigération peuvent conduire à des multiplications bactériennes très dangereuses.

Une visite a été effectuée dans 4 laitières. Celles qui avaient été construites avant le génocide étaient toutes en mauvais état. Certaines d'entre elles sont maintenant en voie de réhabilitation. Les standards varient d'une ferme à l'autre. Une nouvelle ferme est en fonctionnement à Kigali et son standard est moderne. En matière d'emballage, une variété d'emballage de qualité a été constatée. Dans les fermes en voie de réhabilitation, beaucoup de machines d'emballage sont dans des conditions déplorables. Il y a un intérêt considérable de la part des fermes en ce qui concerne un emballage durable du lait, soit sous forme stérilisée ou UHT. Etant donné que la demande effective à l'intérieur du pays pour ce produit est limitée, ce genre de produit semble ne pas être économiquement réalisable pour le moment.

En matière de la production de la viande, le bétail est généralement acheté par les intermédiaires et vendu pour l'abattage. La préparation industrielle de la viande reste très rudimentaire dans le pays. Les animaux sont abattus, puis dépecés (souvent à la machette) chez le boucher. En dehors de Kigali, il n'y a pas d'abattoirs au vrai sens du terme. A l'exception d'une boucherie moderne à Kigali, la viande est coupée en morceaux sans tenir compte des standards recommandés. La

boucherie de Kigali se conforme aux standards européens et met sur le marché d'autres produits dérivés de la viande (saucisses et autres produits).

Une idée potentiellement intéressante est celle de l'exportation de la viande vers les marchés du moyen orient où il y a une forte demande pour ce genre de produit. Cette idée dépendra toutefois de deux choses :

- l'établissement d'un approvisionnement consiste en viande de qualité et,
- la fin des travaux de rénovation de l'abattoir de Nyabugogo.

La première de ces conditions peut être remplie par la création des coopératives d'éleveurs et la deuxième condition dépend de la disponibilité des fonds pour finir les travaux de rénovation.

## **2. Transformation et emballage des produits horticoles**

L'industrie rwandaise de transformation des produits horticoles est petite et le matériel d'emballage et la technologie utilisée sont presque rudimentaires. Un marché local très limité, ajouté au volume insignifiant des produits destinés à l'exportation sont des signes caractéristiques de l'état de ce secteur de l'agriculture rwandaise. L'industrie de préparation de produits horticoles est plus orientée à la production d'une variété de jus de fruits (fruits de la passion, ananas ...) et les conserves de fruits (confiture, pommades). Il existe un nombre élevé de contraintes et de défis que doit affronter l'industrie horticole au Rwanda. En premier lieu, il n'y a pas généralement de produits de base en quantité suffisante et cela pour une période de temps assez longue. Le maintien de la qualité des produits de base est entravé par le manque de réfrigérateur et de chambres froides. En deuxième lieu, le marché local offre un taux d'achat très faible car la majorité des Rwandais ne disposent pas de moyens financiers de se procurer les produits transformés qui sont très chers. Dans le but d'étendre les opportunités du marché, les entreprises de transformation doivent se concentrer sur le développement du marché d'exportation. L'Europe de l'Ouest constitue le marché d'exportation de destination des produits Rwandais à cause de sa forte population (plus de 300 millions de personnes), des pouvoirs d'achats immenses et une forte demande pour les fruits, les légumes et les fleurs.

Le développement de l'industrie de transformation des produits horticoles nécessitera un capital considérable d'investissement en équipements et transfert des technologies. Le capital disponible pour commencer, ou développer le marché existant, ou revaloriser l'activité d'exportation des produits horticoles est extrêmement limité pour le Rwanda.

Un obstacle supplémentaire que l'industrie de transformation doit affronter et celui du manque de conformisme aux protocoles d'accords internationaux sur la sécurité alimentaire. Il n'y a aucun signe d'adhésion à la qualité des standards recommandés par ISO, pas de référence en programme de HACCP (Hazard analysis critical control points), d'adhésion aux standards internationaux de sécurité du travailleur et de sécurité du produit.

Le type de diversité du matériel d'emballage au Rwanda est très limité. En plus de cela, la qualité des produits finis ne répond pas souvent aux exigences des standards internationaux. Il y

a actuellement une seule société active dans la production des emballages en carton ondulé pour les produits secs. Il n'y a pas de moules appropriées pour la fabrication des cartons d'emballage de produits frais. La grande majorité du matériel d'emballage utilisé pour les produits horticoles sont importés de l'Uganda, Kenya ou l'Europe. Les vases en verre sont importés du Burundi.

Bien que l'état actuel de transformation de produits horticoles rwandais et le secteur de la valeur ajoutée soit extrêmement limité, des opportunités significatives existent en ce qui concerne les produits/semences et une croissance potentielle significative peut être réalisée en une période de temps relativement court.

Processing and packaging relate to a number of priority commodity chains. These include branded teas and coffee, processed fruits and vegetables, dairy products, poultry, and horticultural crops. In addition to commercial processing ventures, there are also local and cottage processing and processing centers both within and outside the urban areas of Kigali.

This review seeks to look at various aspects of the processing and packing of selected commodity chains. Among the issues to be examined include the following:

- Describe and evaluate the present status of processing and packaging of meat, dairy, and horticultural products.
- Identify the primary constraints (financing, human resources, markets, information, etc.) at both the cottage and commercial level of meat, dairy and horticultural processing and packaging.
- Identify and justify the selection of the most promising area for additional support for processing and packaging within these commodity chains for broad-based economic growth.
- Provide suggestions, with supporting rationale, for interventions by donors, private sector or government (additional or supportive to work already on-going or planned by them) to improve the processing and packaging of agricultural products in Rwanda.

## A. Background

Due to the shortage of milk, Rwanda has been relying on the importation of raw milk from neighboring countries (Uganda) that is estimated at 20,000 liter a day. Milk powder importation is estimated at 1,000 metric tones per year. According to MINAGRI, the annual deficit of milk in 1999 will be 1.850 million liters. In an effort to encourage the importation of pasteurized, sterilized and UHT packaged milk, the government has proposed that there should be restriction on the flow of raw imported milk.

## B. Description and evaluation of the present status

Visits to a number of dairies revealed that most farms did not possess a milking parlor and/or reefer (refrigerated) although, by some accounts, some farmers are looking for such installations. Generally, milk collectors work with bicycles or pick-up trucks. Milk is sometimes collected in plastic Jerry can. This practice is very dangerous for two reasons, first, these Jerry Cans were not made for use with food material and they may contain oil, benzene and other chemical products. Secondly, it is impossible to properly clean these Jerry cans because their neck is not large enough to put one's hand inside.

The milk which is collected in the mornings waits five or six hours in the sun on a bicycle or in a pick-up truck before arriving at the collecting center. Milk often arrives at a temperature around 25 / 30°C. The milk that is collected in the evenings is generally only for family consumption.

### 1. Collecting center

At the collecting center, incoming milk is tested for density, smell and often resazurine. If milk is not up to the " norm", it will be refused. After testing, milk is then screened through a kitchen screen into a drum. Drums are then supposed to be cooled down in the reefer-tank to normally around 5°C. The collecting center often sells raw milk, sometimes even before it has been cooled. This is a dangerous practice. Generally speaking milk should not be sold until 3 hours later after it has been cooled.

Investigation of these dairies revealed that although reefer-tanks are equipped with CIP (cleaning in place) capabilities, others must be cleaned by hand.

### 2. Processing

A total of six of dairies were visited including: Rubiruzi, Umutara, Byumba, Nyabinsindu (Butare and Giterama), Inyange and Karuranga (goat cheese factory). Before 1994 five dairies were operating in the country, each processing some 10,000 liters /day. The majority of the dairies are currently working well below their optimum production and full capacity. The government dairy (MINADEP) in **Nyabisindu** (prefecture of Butare) processes around 6,000 liters/day of fermented milk. **Rubirizi Dairy Co-operative**, a recently privatized government-owned company, has 30 members and produces pasteurized milk in ½ liter preformed carton boxes, fresh cream in same packaging and butter. Its potential capacity runs at 4,000 liters a day.

sale. The **Byumba** dairy too is under review for sale. The **Nyagatare Dairy** is completely inoperational. The **Karuranga Dairy** only produces goat cheese in Kigali.

Most of the dairies, which were built before the war, were more or less destroyed. In addition, the stainless steel plates had often been stolen. In the case of Rubirizi, the Nova filling machines were completely destroyed. Other dairies lost engines, pipes, faucets, etc. In some cases standard repairs and maintenance could make these dairies operational once more. Two factories that were visited are in need of total reconstruction. The broken tiles and joints on the walls and the floor make it impossible to maintain even a minimum level of hygiene, as you cannot properly clean walls and floors. Some dairy workshops were full of outdated, unusable machines. The Nyabisindu Dairy's machinery, for example is completely antiquated, resembling a museum rather than a functional dairy operation.

In the case of the Nyagatare Dairy factory, the entire facility was destroyed during the war. In addition all of the machinery is out of service. The workshop, however, contains several butter-churns without engines. The machines, nonetheless, remain in good condition. With some maintenance, once the engines have been replaced, butter-production could start again.

The inspection trip found only two reliable installations in terms of well established and functioning dairy facilities. The first is a goat dairy in Kigali known as KARURANGA, which is owned and operated by a gentleman named Innocent. He processes a very small quantity of goat milk coming from its own goats. Production is on a very small scale (6 liters a day), but the process is the same used in France and has a good niche market (embassies, BCK, APEX) selling fresh cheeses only. All processing is done by hand. No machinery is used except a batch pasteurizer. The cheese maker also uses some plastic moulds; stainless steel racks and drains tables. The operation area was exceptionally clean.

The second example is also in Kigali. Inyangue Dairy was built by a French company, and produces pasteurized milk, yogurt and fresh cream. The workshops are very organized and clean. They also process fruits juices. This is the only dairy that uses a refrigerated (reefer) - truck for the deliveries of its produce. Inyangue Dairy employs laboratory control tests for all of their products.

### **3. Packaging of Dairy Products**

Packaging machines at the operational dairies were found to be in questionable working condition. Some machines appeared to be leaking, while other machines seemed to be packing unequal volumes. At least one butter-packaging machine needed only basic repairs to become fully functional. A large number of inspected NOVA filling machines were clearly in need of more extensive improvements. Machines such as those found at the Rubirizi Dairy would require more such involved reparations.

In some cases plastic bags were used for packaging butter and raw milk. Plastic bags are not considered the best packaging material as they are rather fragile, which may pose problems during transportation. For pasteurized milk the best practice is to use an automatic or half

better to cover the cheese in muslin paper or a colored paper labeled according to general marketing standards.

## **C. Recommendations on Milk Packaging**

### **1. Regarding all milk operations**

Throughout the collection chain, including the cottage, farms and collecting centers there is an urgent need for 10, 20, and 30-liter aluminum milk cans. The present use of plastic Jerry cans should be banned. They are unsanitary, extremely difficult to clean and may have been contaminated with petroleum products.

Research has shown that for those farms or associations that can produce a minimum of 200 liters a day, it is advisable to use a refrigerated (reefer) tank truck. At least one reefer tanker was seen in operation. This would indicate that although equipment does exist in country, the numbers are clearly insufficient. In areas where there is no electricity to support refrigeration equipment, a photovoltaic system or a generator can be used.

### **2. Collecting center**

Each collecting center should have the following basic facilities:

- Sufficient quality and quantity of warm water to clean equipment
- A tank to clean the milk cans in
- A proper drainage system
- A clean work surface of adequate size to inspect the arriving milk
- A foot bridge to access to the top of the reefer-tank
- Walls and floor covered with tile or other surfaces that are easy to clean

If more than 3,000 liters is collected per day or if the driving time to the dairy is more than two hours, the milk should be pasteurized.

### **3. Dairies**

All but two or three of the dairies visited by the consultants must be rebuilt. (The Byumba dairy needs extensive reconstruction). The consultants were told that there are 5 Isothermal tankers in the country, but did not see them. They may be in used for another purposes.

The minimum needs for each dairy are:

- Cold and warm water in quality and quantity
- Electricity and /or generator

- A CIP
- A cold store
- A Isotherm tanker 5,000 liter
- A cooling delivery van. 1,000 kg
- Laboratory for quality control

Optional possibilities are

- A yogurt line with vats, pump filling machine, incubator choke-cold room.
- A butter line with pasteurizer, fermentation tank, churn, wrapping machine.
- UHT or sterilization unit with storage.
- A fresh cheese unit, incubator, moulds, drain table, bags racks...
- A soft cheese unit, incubator, vats, moulds racks, cellar...
- A hard cheese unit vats, incubator, moulds, brine vat, canvas, racks, and cellars.

From an economic point of view, it would be advisable, given the small market, to have specialization among the dairies with a diversification of products produced. One dairy, for example, could produce one of these optional specialties noted above and a second dairy, another. This type of specializations could allow each dairy to exploit its own niche market in addition to its standard milk production. It should be noted that capital investments are often not proportional to the processing quantity and a very small unit is more expensive than a big one. In other words, it would be more cost-effective for one dairy to produce a large amount of its specialty than to have several dairies producing the same specialty product in lower quantities.

#### 4. Long Life Milk Processing

Regarding the possibilities of production of sterilized and UHT, the table below shows some of the difference between this two long-life milk products.

#### Comparison between UHT and Sterilized Milk Processing

| Compared Item   | UHT milk   | Sterilized Milk   |
|-----------------|--|---|
| Final packaging | Printed Carton   | Plastic bottle with label   |
| Technology      | Milk is warming at 140°C by steam instillation followed of a vacuum time   | Milk is autoclaving after bottling and pasteurization   |
| Advantages      | <ul style="list-style-type: none"> <li>• Possibility to produce milk, fruit juice etc.</li> <li>• Conservation 3 months</li> <li>• Packaging               <ul style="list-style-type: none"> <li>- attractive (marketing)</li> <li>- low pollution</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Possibility to produce pasteurized milk, sterilized milk at the same time.</li> <li>• Conservation 6 months</li> <li>• No contamination risk after autoclaving.</li> </ul> |

|   |  |   |  |
|---|--|---|--|
|   |  | <ul style="list-style-type: none"> <li>• Autoclaves can be used for vegetable cans sterilization</li> </ul>   |  |
|   |  | <ul style="list-style-type: none"> <li>• technology simple</li> </ul>   |  |
| Disadvantages   | <ul style="list-style-type: none"> <li>• Fragility of the material</li> <li>• High technicality</li> <li>• Maintenance</li> <li>• Processing must be made in a clean room; there is a possibility of recontamination before filling.</li> <li>• Conservation 3 months</li> </ul> | <ul style="list-style-type: none"> <li>• Packaging no very attractive</li> <li>• Empty bottles and finish products take space in store</li> <li>• Some consumer resistant to caramelized milk taste.</li> </ul> |  |
| Cost prices   | <ul style="list-style-type: none"> <li>• very expensive</li> <li>• expensive</li> <li>• high</li> </ul>  | <ul style="list-style-type: none"> <li>• less expensive</li> <li>• less expensive</li> <li>• normal</li> </ul>  |  |
| <ul style="list-style-type: none"> <li>• for a new installation</li> <li>• erection</li> <li>• maintenance</li> </ul> |  |   |  |

Give the necessary investment a long-life milk-processing unit will involve, it is strongly advised that a detailed market analysis be undertaken to see what effective demand there is for the output of such a factory.

## D. Primary constraints

### 1. Financing

Modern dairy equipment is expensive. To invest in this sector requires substantial financial resources. The extent of investment depends on the availability of financing.

### 2. Human resources

At the present time there are no dairy schools in Rwanda. In most cases what is needed is practical hands-on training of technician and equipment operators.

### 3. Management

In addition to technical training, noted below, there is also a need for upgrading the management skill of dairy workers and manager.

### **5. Markets**

The principal problem facing the dairy industry is the low purchasing power and the present living conditions in Rwanda. Most people do not have refrigerator and the basic cold chain for milk products does not exist. Without a viable effective demand in an accessible market, the dairy industry can only grow at a very limited rate. The export market is still not well known in terms of its quantity and the quality requirements to enter it.

### **6. Milk Quality, Marketing and Information**

There is a tremendous need for information and focus on improving the quality of milk products. At the farm level, training is required on what is needed to produce good quality milk that is clean and healthy. At the processing level, there is a need to assure a good quality product that is attractively presented. At the consumer level, there is a need to educate the consumer regarding the quality, how to buy, how to preserve, and how to use good milk products.

## A. Description and evaluation of the present status

### 1. Farms

The following tables indicate the national herd estimate by type for 1997 and Cattle by prefectures

#### National Herd Estimates (1997)

| Cattle  | Goats  | Sheep   | Swine   | Chicken     | Rabbits |
|---------|--------|---------|---------|-------------|---------|
| 702 855 | 611575 | 305 455 | 168 782 | 1 4 328 277 | 303 134 |

#### Number of Cattle by Prefecture

| Butare                                  | Byumba | Cyangugu | Gikongoro | Gisenyi | Gitarama |
|---|--------|----------|-----------|---------|----------|
| <i>Cattle repartition by prefecture</i> |        |          |           |         |          |
| 82079                                   | 27000  | 35661    | 25280     | 24750   | 100667   |
| <i>People living in the prefecture</i>  |        |          |           |         |          |
| 612000                                  | 214000 | 103000   | 80000     | 184000  | 850000   |

| Kibungo                                 | Kigali | Kibuye  | Umatara | Ruhengeri |
|---|--------|---------|---------|-----------|
| <i>Cattle repartition by prefecture</i> |        |         |         |           |
| 24227                                   | 61444  | 33468   | 293726  | 44533     |
| <i>People living in the prefecture</i>  |        |         |         |           |
| 698000                                  | 415000 | 1266000 | ND      | 817000    |

Because Rwandans farmers tend to hold cattle as long-term capital, the general livestock population is quite old. Cattle seen on the meat market are consequently nine to ten years old and the meat is often very tough. Animals are generally sold to brokers (middle men) for slaughter.

### 2. Brokers

Brokers buy animals from the farmers and transport their animal to the slaughterhouse and sell the carcasses to the supermarkets and butchers.

### 3. Slaughterhouses

Evaluations of characteristics of the main butchereries in operation are seen in the following table.

|            |                          |                     |                       |
|------------|--------------------------|---------------------|-----------------------|
| Gisenghyi  | Bovine<br>Goat<br>Swine  | 36                  | every day of the week |
| Gitarama   | Bovine<br>Goat<br>Swine  | 50/60<br>30/35<br>0 | six days a week       |
| Katonza    | Bovine<br>Goat<br>Swine  | 8                   | twice a week          |
| Matyazo    | Bovine<br>Goat<br>Swine  | 90                  | every day of the week |
| Mulindi    | Bovine<br>Goat<br>Swine  | 50                  | every day of the week |
| Nyabugogo  | Bovine<br>Goats<br>Swine | 180<br>180/200<br>0 | every day of the week |
| Nyanzi     | Bovine<br>Goat<br>Swine  | 7                   | every day of the week |
| Ruhango    | Bovine<br>Goat<br>Swine  | 25                  | every day of the week |
| Ruhengeri  | Bovine<br>Goat<br>Swine  | 27                  | every day of the week |
| Rwanmanaga | Bovine<br>Goat<br>Swine  | 30/35               | from time to time     |

Meat processing activities in Rwanda are still relatively rudimentary. Essentially, most meat processing consists of the slaughter of animals and cutting into pieces in butchereries often with a machete.

The consultant made a visit to a new Association of Women Farmers who runs the Byumba Slaughterhouse. This facility comprised a livestock holding area with a broken weigh scale, a killing room of 4 X 3 meters and a cutting room with poor hygiene and no equipment except 2 cutting knives (machetes). The sale of meat was made from the third adjoining room. The refrigerator and the freezing unit were both broken.

The Kigali slaughterhouse is the largest in the country with a capacity of handling 47 cattle and 25/30 small animals a day. SABAN s.a.r.l., with the assistance of a French company, is rebuilding this former Kigali abattoir to be able to meet European standards. The process is being done in a step-by-step manner, the first part of which is now ending. More than 193 million Rwf have been spent to date on the renovation.

In the countryside, there no true slaughterhouses, but rather butchers. Generally these operations are simple open structures of one to three rooms, which operate often under minimal hygienic

Slaughterhouses charge a "tax" for services in Kigali (3000 Frw). The only existing standard seems to be that carcasses are controlled by a veterinary paid by the slaughterhouse and controlled by the ministry.

#### **4. Butcheries**

The same brokers that buy cattle on the farm for slaughters will often sell the carcasses to butchers in either half carcass or piece by piece.

Except for BCK in Kigali, meat processing doesn't exist in Rwanda. Meat is usually cut into pieces without any standard part, often with a machete. BCK has a large cutting workshop and a delicatessen shop that makes ready-to-eat products. BCK work with four brokers for beef and four for small animals. They use the same broker to assure consistency of quality. Meat arrives at BCK on a tarp in a pick up truck. It is then controlled, weighted and sent to the cold room or to the cutting workshop.

The BCK workshop is in the basement under the supermarket. BCK uses German cuts as its standard for cutting the carcass for sell in the supermarket or to restaurants. All sausages, pies, hams are made on the premise. Products are generally of good quality but sometimes they have some problems with the refrigeration unit resulting in some toughness. Meats are tested in their laboratory but much of the working areas are too warm (23°C). It is recommended that cutting and preparation work be done at lower temperatures. The machinery that is used is not in bad condition but needs to be better cleaned. All in all, BCK operates well but could make some improvement in their operation. The consultants felt that they will be able to do so after renovations they are now undertaking are completed.

Meat packaging at BCK is attractive. The protective film on the prepared meats meets European standards with one color for each variety. Small sausages are prepared by 6 pieces together on a tray sealed under vacuum. Refrigerated display units in the selling area are in good working condition. The slicing machines were clean and also in good working condition.

### **B. Recommendations**

#### **1. Regarding all elements in the commodity chain**

The production of quality meat requires training and skilled judgment. People's mentality about meat production and processing in the country needs to change. The production of cattle should be a profitable operation. Workers need to learn basic skills such as determining the optimum point at which the meat should be sold. Workers must be trained in the entire production process: to know how to properly feed and watch the health of the herds, to properly transport the animals, to slaughter and butcher them and to pack and process the meat. Producers

visits to the bigger slaughterhouse units in Gatarania, Muringi, Kwanaigalla, Kunango, and Ruhengeri, revealed a lack of means to properly dispose of used water and other waste material. The slaughterhouse in Kigali is now being rebuilt but even here, there is a concern on how to deal with used water and other waste.

Individual slaughterhouses were mostly too dark, even though doors and windows kept open, which in turn exacerbated the problem of fly swarms. The cold storage facilities were in generally bad condition, many of the refrigeration units had no engines and the refrigeration compressors had been destroyed. Clearly, there is a need for immediate investment in this area.

Given the current state of the market situation and relatively low consumer demand, any heavy investment in the infrastructure for slaughter facilities outside the main urban centers would not be cost effective or recommendable. Instead, all efforts should be directed to produce quality meat at modern standards. At this development juncture in Rwanda's meat market it would be advisable to have three or four functioning quality abattoirs. In contrast, there is a risk of trying to go beyond the present management capacity of the meat sector.

### **3. Butcheries and meat cutting workshops**

Meat processing requires adequate working areas. Walls, floors and equipment need to easily cleaned. The junction between wall and floor should be curved. There should be absolutely no insects or pests in the workshop area. Most importantly, the working area must be kept at a recommended low temperature. It is imperative that the cold storage rooms are maintained and function properly. The "cold chain" must be realized from slaughterhouse to the consumer. This will require improved cold storage, reefer trucks, refrigeration display units and home fridges. Training is also very important and at present nothing is being done in this area.

## **C. Primary constraints**

### **1. Financing**

Except in Kigali, the slaughter capacity is very much underutilized. Maintenance of the existing infrastructure is too expensive. The government should encourage the concentration of slaughterhouses in a few regional centers and then seek investment to bring these few factories up to modern standards.

### **2. Human resources**

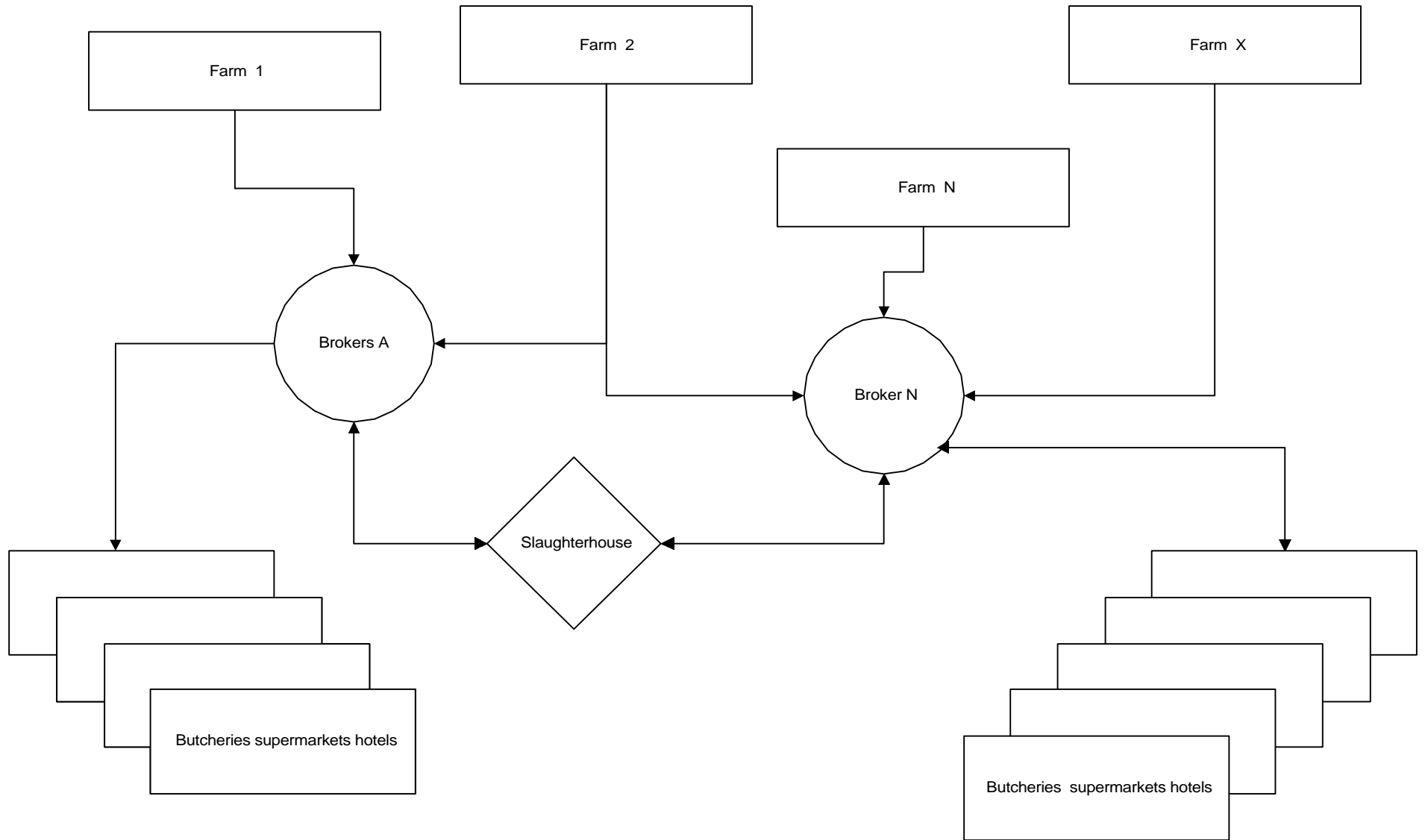
Except in two or three establishments, butchers do not know how to properly cut down the carcasses. They are few qualified butchers in this country. It is important to train workers in

cold chain and the low purchasing power of most consumers in the country. Meat is very fragile and to be a healthy product it must be refrigerated. Today, in most of Rwanda this is impossible.

#### **4. Marketing and information**

Research revealed no significant marketing information for fresh Rwandan meat.

# Flow chart of the Meat chain



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## SECTION IV. PROCESSING AND PACKAGING OF FISH PRODUCTS

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### **A. Background**

The market for fish in Kigali alone is estimated at 40 metric ton a week. The potential consumption in Rwanda could be as high as 7,000 ton per year, that is 135 ton per week. This means that production has the potential triple. At current market prices for fish of around 600 / 750 FRW per kg total potential market value is near 12 million dollars.

### **B. Description and evaluation present status**

#### **1. Fishing Farms**

##### *Small fish farmers*

A number of small fish farms are found in the prefectures of Butare, Gitarama and Kigali. Generally the fish taken from these farms are small Tilapias being sold after they reach 100 grams. The quality of production is quite low with no specific controls on feeding, sexing, etc.

##### *Large fish farmer*

The consultant visited only one large fish farm located near Butare. This operation started in 1996 with 53 ha in 23 ponds. The operation is an integrated farm with pigs, rabbits, chickens, and ducks producing compost used in feeding. The production capacity of the farm is estimated at 5 metric tons per week in tilapia, carps and clarius. At the present time, the farm is just getting started. The availability of credit for fish farming is very low. The present single commercial fish farm, for example, has been having major problems in getting adequate financing. This has resulted in a number of production constraints including inability to pay workers on time. The manager is presently waiting for a possible credit from the bank in order to invest in ice chip makers (Cold-Ingvar from Iceland) to produce 1.5 ton of ice per day and to upgrade fishponds. Expenses to repair the ponds have been high and only six ponds are now producing. There are about 50 worker on the farm with one "engineer" is responsible for the entire production. Most of the workers have either limited or no training.

Clearly the profitability of the fish farm hinges on the systematization of the method of production. In addition, it would be recommendable to the operation to should shift to unisex tilapia production in order to obtain larger, more marketable fish.

#### **2. Processing and packaging**

They have no special technology to process fresh fish. The fish, after being caught, is killed and cleaned and then arranged on ice flakes.

## **C. Recommendations**

### **1. Regarding the entire commodity chain**

The essential problem with the fish commodity chain is the lack of an adequate cold chain. Fish should be iced from the time they are caught until they are sold to the final consumer. Delivery of fish to its selling point should be made in ice. For fish that is sold in small quantities, the suppliers should use ice chest. To transport larger quantities of fish, an isothermal truck should be used.

### **2. Regarding farmed fish**

In order to obtain larger fish (2 - 3 kg), it is necessary to sexed fish, i.e., to use single sex fish. There is a need to provide more training to fish farmers on this point. There is also a need to have the ability to easily buy mono-sex fish.

The processing of the fish after they are caught, must be done at low temperatures  $< 7^{\circ}\text{C}$ . Once the fish's innards have been removed, it should be transported and delivered at a temperature not to exceed  $5^{\circ}\text{C}$  in ice chips. Any commercial farm should be equipped with access or production of ice chips product and a cold workshop area for gutting.

### **3. On the market**

The selling of fish should be done with access to cold stalls using ice chips. There should also be available cold storage with the used of either refrigerated by compressor or ice

### **4. Training**

- While there is basic understanding within the country of the technique for small scale fish farming they still is a need to upgrade this skill and to provide the necessary training to manager, workers, handlers, transporters and sellers of fish in the proper use and protection of fish products to obtain a safe and high quality product

## **D. Conclusion**

In the processing of milk, meat and fish, there is a need to rehabilitate the destroyed investment that was in place before the genocide to the extent possible. These investments are very expensive and it is absolutely necessary to pay particular attention to the following points:

- Two small units are more expensive to build and operate than one with twice the capacity. Economies of scale are important. It is useless, for example, to have two milk sterilization unit in this country
- Without an adequate cold chain there is secure quality and hence no exports.
- Without grades and standards it is impossible to build a modern marketing system

- Training is very critical at all levels. From farm producing, processing, management, and marketing. The most important training in many regards is in proper maintenance of equipment and structures. It is unacceptable to see material destroyed, not by war, but by lack of simple maintenance.

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## SECTION V. PROCESSING OF HORTICULTURAL CROPS IN RWANDA

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### A. Present Situation

Currently, there is a very limited horticulture processing industry in Rwanda. It is mostly confined to the production of several fruit juices and preserves (jams, jellies). The equipment available in country for fruit processing is typically rudimentary with very limited capacity. Several companies produce single strength passion fruit and pineapple juices (Inyange Dairy and Pronature). Passion fruit juice is preferred over pineapple in the domestic market. It requires about 100 kg of fresh passion fruit to produce 30 liters of single strength juice (12-14° Brix). There are about 24 fruit per kg and growers receive between 3 to 15 francs per kg (depending on season of the year). Pineapple growers receive about 90 francs per kg. Total passion fruit juice production is only about 2 to 4 tons per week and pineapple juice is about 1 ton per week.

Inyange Dairy is a new company that started producing fruit juices about a year ago. They have a mechanical cutter for passion fruit, a pulping machine for both passion fruit and pineapple, a mechanical press for extracting pineapple juice, and a series of wood-cloth sieves for juice filtration and clarification. The company uses its dairy equipment for fruit juice preparation and container filling. In addition to local scales, small volumes of juice are exported to Burundi and Tanzania. Inyange Dairy also produces artificial flavored strawberry yogurt.

Pronature is a small cottage-level processing company that produces mostly passion fruit juice and nectar for the local market. Fruit procured from the producer is delivered in large jute sacks, de-stemmed by hand, washed, cut open, and the pulp is spooned out. A small stainless steel fruit pulper is used to extract the juice followed by filtration through various cloth screens. Capacity is about 150 kg of pulp extracted per hour. The juices and nectars are formulated through the addition of water, sugar, and acidulants. Used 330 ml beer bottles (obtained for 5 francs) are cleaned by hand and filled with hot (about 85°C) juice followed by manual crimping of the metal caps. Citric acid and chemical preservatives (potassium sorbate or sodium benzoate) are added to the juice. Settling and sedimentation of insoluble material in the bottom of the bottle is noticeable. Shelf life of the bottled juice is reputed to be up to 1 year. However, spoilage (fermentation) of the juice in some bottles occurs due to non-sterile filling or sealing. Although the passion fruit juice is distributed throughout the country, it does have to compete against slightly higher quality product imported from Burundi.

Fruit preserves are produced by two small-scale operations, Pronature and Confide. Strawberry jam/jelly is the principal product, complemented by pineapple, mango, and papaya preserves. Infrastructure typically consists of manual labor used to de-stem and peel the fruit, small capacity mechanical pulping/extracting equipment, boiling in open-air charcoal-fired kettles with dissolved sugar, hand stirring of the syrup-fruit concentrate mixture, followed by manual addition of imported pectin, and citric acid/chemical preservatives. The fruit preserves are poured into plastic containers (typically 500 gm), capped and temporarily stored at room

temperature before distribution to market. Rwandan preserves have to compete against Kenyan and European imports.

A non-functioning starch operation along with a defunct tomato paste plant comprises the remains of the processing capacity. There is no snack food production (e.g. chips, fries). There may also be occasional cottage-level potato chip production, although the production volume is so low and sporadic that chips are not found in the Kigali market. Essentially there is no canning, drying, or freezing industry in the country.

## **B. Constraints**

There is a multitude of constraints and challenges facing the horticulture processing industry in Rwanda. First of all, there is generally not enough raw product available over an extended time period. Maintenance of raw product quality and shelf-life is hindered by the lack of refrigeration and cold storage. Secondly, the domestic market offers very little buying power, as the vast majority of Rwandans do not have the economic means to purchase high cost processed products. Buying power is basically confined to several percent of the total population, foreign expatriates, along with the two business-class hotels. The very limited domestic demand does not justify the investment in large-scale processing facilities. Therefore, the processing industry is confined to limited-capacity operations.

In order to expand market opportunities, processors must focus on export market development. However, this brings with it the additional constraint of lack of international market intelligence. Western Europe is the most logical export market destination for Rwandan products, due to its large population (> 300 million people), immense buying power, and strong demand for fruits, vegetables, and flowers. Current and potential Rwandan processors have very little information on European market opportunities, market windows, prices, product quality and packaging requirements, and international trade practices.

Transportation of horticultural crops to European market destinations represents another serious constraint. Currently, only one airline (Sabena) offers regularly scheduled direct service to Europe (Brussels). However, there are only two flights per week (Saturday and Monday evening) and cargo capacity per plane for Rwandan products is only 3 tons. In addition, the plane stops in Nairobi to pick up additional passengers and cargo. The airline will increase cargo capacity in April 2000 by flying a larger aircraft (e.g. MD11). Airfreight cost is high (\$ 1.45 – \$ 1.70 / kg, depending on volume) and must be paid in advance of shipping. This limits export to only the very high-valued products that can justify the high airfreight rate. A dedicated cargo plane (D.A.S) does provide approximately weekly service to Europe from Kigali, but flight times are not fixed as the plane flies only when it has a full cargo load from Europe. Freight rates are \$ 1.70/kg. Several other airlines (e.g. Kenya Airlines, Uganda Airlines) have passenger service with limited cargo capacity to Europe via their hubs in Nairobi or Entebbe. However, utilization of these airlines for transport of Rwandan product to Europe would be a gamble, since the cargo would have to be unloaded and put on another plane destined to Europe. Currently, this off-loading and re-loading process in Kenya or Uganda is not sufficiently reliable to have confidence in the system. Airfreight rates from Kigali to Europe are only slightly higher than from Nairobi to Europe (approximately \$ 1.35/kg). Cargo capacity from Kigali to other market destinations is extremely limited. South African Airways only offers weekly service to Johannesburg and

charges \$1 per kg for airfreight. Air cargo capacity on the daily turbo-propeller Dash 8 aircraft of Alliance Express to Nairobi is only 300 kg.

Transporting perishable or processed horticultural products by land to the sea ports of Mombassa, Kenya or Dar es-Salaam, Tanzania is currently too problematic to be considered a viable option. Road conditions are not good and delays at the border restrict the flow of goods.

Development of the horticulture processing industry will require substantial capital investment in equipment and also in technology transfer. The amount and capacity of processing equipment for horticultural crops is extremely limited. The two enterprises involved in making fruit preserves are essentially low volume cottage-style operations. Between the two businesses involved in fruit juice, there is no aseptic filling facility for concentrates or single strength juices in TetraPak consumer packages.

Capital available for starting or expanding existing fresh market or value-added horticultural export businesses is extremely limited in Rwanda. Thus, the financing of horticultural enterprises remains a huge constraint to establishment of a viable industry. Commercial banks have limited lending capacity and require high amounts of collateral, which typically are not available.

A further constraint facing the horticulture processing industry is the lack of compliance to international food safety and sanitation protocols. There is no adherence to ISO quality standards, no use of HACCP (hazard analyses critical control points) programs, nor adherence to international worker safety and product safety standards.

## **C. Recommendations**

Overcoming the aforementioned constraints facing the development of the processing and fresh market horticulture industries in Rwanda will take considerable effort, patience, and hard work. It is unlikely Rwanda will become a major EU supplier of any fresh or processed horticultural product during the next 5 years. However, it has the potential to become a minor supplier of certain high value crops and a source of specialty products destined for certain niche markets.

In order to have a viable processing and fresh product industry, it will be necessary to have a consistent supply of high quality raw product. Quality of the raw materials is the single most important factor affecting final processed product quality. Therefore, the implementation phase of the AAD Project should address production practices, pest management, and postharvest handling of the prioritized crops. Significant improvements in crop yield and quality can be realized through dissemination of up-to-date technical information to the producers, guided by a long-term expatriate horticulturist. The expatriate horticulturist should be supported by periodic visits of short-term crop specialists (either local or expatriate).

Postharvest handling practices and temperature management of horticultural crops needs improvement. In order to be able to supply the export market with the desired quality fruit, Rwandan exporters will need to use appropriate packing, forced air-cooling, and in-transit temperature management. Limitations in refrigeration and cold storage facilities for perishables

should be overcome in order to preserve raw and processed product quality. The AAD Project should train perishable producers in the use of forced air cooling to preserve fresh product quality prior to export or during temporary holding periods prior to processing. Good temperature management by proper cooling followed by maintenance of the cold chain is the most important factor in reducing fruit deterioration and maximizing shelf-life.

Techniques used to maintain the cold chain during transportation of fresh product should also be employed. This should include the introduction of e-containers, gel packs, thermal blankets, and Envirotainers. E-containers are large styrofoam-insulated double-wall corrugated fiberboard boxes (typically 92 cm x 69 cm x 65 cm) containing gel packs (frozen gels contained in a plastic bag), which are sealed with a top after loading the containers. The fresh product inside the e-container is kept cold by the gel packs during the air transit period. Thermal blankets are made of thin insulated polyethylene and foil laminated insulation material. The foil reflects ambient heat from the outside surface while the air pockets inside the insulation material prevent the cool air on the inside surface of the thermal blanket from escaping. Thermal blankets can be fabricated to overwrap a pallet of cartons.

Envirotainers are basically insulated LD-3 containers in which the inside compartment is kept cool by dry ice (or by mechanical refrigeration). A battery powered fan connected to a thermostat blows cool air from the dry ice as needed to maintain the programmed temperature. The AAD Project should also try to encourage the construction of an insulated cold storage room inside the airport cargo warehouse.

The implementation phase of the AAD Project should work with new and existing fruit juice and preserve manufacturers in an effort to increase their output and product quality. Development of new juice flavors and blends for the domestic market should be encouraged and supported (e.g. carrot juice, naranjilla juice, strawberry / passion fruit juice, etc.). Excellent flavored purple passion fruit types and papayas may allow for possible export market penetration. One company is gearing up to export juices to Tanzania. Potential also exists for developing an export market for preserves of strawberries, raspberries, blackberries, cape gooseberries, and other small fruit.

For highest quality, most jellies and preserves are cooked and the excess water removed by cooking in vacuum vessels rather than open kettles. The use of a vacuum allows a lower cooking temperature to be used, resulting in less heat damage to the product. Currently, only open kettles are used in making preserves in Rwanda. The AAD Project should educate processors on the importance of converting to vacuum kettles in order to obtain a higher quality end product that could better compete with imported product. The fruit, sugar, and pectin mixture inside the kettle should be evacuated under vacuum and heated to about 60° C and concentrated until the desired end point is reached (65° Brix for jellies and about 68° Brix for preserves).

The fruit juice industry in Rwanda is based on single strength juices. It is expensive to package, store, and ship single-strength juices. In many cases, it is desirable to remove a part or all of the water from such juices. The refrigeration, storage, transportation, and distribution costs of single-strength fruit juices could be greatly reduced by concentration, i.e., the removing of substantial water from the fruit juices. Further concentration of fruit juices offers several advantages: (1) reduced requirements for storage space by virtue of smaller volumes, (2) reduced

refrigeration loads, (3) reduced transportation costs, (4) cheaper packaging, (5) more profitable export marketing via efficient handling, and (6) improvement in product quality, stability, and shelf-life. The fruit juice processors in Rwanda should be aware of export market opportunities for juice concentrates. This would facilitate the private sector investment in equipment to produce a commercial concentrate product (i.e. frozen, canned, or chemically preserved).

Introduction of appropriate processing equipment and technologies should be a principal objective of the AAD Project. The Project staff should guide the processors in selecting the most effective and economical machinery and equipment to match the production output. Small volume processors will always rely on hand labor to complement the mechanical equipment, but can improve efficiency by adapting appropriate technologies. For example, there are several methods used for the extraction of passion fruit pulp and juice. The manual method used by the small-scale cottage enterprises in Rwanda consists of slicing the fruit and scooping out the pulp by hand and separating out the seeds through either sieving or expression through a cloth. The most effective and recommended method of pulp extraction for the small-scale Rwandan enterprises consists of using a pulping machine. The passion fruit is oriented fruit into rows of hemispherical pockets, where they are held and then pierced with knives from underneath to give a cross-shaped cut in the skin. A plunger then descends on the fruit and ejects the juice, seeds, and pulp through a hole in the bottom of the pocket. In completing this operation, the plunger virtually turns the fruit inside out. This procedure provides minimum contact with the cut surface of the skin, and therefore very little contamination with enzymes of skin pigment, which is a very important consideration when handling the purple fruit. This improved pulp extraction method would give a higher quality finished juice product. The Project should facilitate the development of the processing industry by supplementing long term staff with short-term food technology and engineering specialists.

Efforts should be made to introduce aseptic packaging along with hydrogen peroxide sterilization of fruit juices (e.g. passion fruit, pineapple, strawberry, raspberry, etc.). Fruit juices are logical candidates for aseptic packaging, since refrigerated transport and storage are not needed with this system. Export marketing of fruit concentrates or purees will require an aseptic filling facility for either large 55-gallon drums or large plastic bags.

Market opportunities in Europe for organic fruit juices and preserves should be explored. Buyers from France have expressed interest in importing passion fruit juice. Identification of potential buyers by a long-term expatriate will greatly aid in penetrating EU markets. The marketing advisor should serve as a linkage between the Rwandan exporter and foreign importer. The AAD office should subscribe to various EU market news service reports (e.g. ITC-Geneva) listing current prices in the EU markets. This information should be disseminated to Rwandan exporters. Market price information should be made transparent and kept at the AAD office. Export market information and price reports will help potential future entrepreneurs to make wise marketing decisions. In addition, exporters will become knowledgeable about appropriate product quality and packaging requirements.

Lack of air transportation capacity and limited cargo space (currently 6 tons per week) for direct shipments to Europe requires the AAD Project focus on very high value horticulture products for export. Berries, cape gooseberries, cut flowers, specialty bananas, organic products, and niche

market products are all examples of items with high export value and do not require huge amounts of cargo space, at least initially. Long term Project efforts should be directed at increasing air cargo capacity out of Kigali. This may include trying to establish a regional airline service (such as Alliance Express), which would consolidate cargo from neighboring countries (e.g. Uganda, Kenya) along with Rwandan product. A well-coordinated consolidation service would allow for this airline to service the export needs of regional perishable exporters, picking up product in Kigali, Entebbe, and Nairobi before flying up to Europe. This consolidation service could also be offered to South Africa. Ideally, an additional Sabena flight during the mid-week and a better connecting service to Entebbe is desired.

Efforts should also be made to expedite the movement of perishables from Rwanda across the Ugandan border. A smooth, rapid flow of goods by truck up to Entebbe would give Rwandese exporters another air cargo option. Of course, it would be necessary to have a freight forwarder at Entebbe looking after the Rwandan product to ensure it is expeditiously loaded onto the appropriate plane.

The AAD Project should address the constraint of lack of capital available to start or expand horticulture export businesses. Recommendations would be for the Project to procure planting materials and distribute them to the exporters and / or appropriate organizations, obtain small allotments of proper packaging materials to jump-start the export process, and subsidize one-time trial shipments by air to Europe for participating growers / exporters. This would reduce the financial liability of the Rwandan cooperator and encourage initial entrance into the export market. This initial Project support effort may be critical in jump-starting an export industry in a country that has almost no past experience in marketing high value horticultural crops in the international marketplace. After this initial planting material, packaging, and transportation support, the grower/exporter would be weaned off the subsidies and encouraged to continue on their own.

Attention should be placed on improving food safety and sanitation programs for fresh and processed horticultural products. Sanitation is an integral part of food production. The cleaning and sanitizing of a food processing plant is vital to maintaining the total processing environment in a clean and safe manner. The opportunity for food to become infected with food borne pathogens or to become adulterated must be eliminated. This can only be done through the design and implementation of a complete sanitation system which includes chemistry, equipment, training, microbiological testing procedures, insect and rodent control and other factors. International buyers demand safe food, making good sanitation practices an essential factor in competing for market share. Food safety is a major concern in the retail and foodservice sectors and importers all require strict adherence to rigid sanitation and quality control protocols, including aggressive HACCP programs. HACCP principles include performing hazard assessments, noting critical points of possible contamination, establishing critical limits and monitoring requirements, detailing corrective action when contamination occurs, implementing verification measures, and establishing detailed record keeping procedures. It is a systematic approach used in food production and preparation to assure food safety. Educational and training efforts should be directed at implementing such HACCP programs at all processing plants, and adoption of ISO quality standards. Potential food safety problems include biological, chemical, and physical hazards. The goal of horticultural producers and processors should be to

provide a commodity that will have an acceptably low probability of being a source of food borne hazards for consumers.

Specialists in food safety and quality should be called upon to work with each exporter in designing an appropriate protocol to ensure product safety and quality. Prevention of food-borne illness or product sanitation problem is of utmost importance. Nothing would kill a fledging export industry faster than a food borne illness traced back to a Rwandan product. International buyers will also require the growers and processors in Rwanda to follow a strict food safety and sanitary protocol, which is subject to their inspection at any time. Individuals or businesses not willing to follow this buyer-demanded food safety program will simply not be able to participate in the export business. It is important the Project emphasizes the significant role that sanitation and personal hygiene play in the production of safe foods free from food-borne illness contaminants.

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## SECTION VI. PACKAGING MATERIALS FOR HORTICULTURAL CROPS

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### **A. Present Status**

There is currently only one company (SulfoRwanda) active in corrugated carton production. Their focus, however, is on carton fabrication for consumer dry goods. They do not have the appropriate molds for making fresh produce cartons. These could nonetheless be obtained and they have the capability to make 3 ply and 5 ply 325 psi test strength fiberboard cartons using virgin paper stock. This fiberboard material would be satisfactory packaging for produce exports to Europe. Since the SulfoRwanda in Kigali does not have the capability to do color printing on the box, it could be handled by their sister factory in Kampala. In addition, the Kampala factory has the capability to wax impregnate the corrugated paper stock for products needed to withstand high humidity transit conditions.

At present the corrugated fiberboard cartons used for banana export are imported from Uganda or Kenya at a cost of 150 francs per carton. The Umballage Rwanda company cannot locally make cartons of sufficient test strength. The 2-kg cartons used for exporting fresh passion fruit are also imported from Uganda. The corrugated cartons used to pack cut roses are imported from Kenya. The 1-kg export cartons for cape gooseberries are imported from Uganda.

SulfoRwanda makes a diversity of injection molded plastic containers for consumer goods, mineral water, and industrial purposes. The company makes 500-gm plastic fruit preserve containers and offer them for sale at 85 francs. They can do injection molds of plastic bottles up to 4-liter size. They also have the machinery for manufacturing plastic films and a range of polyethylene containers for fresh and processed fruits and vegetables.

### **B. Constraints**

The type and diversity of packaging materials in Rwanda is very limited. In addition, the quality of the finished product would often not meet international standards. The vast majority of packaging materials used for horticultural products are imported from Uganda, Kenya, or Europe.

SulfoRwanda lacks the specific molds for fabrication of containers appropriate for the European market. Currently, they are not interested in obtaining these molds, as their cost (up to \$ 30,000 each) could not be recovered by the extremely limited domestic demand for produce packaging. However, as future domestic demand increases for fresh and processed produce containers, the company does have the potential to fabricate a diversity of materials.

Glass jars are imported from Burundi, which has a bottling factory. Presently import costs are high, and a 500-gm glass jar for fruit preserves costs 220 francs (compared to locally fabricated plastic containers at 85 francs). There are two dairy facilities capable of packaging fruit juices in sterilized TetraPak cartons, but the packaging must be imported from Kenya, Uganda, or Europe, and it is difficult to obtain timely shipments.

There is no fabrication of glass bottles, TetraPak cartons, laminated pouches, or cans in Rwanda. The 100-gm plastic punnets and film overwraps used for cape gooseberries are imported from Kenya at a cost of 20 francs. The 250-ml foil-sealed mesh thermoformed fruit juice cups of Inyange Dairy are imported from Dubai. Packaging materials currently used for fruit juices include re-washed and re-sealed beer bottles or polyethylene bottles made locally.

### **C. Recommendations**

A diversity of packaging materials is used in the international trade of horticultural products. It is important to select the type of packaging that will ensure the necessary shelf-life for a given product. Proper packaging materials are necessary to protect fruit, vegetable, and flower quality after harvest and to enhance product appearance during marketing. Packaging materials must be of sufficient physical strength and must be of high quality design. It makes no sense to export high value delicate horticultural products in low quality weak packaging, which may result in bruise damage, decay, and reduced market value. Regardless of package size and contents, the carton must be able to withstand rough handling during loading and unloading and vibration during transportation. Also, packages used for Rwandan product should be recyclable and have an attractive design, with colorful graphics. The packages should be capable of being stacked onto pallets without losing their structural integrity and have sufficient ventilation to allow for appropriate cooling of the contents. The most popular size cartons in Europe are 40 x 60 cm and 30 x 40 cm, which fit perfectly on the Europallet.

A minimum 1724 kPa (250 lb/in<sup>2</sup>) bursting test strength fiberboard is recommended for cartons intended for export. This amount of strength is needed for the handling, transport, and high humidity the cartons must endure during distribution from farm to market. Corrugated cardboard cartons should be manufactured from high quality stock with a strong internal bond and low water absorption. The glue holding the layers of the carton together should be moisture resistant to avoid delamination of the layers. Although this will increase the carton cost, in the end, it will be a wise investment. Importers will favorably view a strong shipping carton. They will realize the Rwandan exporter is serious about quality control and is taking the steps necessary to protect the fruit. While this may seem to be an intangible advantage, when the competition for market presence intensifies, the importers will stick with those suppliers who provide the highest quality fruit protected in the strongest containers.

The EU has specific labeling requirements for all imported horticultural products. All cartons should be clearly labeled in the language of the destination country. The following information should be listed on the outside of the carton:

- Common name of the product (i.e. cape gooseberry)
- Class of product (i.e. class I)
- Net weight (i.e. 1 kg)
- Brand name as well as name and address of the exporter
- Country of origin (i.e. Rwanda)
- Recommended storage temperature (i.e. 10° C)

Labeling of individual punnets within cartons is also mandatory under EU regulations. The name of the product, net weight, and country of origin must be specified. Packaging helps sell products, especially when the cartons and punnets are attractively labeled and provide the necessary product protection.

The AAD Project should identify the most appropriate carton for each of the prioritized export crops. It should help facilitate the introduction of these cartons into Rwanda, perhaps as a one time only direct purchase of small quantities for redistribution to exporters to be used in trial shipments to appropriate export destinations. Once the exporters have gained first hand knowledge of the value of using the proper package, it may be possible to fabricate it within Rwanda (i.e. at SulfoRwanda) if sufficient quantities are requested in order to justify purchase of the mold for that specific container. Until sufficient export volumes are reached, it is likely all specialized containers will have to be imported.

Snack foods hold promise as new products for local markets. Examples may include potato chips, cassava chips, banana chips, etc. Packaging technology for snack foods is very rudimentary within Rwanda. Significant improvements are needed in the type and quality of the packaging materials. Snack foods are sensitive to oxidation because of their high fat content. The oxygen concentration inside the package headspace is directly correlated with the extent of lipid oxidation, which leads to chip rancidity and off-flavors. Chips should be packaged in moisture-proof hermetically sealed foil pouches to minimize oxidation, rancidity, and flavor loss.

## ANNEX A

### Persons Contacted

|                          |  |
|--------------------------|--|
| Dr. Tharcisse Seminega,  | Proprietor. PRONATURE s.a.r.l.   |
| Mr. Eduard Murenzi,      | Plant Manager, Inyange Dairy   |
| Mr. Emmanuel Semwaga     | Food Technologist, Inyange Dairy   |
| Dr. Menwuyellet Moussie  | SO3 Team Leader, USAID   |
| Ms. Agnes Kayijire       | Director of Industry, Ministry of Commerce                                 |
| Ms. Tatiana Mukarusagara | Secretary General, Ministry of Agriculture                                 |
| Mr. Willy Makelberge     | General Manager, MAGERWA (Rwanda Bonded Warehouses)                        |
| Mr. Thomas Niyongira     | Assistant General Manager, MAGERWA   |
| Mr. John Nkera,          | Managing Director, Highland Flowers  |
| Mr. Walt Verweij         | Horticultural Consultant, WV.Consultancy                                   |
| Mr. H. Dharmarajan       | Director General, SulfoRwanda Industries                                   |
| Mr. Seth                 | Cargo Manager, Sabena Airlines/Swiss Air Cargo                             |
| Mr. Didas                | Cargo Manager, Alliance Airlines   |
| Mr. Rivahungu Jumapilli  | Manager, Umballage Rwanda  |
| Mr. Kazoza               | Private operator-potatoes, Ruhengeri area                                  |
| Mr. John Tugulimana      | Cargo Manager, Alliance Airlines   |
| Mr. Anthere Iyakaremye   | Vice President, COODAF, Ruhengeri  |
| Ms. Alphonsine Mutabonwa | Managing Director, Gaperi Fruits s.a.r.l.                                  |
| Mr. Canisius Kanangire   | Director, Project EAP-RW, FUNDP-UNR, Butare                                |
| Dr. Mugunga Muhinda      | Director of Research, Rwanda Agriculture Research Institute (ISAR), Butare |
| Mr. Chris Thorne         | Proprietor, Gone Fishin, Butare  |
| Ms. Odette Nukangwije    | Research Scientist, ISAR- National University of Rwanda, Butare.           |

## **ANNEX B**

### **Sources of Equipment, Supplies, and Services for the Horticultural Food Processing Industry.**

A number of international equipment manufactures and supply companies offer appropriate technologies and products to the Rwandan horticultural food processing industry. A listing of key companies, their contact information, and the types of equipment / supplies / services they offer is shown below.

| <b>Company</b>  | <b>Available Items</b>  |
|---|---|
| Best Sanitizers, Inc.<br>Box 707<br>Penn Valley, CA 95946<br>Ph: 888-225-3267                               | food sanitation<br>supplies/equipment   |
| Premier Foodservice Distributors of America<br>4226 Coronado Ave.<br>Stockton, CA 95204<br>Ph: 209-948-8122 | food sanitation<br>supplies, equipment  |
| FMC Food Tech<br>57 Cooper Ave.<br>Homer City, PA 15748<br>Ph: 724-479-4500                                 | diversity of food processing<br>equipment, fully integrated<br>processing lines, conveyors,<br>scales, fryers |
| Hughes Co. Intl<br>1200 W. James St.<br>Columbus, WI 53925  | vegetable processing equip-<br>ment, blanchers, coolers   |
| Key Technology, Inc.<br>150 Avery St.<br>Walla Walla, WA<br>Ph: 509-522-3375                                | full line of washers, cleaners,<br>cutters, conveyors, blanchers,<br>for vegetable processing.                |
| Magnuson Corp.<br>1 Magnuson Ave.<br>Pueblo, CO 81002<br>Ph: 719-948-9500                                   | fruit & vegetable processing<br>equipment, washers, cutters,<br>peelers.                                      |
| Ecolab Inc.<br>370 Wabasha St. N.<br>St. Paul, MN 55102<br>Ph: 651-293-2233                                 | food sanitation supplies and<br>equipment   |

Urshel Laboratories, Inc.  
2503 Calumet Ave.  
Valparaiso, IN 46384  
Ph: 219-464-4811

diversity of fruit & vegetable  
cutting, slicing, peeling,  
shredding, juicing, sterilizing  
equipment.

Food Design Machinery & Systems, Inc.  
29103 SW Kinsman Rd.  
Wilsonville, OR 97070  
Ph: 503-685-5030

cooking, baking, frying,  
coating, and customized  
processing equipment.

Machinery Engineering & Technology  
4634 Case Dr.  
Janesville, WI 53546

specialty filling, sealing, and  
lidding equipment for the  
food processing industry.

DJS Enterprises  
110 West Beaver Creek Rd.  
Richmond Hill, Ontario L4BIJ9  
Ph: 905-764-7644

diversity of used processing  
equipment.

## ANNEX C

### Sources of Equipment and Supplies for the Horticultural Packaging Industry

A number of international manufacturers or supply companies offer packaging materials for fresh and processed horticultural products. A listing of key companies, their contact information, and the types of equipment and supplies they offer is shown below.

| <b>Company</b>   | <b>Available Items</b>   |
|--|--|
| Curwood Co.<br>2200 Badger Ave.<br>Oshkosh, WI 54903<br>Ph: 800-544-4672                       | plastic films, pre-formed trays, packaging machinery, printers     |
| NimCo Corp.<br>1000 Nimco Drive<br>Crystal Lake, IL 60039<br>Ph: 815-459-4200                  | fruit juice carton machinery, plastic spout addition to any carton |
| Harpak<br>117 Eastman St.<br>Easton, MA 02375<br>Ph: 508-238-8884                              | tray filling and sealing equipment                                 |
| Automated Packaging Systems<br>10175 Philipp Pkwy<br>Streetsboro, OH 44241<br>Ph: 800-331-4414 | fruit and vegetable packing equipment and materials                |
| Cryovac Corp.<br>Box 464<br>Puncan, S.C. 29334<br>Ph: 864-433-2000                             | plastic films and packaging  |
| Dupont Packaging<br>Box 80026<br>Wilmington, DE 19880<br>Ph: 302-992-5225                      | plastic films and packaging  |
| Tenneco Packaging<br>1900 West Field Court<br>Lake Forest, IL 60045<br>Ph: 847-482-2000        | plastic clamshell punnets, rigid plastic containers                |

TetraPak Inc.  
101 Corporate Woods Pkwy  
Vernon Hills, IL 60061

aseptic cartons for beverages

CWR Resources, Inc.  
P.O. Box 358  
Batavia, IL 60510  
Ph: 630-879-8855

used packaging equipment,  
cartoners, fillers, sealers,  
wrappers

Westvaco Corp.  
320 Hull St.  
Richmond, VA 23224  
Ph: 804-233-9205

corrugated cartons

UltraPak, Inc.  
21925 Industrial Blvd.  
Rogers, MN 55473  
Ph: 612-428-8340

plastic clamshell punnets,  
rigid plastic containers

DJS Enterprises  
110 West Beaver Creek Rd.  
Richmond Hill, Ontario L4B 1J9  
Ph: 905-764-7644

diversity of used packaging  
equipment

Union Standard Equipment Co.  
4248 W. 47<sup>th</sup> St.  
Chicago, IL 60632  
Ph: 773-376-5400

wide assortment of used  
packaging machines, fillers,  
sealers, cleaners

ATW Manufacturing Co.  
4065 W. 11<sup>th</sup> Ave.  
Eugene, OR 97401  
Ph: 800-759-3388

bag sealing equipment for all  
types of bags and pouches

Change Parts, Inc.  
801 N. Rowe St.  
Ludington, MI 49431  
Ph: 232-845-5107

bottle cleaners, fillers,  
cappers, labelers

Inline Filling Systems, Inc.  
216 Seaboard Ave.  
Venice, FL 34292  
Ph: 941-486-8800

bottle fillers, cappers,  
conveyors

Machinery & Equipment Co.  
P.O. Box 7632  
San Francisco, CA 94170  
Ph: 415-467-3400

diversity of packaging,  
bottling, and filling  
equipment

**ANNEX D**Sources of Refrigeration/Cooling Equipment and Supplies**Company****Available Items**

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|   |  |
|---|--|
| Barr Inc.<br>1423 Planeview Dr.<br>Oshkosh, WI 54904<br>Ph: 920-231-1711                        | used refrigeration equipment<br>and insulated marine<br>containers             |
| Carrier Corp.<br>Box 4805<br>Syracuse, NY 13221<br>Ph: 315-432-6000                             | refrigeration units for trucks,<br>marine containers, and<br>storage buildings |
| Thermo-King Corp.<br>314 W. 90 <sup>th</sup> St.<br>Minneapolis, MN 55470                       | refrigeration units for trucks<br>marine containers, and<br>storage buildings  |
| Kelly Container, Inc.<br>772 Union St.<br>W. Springfield, MA 01090<br>Ph: 413-788-0917          | refrigerated marine<br>containers  |
| Cool Care Inc.<br>601 NW 12 <sup>th</sup> Ave.<br>Deerfield Beach, FL 33442<br>Ph: 954-698-0067 | modular cooling units  |
| Envirocontainer Inc.<br>440 S. Hindry Ave.<br>Inglewood, CA 90301<br>Ph: 310-410-4090           | temperature-controlled air<br>containers                                       |
| IFC, Inc.<br>Pomona, CA<br>Ph: 909-517-1080   | thermal blankets   |
| Cold Ice Inc.<br>9999 San Leandro Blvd.<br>Oakland, CA 94603<br>Ph: 510-568-8129                | gel packs  |
| Tekpak Inc.<br>2 Fifth Ave.<br>Peabody, MA 01960<br>Ph: 978-532-3500                            | gel packs  |