REPUBLIC OF RWANDA

MINISTRY OF AGRICULTURE AND ANIMAL RESOURCES

PADEBL

FINAL REPORT

UPDATING THE MASTER PLAN

OF THE MILK CHAIN IN RWANDA

May 2009

By

DMS DEVELOPMENT & MANAGEMENT SOLUTIONS
Research & Consulting Chambers

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ABBREVIATIONS & ACRONYMS

AIV	Aides Infirmiers Vétérinaires
BAD	Banque Africaine de Développement
BL	Bassin laitier
BOD	Biochemical Oxygen Demand
BPR	Banque Populaire du Rwanda
BRD	Banque Rwandaise de Développement
°C	Degré Celsius
Ca^{2+}	Ion Calcium
CAPMER	Centre d'Appui aux Petites et Moyennes Entreprises au Rwanda
CCL	Centre de collecte du lait
CH_4	Méthane
CO_2	Dioxyde de carbone
COD	Chemical Oxyen Demand
CSS	Credit and Saving Services
CVL	Comptoir de vente du lait et des produits laitiers
DMS	Development & Management Solutions
EA	Environmental Audit
EDPRS	Economic Development and Poverty Reduction Strategy
EIA	Environmental Impact Assessment
EIA	Environmental Impact Assessment
EPQD	Eastern Province Quality Dairy
FAD	Fonds Africain de Développement
FAO	Food and Agriculture Organisation [Organisation des Nations Unies pour l'alimentation et l'agriculture]
FGA	Facilité de Garantie Agricole
FRW	Franc Rwandais
FSP	Fédération du Secteur Privé
g	Gramme
GDP	Gross Domestic Product
GoR	Government of Rwanda
HPI	Heifter Project International
ISAR	Institut des Sciences Agronomiques du Rwanda
km	Kilomètre
kW	Kilowatt
L	Litre
LAAICO	Libyan Arab African Investment Corporation
LVNR	Laboratoire Vétérinaire Nationale du Rwanda
LWF	Lutherian World Federation
m	Mètre
MCC	Milk Collection Center

mg	Milligramme
MINAGRI	Ministère de l'Agriculture et des ressources animales
mm	Millimètre
MVC	Milk Vender Centre
MVK	Mairie de la Ville de Kigali
NO_x	Composés nitreux
O_2	Dioxygène
ODM	Objectifs de Développement du Millénaire
OMS	Organisation Mondiale de la Santé
PADEBL	Projet d'Appui au Développement de l'Elevage Bovin Laitier
PAPSTA	Projet d'Appui au Plan Stratégique de Transformation de l'Agriculture
pH	Potentiel Hydrogène
PIB	Produit Intérieur Brut
PPCB	Péripneumonie Contagieuse des Bovins
RADA	Rwanda Agriculture Development Authority
RARDA	Rwanda Animal Resources Development Authority
RBS	Rwanda Bureau of Standards
REMA	Rwanda Environmental Management Authority
SACR	Send A Cow Rwanda
SO_2	Dioxyde de soufre
SS	Suspended Solids
t	Tonne
TVA	Taxe sur la valeur ajoutée
UHT	Ultra Haute Température
USAID	United States Agency for International Development
USD	Dollar Américain
VK	Ville de Kigali

1. BACKGROUND

1.1. Rwanda Context

Rwanda is a landlocked country with no access to the sea, located between Central Africa and Eastern Africa. It is known as the country of a thousand hills, and it has a surface area of 26 338 Sq km. With a population of 9.3 million inhabitants, Rwanda has one of the highest population densities in the world: 353 inhab./Sq km.

Agriculture employs 78.8% of the active population (EICV2 data) and contributes 36% [of which 90% is by livestock production] to the GDP of the country. Rwanda is classified among countries of "Low Human Development" index with a GDP per capita of 370 USD. The GDP growth rate is estimated at 8% and the total expenditure and net lending amounted to 386,5 billion RWF in 2006.

The political regime is republican with three powers: Executive, Legislative and Judiciary.

The Executive Power is vested in the President of the Republic and the Cabinet. The members of cabinet are all selected from political organizations on the basis of their seats in the Chamber of Deputies without excluding the possibility of appointing to the Cabinet other competent people who do not belong to any political organization.

The Legislative Power is exercised by a bicameral Parliament which consists of 80 members in the Chamber of Deputies and 26 members in the Senate.

The Judicial Power is exercised by the Supreme Court and other courts and tribunals established by the Constitution and/or laws.

The country is administratively subdivided into 4 deconcentrated Provinces plus the City of Kigali, further subdivided into 30 decentralized Districts (Local Governments).

The 1994 genocide in Rwanda destroyed almost all economic, legal and social infrastructures and led the country into quasi-total ruin.

After this period, the country had to be reconstructed in all sectors. This rehabilitation, among other things, required the setting up of an adequate legal framework to manage the situation of post-genocide and war.

The documents of the Vision 2020 and the Economic Development and Poverty Reduction Strategy [EDPRS] highlight the challenges that Rwanda faces. Among these, PADEBL is particularly concerned by the country's economic growth through its contribution to food self sufficiency and poverty reduction.

1.2. Milk Chain

Under Vision 2020 and the Millenium Development Goals (MDG), the Government of Rwanda has placed poverty at the heart of its concerns because it is really a development limiting factor. Indeed, the depth and the gravity of poverty affect both the rural (65.7%) and urban (14.3%) areas. While focusing on positive indicators (increasing GDP by more than 6%), the Government has set for itself the following objective under the National Strategy for Poverty Reduction: *To reduce poverty by half by 2015.* The success of this strategy will be achieved through the following:

(1) Development of the rural sector, particularly the technological transformation of agriculture through intensification, rational management of natural resources and promotion of non agricultural employment;
(2) Transfer of productive assets to the underprivileged in the society, particularly the unemployed, the women and the youth, availing them with greater land security;

(3) Development of the agricultural sector through increased productivity, with more trading activity which will generate better revenues.

Although it has recorded a slight increase in its contribution to GDP, the share of livestock in the national economy is still low and almost nil in the external trade. According to FAO/WHO standards for Rwanda, the diet requirements of the population are 2 100 kilocalories, 59 g of proteins and 40 g of lipids/head/day. The livestock subsector is supposed to contribute 10% of protein requirements, representing 6 g/head/day of which 3.1 g of milk, 2.2 g of meat, 0.5 g of eggs and 0.2 g of fish. Protein intake is 4 g/head/day, representing a deficit of 2 g/head/day. This deficiency leads to protein malnutrition with harmful consequences on the health of the population (sensitivity to disease, inefficiency at work), especially the vulnerable categories (women and children). This situation of protein malnutrition, poor participation in the national economy and environmental degradation impedes the country's sustainable development.

At the local level, national production is far from meeting the demand in animal products. As a result of a very high population growth, the number of consumers has increased rapidly. Also, individual ration of animal proteins, which is already insufficient, decreases as the population increases. Considering its current growth rate of 2.9% which is expected to stabilize at around 2% by 2020, the population will be around 14 million by that year.

In order to meet the population requirements in animal proteins in the year 2020, livestock will need to produce 483 693 tons of milk, 83 291 tons of meat, 38 546 tons of eggs, 17 362 tons of fish and 11 363 tons of honey.

The aim of the current strategies is to improve the existing livestock genetically instead of increasing their population, and the recent introduction of GIRINKA « one cow for every poor family » fits quite well in this context, and this programme is expected to yield great impact. This strategy, through which the Government intends to fight poverty and food insecurity, targets more than 600 000 households and is already operational. By 2020, the cattle population will decrease and settle at the acceptable stocking level of about 505 816 heads. The significance of this strategy is that it respects the potentialities on one hand and that, on the other, the results in terms of production will exceed the protein requirements of the population [increased milk and meat production]. With a population consisting of 80% of farmers today, the number of farmers will decrease in favour of the secondary and tertiary sectors.

By 2020 Rwanda will be a country freely flowing with milk and honey:

- Stock farming will avail 6 g of proteins/head/day, representing 10% of protein requirements of the population as a contribution to food security;
- The contribution of stock farming to GDP will be 8% at least;
- The subsector will contribute to foreign exchange earning through the export of animals and animal products, particularly milk and dairy products.

In the light of the strategic advantages of various productions and systems, milk appears to be an essential commodity. As a rich and complete food, milk plays a significant role in the fight against malnutrition and underfeeding. In addition, this chain generates employment and revenue. It is for this reason that the involvement of partners in this chain is a great opportunity for the overall development of the country.

The chosen policy option is *genetic improvement through the introduction of performing breeds, mainly artificial insemination and the dissemination of improved sires*. For MINAGRI, PADEBL is a major player in this endeavor. Its contribution in improving food security and poverty reduction is significant. Specifically, it aims at meeting the domestic demand in milk and cattle meat and

improve producers' incomes. To achieve these aims, the project executes the following objectives:

- To organise, train and equip grassroots producers to enable them to participate in the implementation and internalizing of the project;
- To improve the genetic potential of the local cattle through crossing with high performing breeds in order to improve productivity;
- To provide appropriate veterinary services;
- To improve livestock nutrition and the rational management of grazing land;
- To build and operationalise infrastructure for the collection, cooling and trading of milk and dairy products;
- To build capacity for national departments involved in the implementation of the project.

Through PADEBL, AfDB has already launched and financed actions upstream and downstream of the milk chain. Upstream actions concerned activities aimed at increasing milk production and organising producers, while downstream activities consisted of interventions regarding mainly the promotion of milk marketing through the establishment of centres for the collection and cooling of milk.

The following two tables provide information about milk collection centres which have already been built and those under construction:

Table 1: Constructed Milk Collection Centres

Province	District	Sector	Cooperative /Association	Site	Financing
East	Nyagatare	Matimba	Tuzamurane	1. Matimba	PADEBL
		Rwimiyaga	Kirebe-Kamate zirakamwa Giramata-isangano	2. Kirebe 3. Gacundezi	PADEBL PNUD
		Karangazi	Terimberemworozi Abarwanashyaka Milk Supplers Rwabiharamba Farmer's coop. Musenyi	4. Mbare 5. Ruhuha 6. Rwabiharamba 7. Musenyi	PADEBL PADEBL PADEBL PADEBL
		Nyagatare	Rwempasha Ville	8. Rwempasha 9. Nyagatare Town	Nyagatare District
	Kayonza	Gahini	Rwisirabo farmer's coop.	10. Nyamiyaga	PADEBL
		Murundi	Mubari farmer'coop	11. Buhabwa	PADEBL
	Kirehe	Nyarubuye	Giramata	12. Nyarubuye	PADEBL
	Bugesera	Mayange	CODECOL	13. Mbyo	Handicap Intern.
South	Kamonyi	Gacurabwenge	Amizero	14. Rugobagoba	PADEBL
		Mugomero	Coop. y'aborozi ba Mugomero	15. Mugomero	RSSP
	Ruhango	Kinazi	Umuhuza	16. Kinazi	PADEBL
		Kabagari	Turengeraborozi	17. Buhanda	PADEBL
	Nyanza	Nyagisozi	Giramata mworozi	18. Rurangazi	PADEBL
North	Gicumbi	Byumba	IAKB	19. Kageyo	PADEBL
		Byumba	GIRAMATA	20. Gicumbi Town	DRB 2
		Kajevuba	-	21. Kajevuba	Handicap Intern.
	Musanze	Kigombe	Zirakamwa	22. Musanze Town	PADEBL
West	Rubavu	Kanzenze	Zirakamwa-twicundire	23. Mizingo	PADEBL
Kigali City	Gasabo	Kabuga	-	24. Rugende	Handicap Intern.
	Kicukiro	-	COABOMU	25. Giporoso	COABOMU

Table 2: Milk collection centres under construction

Province	District	Sector	Cooperative /Association	Site	Financing
East	Gatsibo	Rwimbogo	Rwimbogo zirakamwa	1. Rwimbogo	PADEBL
		Kiziguro	Koperative y'aborozi ba Kiziguro	2. Ndatemwa	PADEBL
	Kayonza	Rwinkwavu	Koperative y'aborozi ba	3. Rwinkwavu	PADEBL
	Rwamagana	Kigabiro	Dukundamatungo-Kigabiro	4. Kigabiro	PADEBL
		Rubona	Koperative y'aborozi ba	5. Rubona	PADEBL
West	Rubavu	Kanama	Koperative y'aborozi ba Nkomane	6. Nkomane	PADEBL
	Nyabihu	Muringa	Koperative y'aborozi ba Muringa	7. Muringa	PADEBL
		Arusha	Koperative y'aborozi ba Arusha	8. Arusha	PADEBL
		-	Koperative y'aborozi ba Nyiragikokora	9. Nyiragikokora	PADEBL
		Rubavu	Koperative y'aborozi ba Gitwa	10. Gitwa	PADEBL
	Rusizi	Nyakarenzo	Koperative y'aborozi ba Rusambu	11. Rusambu	PADEBL
	Karongi	Rubengera	Koperative y'aborozi ba Rubengera	12. Rubengera	PADEBL
South	Kamonyi	Kayenzi	Koperative y'aborozi ba Kayenzi	13. Kayenzi	PADEBL
	Muhanga	Nyamabuye	COEPROMU	14. Nyamabuye	PADEBL
	Nyanza	Busoro	Koperative y'aborozi ba Busoro	15. Busoro	PADEBL
North	Musanze	Kinigi	Agiragitereka	16. Kinigi	PADEBL

1.3. Methodology

In August 2008, the "Projet d'Appui au Développement de l'Elevage Bovin Laitier" [PADEBL] contracted DMS [Development & Management Solutions], a Rwandan research and consulting company, to update the current master plan for the milk chain in Rwanda. As per the Terms of Reference, the purpose of the exercise was to study and come out with proposals to overcome the constraints within the segments of the milk chain, relating to the collection, conservation, processing, trading and marketing of milk and milk products.

As also indicated in the Terms of Reference, the contracted firm was asked to provide business plans for the milk processing plants at:

- Gishwati;
- Nyanza;
- Nyagatare; and
- Kigali.

The project was financed through the "Fonds Africain de Dévelopment" [FAD] (Project ID: n° F/RWA/AGR/DEV.SUP/01/36).

The assignment was carried out by DMS Consultant Team: Dr. Carpophore Ntagungira, Specialist of Agro economy, Mr. Philip Rushigajiki, Specialist of Livestock, Mr. Paulin Ngirumpatse, Specialist of Rural Development, Mr. Silas Sililo Sinayobye Kamanzi, Specialist of Milk Technology, Ms. Coletha Ruhamya Uwineza, Specialist of Environment, and Mr. Fiacre Kamanzi, Specialist of Databases, responsible for overall coordination, quality control and compilation of reports. The methodology employed is described in section below. Essentially the team was selected to give the most effective combination of experience, skills and knowledge.

Field work commenced on 27 October 2008 – that is, the gathering, recording and analysis of information from PADEBL and its partners and stakeholders –, according to the contract, this process was to culminate in a large consultative workshop involving participants from across Government, the private sector and other stakeholders which was supposed to take place sometime after submission of the draft report. Before the submission of the final report, a

presentation of the draft report to PADEBL staff was planned on 22nd December 2008. A final report incorporating all the comments was planned to be finalised and submitted to PADEBL on 29th December 2008.

The above set time frame was not fulfilled due to:

A copy of master plan which was to be updated reached the team on the 24th November 2008 while the team started our work on the 15th October 2008, lack of this document delayed field visits and due to that the team went back to the field where we spent two weeks. In addition to that the master plan was in hard copy and hence we were obliged to write it out so that we get the soft copy. One week was spent for reading, writing and understanding this document by the team. This explains why the draft report was not ready till 30th Jan 2009.

1.3.1. Data collection and analysis

The information required to complete this assignment was to be gathered from a range of sources, both written and oral. Written sources included both formal publications - by PADEBL and the government, including legal and regulatory texts - and informal working papers, procedural manuals, and other internal documents. A list of the principal documents consulted is included at the end of this document.

Oral information derived mainly from individual interviews with PADEBL & RARDA staff, partners and various stakeholders. A list of people met is attached at Annex 10.

Considerable weight was put on the use of interactive and participative discussions with PADEBL & RARDA staff to supplement information drawn from documents and individual interviews.

It was felt that such an approach would maximise the involvement and participation of staff in the process, easing the way and increasing the chances for implementation of subsequent paper. At the same time, however, it was recognised that individuals would necessarily have their own distinctive perspective on the issues under discussion, and that conflicting points of view were to be expected. It was therefore important that no single piece of information be taken merely at face value; as far as possible evidence on each issue has been sought from a number of sources and the findings correlated and triangulated against each other, in an attempt to obtain an objective and well-balanced view.

Views and comments have not been directly attributed to individuals in this report; so that people feel able to speak as freely as possible about their experience, it was important that assurances of anonymity be able to be given if necessary. At the same time, clear records of all discussions and of documentary sources have been kept by the Consultant Team, so that – in case any of the findings are queried – there is a definite audit trail of evidence to be consulted.

Most importantly, during the course of the data collection, the Consultant Team did a working tour in the four Cattle Production Zones (namely Gishwati, Nyanza, Nyagatare and Kigali) and in all districts of Rwanda to collect information. The input from them has been incorporated in this document.

The table below was designed and translated into kinyarwanda and used to gather information which constituted the database developed.

Akarere					
Umurenge	**Inka nyarwanda**	**Inka z'ibyimanyi**	**Inka z'inzungu**	**Inka zikamwa**	**Amalitiro zikamwa ku munsi**
Umurenge 1					
Umurenge 2					
Umurenge 3					
…/…					
Umurenge wa nyuma					

This table is meant for the collection of quantitative information on the livestock situation.

Annexes 12 to 15 provide the questionnaires respectively for Primary Producer, Milk Collection Center, Milk Processor and Beneficiaries & Investors in dairy inputs.

1.3.2. Report writing

After the long process of data collection from 27th October to 12th December 2008, the following tasks were carried out in order to finalise the report:

- Analyse the data collected, draw findings and identify the problems and priority areas per segment of milk chain;
- Update the master plan for the milk chain;
- Develop the business plan for the four Cattle Production Zones;
- Raise the main points to give proposals in relation with the national orientations within the milk chain;
- Prepare the Income Statement for each cattle layering areas;
- Draft the report.

2. UPDATING THE MASTER PLAN OF THE MILK CHAIN IN RWANDA

2.1. Introduction

Through PADEBL, the Ministry of Agriculture and Natural Resources (MINAGRI) is seriously committed to the promotion and the development of the milk chain and to the programme « One cow for every poor family ». In this connection, several projects and programmes are underway in the country, particularly in the main dairy farming areas. However, some constraints still remain, particularly in the segments of the milk chain related to:

- the collection;
- the conservation;
- the processing;
- the trading; and
- the marketing.

In order to overcome these various constraints, PADEBL project launched a study for updating the master plan of the milk chain, a common concern for both MINAGRI and AfDB, as confirmed during the mid-term review of PADEBL project in April 2006.

2.2. Situation of the livestock subsector

2.2.1. Livestock areas

The milk subsector in Rwanda has made great progress after the war and the 1994 genocide. A large number of cows were killed, but the return of Rwandans from exile with a substantial number of cattle contributed to the revival of dairy farming. Subsequently, the Government and individuals made great efforts to import pure or improved dairy breeds. In recent years, many initiatives were undertaken by the Government and the development partners as well as private investors and a cattle restocking has reached a satisfactory level.

The current Government programme known as « One cow per every poor household » intends to distribute dairy cows throughout the country, particularly in the poorest areas. All these efforts have greatly contributed to the increase of the cattle population in the country.

Table 3 below shows cattle population distribution in the country. Eastern province has the highest population, followed by Western, Northern, Southern and Kigali City in descending order.

Table 3: Cattle population per province by end 2008

Province	Local breed	Crosses	Pure breed	Total	% Total
East	376 566	61 823	27 694	**466 083**	**39%**
West	123 615	43 014	15 322	**335 462**	**28%**
North	138 142	22 870	7 794	**181 951**	**15%**
South	260 170	61 777	13 514	**168 806**	**14%**
Kigali City	22 984	9 086	10 523	**42 593**	**4%**
Grand Total	**921 477**	**198 571**	**74 847**	**1 194 895**	**100%**

Table 4: Cattle population by breed by end 2008

	Value	%
Local breed	921 477	77%
Crossed breed	198 571	17%
Pure breed	74 847	6%
Total	**1 194 895**	**100%**

The cattle population is composed of 77% of local breeds, 17% of crossbreeds and 6% of pure breeds as shown in the preceding table.

According to the December 2008 census carried out by the study mission, the total cattle population is slightly higher than the estimates by MINAGRI for 2007. Indeed, MINAGRI had estimated that the total population would be 1 147 000 heads in 2007, showing a difference of 47,895 heads.

In addition, based on these numbers, the cattle population which was estimated at 645 848 heads in 1997 has increased almost two-fold, representing a growth rate of nearly 76% in 11 years.

This high growth rate is the outcome of the efforts made by the Government and its partners to restock the herds which were decimated mostly by the war and the 1994 genocide. These efforts led to improved food security and poverty reduction in some zones.

Nonetheless, this cattle population exceeds by far the stocking capacity of the available land for cattle keeping since studies have shown that Rwanda could accommodate only less than 700 000 heads of cattle.

Another significant finding is the change that has occurred in the genetic make-up of the cattle population in Rwanda. Out of a total of 1 194 895 heads of cattle, 198 571 cows, or 17%, are of improved breed. The study notes also the introduction of 74 847 pure breed heads of cattle, or 6% of the total population.

Table 5: Cattle Population per Production Zone

Cattle Production Zone	Local Breed		Crosses		Pure Breed		Total	
	Absolute Number	%	Absolute Number	%	Absolute Number	%	Absolute Number	%
Nyagatare	218 309	24%	40 419	20%	17 543	23%	**276 271**	**23%**
Nyanza	198 438	22%	50 138	25%	10 986	15%	**259 562**	**22%**
Inyange	163 812	18%	33 682	17%	21 538	29%	**219 032**	**18%**
Gishwati	115 003	12%	45 884	23%	16 783	22%	**177 670**	**15%**
Ngoma	103 873	11%	14 802	7%	5 188	7%	**123 863**	**10%**
Nyirangarama	52 118	6%	5 643	3%	1 400	2%	**59 161**	**5%**
Karongi	36 188	4%	3 586	2%	396	1%	**40 170**	**3%**
Rusizi	33 736	4%	4 417	2%	1 013	1%	**39 166**	**3%**
Grand Total	**921 477**	**100%**	**198 571**	**100%**	**74 847**	**100%**	**1 194 895**	**100%**

The analysis of the figures in this table shows that the cattle population is found around the main traditional areas such as Nyagatare, Gishwati, Nyanza and Kigali. These high concentration cattle areas were traditionally characteristics as dairy farming areas.

A dairy farming area is an area with high concentration of milk production. In this area there is spirit of milk production. Moreover, the problems of livestock experience are shared and they are solved together.

It should also be noted that some distant districts from the above mentioned points may be grouped together and show a significant cattle population by themselves to constitute autonomous dairy farming areas.

According to this table, Ngoma, Nyirangarama, Karongi and Rusizi are areas not close to any of the traditional dairy farming areas. Yet, each of these areas has quite a consideratble cattle population and its milk production is quite significant to merit own specific dairy processing units.

The following tables show the evolution of the cattle population and milk production in these new dairy farming areas proposed by the study mission.

Ngoma Dairy Farming Area

Table 6: Evolution of Cattle Population in Production Zone of Ngoma

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	103 873	100 946	90 328	85 577	81 154	77 083	73 174	69 462	65 939	62 595	59 573	56 665	53 898
Crosses	14 802	34 754	61 161	75 953	82 296	89 196	96 674	104 779	113 564	123 085	133 625	145 112	157 586
Pure	5 188	11 669	24 959	36 792	39 865	43 207	46 830	50 756	55 011	59 623	64 729	70 294	76 336
Total	**123 863**	**147 368**	**176 448**	**198 322**	**203 315**	**209 486**	**216 677**	**224 997**	**234 514**	**245 303**	**257 927**	**272 070**	**287 821**

Table 7: Evolution of number of lactating Cows in Production Zone of Ngoma

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	31 422	30 793	28 890	27 370	25 956	24 614	23 366	22 181	21 056	19 988	18 992	18 065	17 183
Crosses	5 329	11 062	20 296	25 205	27 264	29 550	32 028	34 713	37 623	40 777	44 196	47 995	52 121
Pure	2 023	3 872	8 282	12 209	13 207	14 314	15 514	16 815	18 225	19 753	21 409	23 249	25 248
Total	**38 774**	**45 728**	**57 468**	**64 784**	**66 427**	**68 478**	**70 908**	**73 708**	**76 904**	**80 518**	**84 598**	**89 310**	**94 552**

Table 8: Evolution of total milk produced in Production Zone of Ngoma

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	11 783	11 547	10 834	10 264	9 733	9 230	8 762	8 318	7 896	7 495	7 122	6 774	6 444
Crosses	10 071	20 908	38 360	47 637	58 891	63 828	69 179	74 979	81 266	99 089	107 396	116 629	126 654
Pure	7 891	15 101	32 302	47 616	59 432	64 414	69 815	75 668	82 012	100 740	109 186	118 572	128 765
Total	**29 745**	**47 557**	**81 495**	**105 517**	**128 056**	**137 473**	**147 756**	**158 965**	**171 174**	**207 324**	**223 704**	**241 975**	**261 863**

Table 9: Evolution of marketable milk produced in Production Zone of Ngoma

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	7 070	6 928	6 500	7 185	6 813	7 384	7 010	6 654	6 317	5 996	5 698	5 420	5 155
Crosses	6 043	12 545	23 016	33 346	41 223	51 062	55 344	59 984	65 013	79 271	85 917	93 303	101 324
Pure	4 735	9 061	19 381	33 331	41 602	51 531	55 852	60 534	65 610	80 592	87 349	94 857	103 012
Total	**17 847**	**28 534**	**48 897**	**73 862**	**89 639**	**109 978**	**118 205**	**127 172**	**136 939**	**165 859**	**178 964**	**193 580**	**209 490**

Nyirangarama Dairy Farming Area

Table 10: Evolution of Cattle Population in Production Zone of Nyirangarama

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	52 118	50 649	45 322	42 938	40 719	38 676	36 715	34 852	33 085	31 407	29 891	28 431	27 043
Crosses	5 643	24 913	52 163	66 219	71 749	77 764	84 284	91 350	99 009	107 310	116 500	126 514	137 390
Pure	1 400	7 439	21 237	32 766	35 503	38 479	41 705	45 202	48 992	53 099	57 646	62 602	67 983
Total	**59 161**	**83 002**	**118 722**	**141 923**	**147 971**	**154 920**	**162 704**	**171 405**	**181 086**	**191 816**	**204 037**	**217 548**	**232 417**

Table 11: Evolution of number of lactating Cows in Production Zone of Nyirangarama

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	15 766	15 450	14 495	13 733	13 023	12 350	11 724	11 129	10 565	10 029	9 529	9 064	8 622
Crosses	2 031	7 930	17 310	21 974	23 770	25 763	27 923	30 264	32 801	35 551	38 532	41 844	45 441
Pure	546	2 469	7 047	10 873	11 762	12 748	13 817	14 975	16 231	17 591	19 066	20 705	22 485
Total	**18 343**	**25 849**	**38 853**	**46 581**	**48 555**	**50 861**	**53 463**	**56 368**	**59 597**	**63 172**	**67 128**	**71 614**	**76 548**

Table 12: Evolution of total milk produced in Production Zone of Nyirangarama

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	5 912	5 794	5 436	5 150	4 884	4 631	4 396	4 173	3 962	3 761	3 574	3 399	3 233
Crosses	3 839	14 988	32 716	41 532	51 343	55 648	60 313	65 370	70 851	86 390	93 633	101 682	110 422
Pure	2 129	9 628	27 485	42 406	52 928	57 366	62 176	67 388	73 038	89 717	97 238	105 597	114 675
Total	**11 881**	**30 409**	**65 636**	**89 087**	**109 155**	**117 645**	**126 885**	**136 932**	**147 851**	**179 867**	**194 445**	**210 678**	**228 330**

Table 13: Evolution of marketable milk produced in Production Zone of Nyirangarama

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	3 547	3 476	3 261	3 605	3 419	3 705	3 517	3 339	3 169	3 009	2 859	2 719	2 587
Crosses	2 304	8 993	19 629	29 072	35 940	44 518	48 251	52 296	56 681	69 112	74 906	81 345	88 338
Pure	1 278	5 777	16 491	29 684	37 050	45 893	49 740	53 911	58 431	71 773	77 791	84 478	91 740
Total	**7 129**	**18 246**	**39 382**	**62 361**	**76 409**	**94 116**	**101 508**	**109 545**	**118 280**	**143 894**	**155 556**	**168 542**	**182 664**

Karongi Dairy Farming Area

Table 14: Evolution of Cattle Population in Production Zone of Karongi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	36 188	35 168	31 469	29 814	28 273	26 855	25 493	24 200	22 972	21 807	20 754	19 741	18 777
Crosses	3 586	22 703	50 142	64 033	69 380	75 197	81 501	88 335	95 741	103 767	112 654	122 338	132 854
Pure	396	6 318	20 251	31 699	34 347	37 226	40 347	43 730	47 396	51 370	55 769	60 563	65 769
Total	**40 170**	**64 189**	**101 861**	**125 546**	**132 000**	**139 278**	**147 342**	**156 264**	**166 109**	**176 945**	**189 177**	**202 642**	**217 401**

Table 15: Evolution of number of lactating Cows in Production Zone of Karongi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	10 947	10 728	10 065	9 535	9 043	8 575	8 140	7 727	7 335	6 963	6 617	6 294	5 986
Crosses	1 291	7 226	16 639	21 249	22 985	24 912	27 001	29 265	31 718	34 378	37 260	40 463	43 941
Pure	154	2 097	6 720	10 519	11 379	12 333	13 367	14 488	15 702	17 019	18 445	20 031	21 753
Total	**12 392**	**20 051**	**33 424**	**41 303**	**43 407**	**45 820**	**48 508**	**51 480**	**54 756**	**58 360**	**62 322**	**66 788**	**71 681**

Table 16: Evolution of total milk produced in Production Zone of Karongi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	4 105	4 023	3 774	3 576	3 391	3 216	3 053	2 898	2 751	2 611	2 481	2 360	2 245
Crosses	2 440	13 658	31 448	40 160	49 648	53 811	58 322	63 212	68 512	83 538	90 541	98 325	106 777
Pure	602	8 177	26 208	41 025	51 205	55 498	60 151	65 194	70 660	86 795	94 072	102 159	110 941
Total	**7 147**	**25 858**	**61 431**	**84 761**	**104 244**	**112 524**	**121 526**	**131 304**	**141 922**	**172 944**	**187 094**	**202 843**	**219 962**

Table 17: Evolution of marketable milk produced in Production Zone of Karongi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	2 463	2 414	2 265	2 503	2 374	2 573	2 442	2 318	2 201	2 089	1 985	1 888	1 796
Crosses	1 464	8 195	18 869	28 112	34 754	43 049	46 658	50 570	54 809	66 830	72 433	78 660	85 421
Pure	361	4 906	15 725	28 718	35 843	44 398	48 121	52 155	56 528	69 436	75 258	81 727	88 752
Total	**4 288**	**15 515**	**36 858**	**59 333**	**72 971**	**90 019**	**97 220**	**105 043**	**113 538**	**138 355**	**149 676**	**162 275**	**175 970**

Rusizi Dairy Farming Area

Table 18: Evolution of Cattle Population in Production Zone of Rusizi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	33 736	32 785	29 337	27 794	26 357	25 035	23 765	22 560	21 416	20 330	19 348	18 404	17 505
Crosses	4 417	23 596	50 958	64 916	70 337	76 234	82 626	89 553	97 061	105 199	114 207	124 025	134 687
Pure	1 013	7 007	20 857	32 355	35 057	37 996	41 182	44 635	48 377	52 433	56 923	61 816	67 130
Total	**39 166**	**63 388**	**101 152**	**125 065**	**131 752**	**139 266**	**147 573**	**156 748**	**166 854**	**177 961**	**190 478**	**204 245**	**219 322**

Table 19: Evolution of number of lactating Cows in Production Zone of Rusizi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	10 205	10 001	9 383	8 889	8 430	7 994	7 589	7 204	6 838	6 492	6 168	5 867	5 581
Crosses	1 590	7 511	16 910	21 542	23 302	25 256	27 373	29 668	32 156	34 852	37 774	41 021	44 547
Pure	395	2 325	6 921	10 737	11 614	12 588	13 643	14 787	16 027	17 371	18 827	20 445	22 203
Total	**12 190**	**19 837**	**33 214**	**41 168**	**43 346**	**45 838**	**48 606**	**51 659**	**55 021**	**58 714**	**62 769**	**67 334**	**72 331**

Table 20: Evolution of total milk produced in Production Zone of Rusizi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	3 827	3 750	3 519	3 333	3 161	2 998	2 846	2 701	2 564	2 434	2 313	2 200	2 093
Crosses	3 005	14 195	31 960	40 714	50 333	54 553	59 127	64 084	69 457	84 690	91 790	99 681	108 250
Pure	1 541	9 069	26 993	41 874	52 264	56 646	61 395	66 542	72 121	88 590	96 018	104 272	113 235
Total	**8 373**	**27 014**	**62 472**	**85 922**	**105 758**	**114 197**	**123 367**	**133 328**	**144 142**	**175 715**	**190 121**	**206 153**	**223 578**

Table 21: Evolution of marketable milk produced in Production Zone of Rusizi

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	2 296	2 250	2 111	2 333	2 213	2 398	2 277	2 161	2 052	1 947	1 851	1 760	1 674
Crosses	1 803	8 517	19 176	28 500	35 233	43 642	47 301	51 267	55 565	67 752	73 432	79 745	86 600
Pure	924	5 441	16 196	29 312	36 585	45 317	49 116	53 234	57 697	70 872	76 814	83 418	90 588
Total	**5 024**	**16 209**	**37 483**	**60 145**	**74 031**	**91 357**	**98 694**	**106 662**	**115 314**	**140 572**	**152 097**	**164 922**	**178 862**

2.2.2. Livestock systems and patterns

The Poverty Reduction and Economic Development Strategy recommends particularly the improvement of the milk chain. As underscored in the document, agriculture is the backbone of the poverty reduction strategy in Rwanda.

Concerning the human population growth, the « land » resource, livestock, forestry and water are key factors in the attainment of this noble objective. Access to land and population growth are

the leading factors. Yet, due to population growth, there is a gradual decline of usable land and, consequently, grazing land becomes scarce in terms of quantity and quality.

The increasing demand of animal products and pressure on available land have led livestock breeding based on pastoralism to take into account its limitations and conform to the new context by adopting more suitable production systems.

Presently, a cattle keeping is mainly of a smallholder type. It is practised in the following four main ways:

1. Extensive Production

The extensive system of production is practised mainly in the Eastern Province, particularly in the districts of Nyagatare and Gatsibo as well as in Gishwati area. The cattle feeds almost always by grazing on individual farms. The stocking rates per hectare per cow are often higher than the recommended capacity. Overgrazing of prairies leads to land overexploitation and the appearence of undesirable plant species. This overgrazing rate has reached dangerous levels and constitutes a serious threat to the environment and the health of the animals squeezed on small surface areas, while cattle productivity leaves much to be desired.

The Government has intervened to reverse this trend particularly through PADEBL under the African Development Bank financing and through PAPSTA, but features of this system are still found in Umutara and Gishwati areas.

2. Agriculture and livestock mixed system

This is a mixed system which can be defined as a system run by households or enterprises where agriculture and livestock are more or less integrated components of a same farm. The most integrated systems are characterized by interdependence between agricultural and livestock activities.

Generally, this system offers more opportunities of checking the negative effects of livestock on environment and strengthens its positive impact, soil fertility conservation by use of farm manure and effective crop/herding rotations. But still this depends on farming objective: food plant cropping vis à vis cattle production.

3. Stalling with basic feeding based on cut fodder from outside the farm

This is a system where the fodder is made up mainly of grass grown on owners or hired land and carried home for the cattle enclosed on the farm or near the farm. Most of the fodder is cut from outside the farm. The system is characterized by land scarcity and the cattle in stall is fed with the grass cut on river banks or on road sides and everywhere where green grass is found in abundance near crop farms. It is recommended for the whole country.

The remains of harvests and household residues are greatly used but are insufficient to meet all the needs.

In some cases, concentrate feeds are provided. Concentrates feeding is rather more used in Kigali city. In rural areas, this system is intensely used in areas with high agricultural potential, particularly around valleys and on the dips of the hills. In these areas, a cattle wandering is no longer authorized. This system is practised by peasants who generally own small farms. Their fields are cultivated intensively to produce mainly for the subsistence needs of their families. Generally, the households are poor, earning poor incomes mainly from tilling the land.

These peasants encounter difficulties related particularly to access to resources and to lack of knowledge and training in cattle management to ensure productivity.

4. Dairy livestock on ranches or big farms

This system is rarely used due to insufficient vast grazing land. A few farms are found especially in the Eastern Province, around Kigali City, and the Government farms at Songa and Rubona in the Southern Province.

Generally, this system requires much investment and can be more cost effective while requiring less human resources. Nonetheless, it has been observed that in many cases, the owners of these farms are not professional breeders who monitor daily the management concerns of their farms.

On the other hand, these are people who have other occupations, leaving it to the herdsmen to manage their farms to the detriment of efficiency.

2.2.3. Importance in the peasant production system

The national economic accounts do not enable one to understand separately the weight of the milk chain in the national economy. According to the available data, the contribution of the livestock to the gross domestic product accounted for 2.4% in current prices in 1997, or about 11.5 billion RWF.

Agriculture contributes greatly to the gross domestic product and its share has continued to grow, ranging between 37% and 41.3% in 2006. During the same period, the share of livestock in agriculture was around 6% as shown in the table below.

Table 22: Progression of Gross Domestic Product [Millions of RWF]

Période	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
Agriculture (include Livestock)	228.7	251.4	277.0	277.4	367.3	441.7	515.7	654.6
Livestock	15.9	15.9	17.6	20.6	21.0	24.3	25.7	28.5
Total Gross Domestic Product	608.4	676.1	741.9	781.5	955.2	1 137.9	1 327.1	1 583.0

Source: NBR

Cattle keeping plays also a very important role in the peasant production system for several reasons, both economic and social. Cattle is at the same time a source of manure, income and savings, and is widely used also during social events

For crop-dairy farmers who are the majority in Rwanda, livestock is a source of very much needed fertilisers considering the insufficiency and the cost of inorganic fertilisers. Thus, the fertility of cultivated soils which is affected by continuous degradation due to erosion depends greatly on organic fertilisers, among which manure is a first-rate choice. Another feature of livestock is that it provides regular income and is a regular source of food.

A cattle breeding is also of particular importance to the Rwandan peasant in that the animals represent a standing saving which can easily be mobilised in the case of need. Animals are thus a source of significant income to meet some basic needs such as school fees for the children, the purchase of production inputs, meeting the primary needs of the family, etc. They are less sensitive to climatic hazards than food crops and cash crops, and they represent a convenient means of meeting urgent needs when necessary and contribute to the accumulation of capital, as the case may be, which can be reinvested in the other sectors of production.

Finally, in addition to being a source of food in the form of on-farm consumption, animals are often given or received as gifts in the form of dowry during wedding ceremonies, without mentioning livestock products which are given or received during feasts or visits by parents or friends.

It should also be mentioned that the breeding of certain animals uses harvest remains and other household residues which would otherwise be wasted and transform them in useful products for

human nutrition. In this way, the breeding of domestic ruminants enriches marginal land for other enterprises (e.g. subsistence crops) for producing meat and milk.

2.2.4. Organisation of the activities of the subsector

Livestock activities are managed by the Rwanda Animal Resources Development Authority (RARDA), an autonomous body supported by the Government through MINAGRI. RARDA was established within the framework of the policy of the Ministry of Agriculture and Animal Resources with the primary aim of increasing production, modernising agriculture and ensuring food security and producing surplus for the market.

As such, RARDA is responsible for all the activities related to animal production and animal health. It is in charge of planning activities and monitoring their implementation on the ground. Though the implementation of plans and strategies is under decentralised structures, RARDA has deployed its staff in the provinces, districts and sectors. Sometimes, a cattle breeding is supported by NGOs partners of the Government. Admittedly, the organisation introduced by the establishment of RARDA has borne considerable success. However, the supervision of livestock activities leaves much to be desired in that it is the same grassroots employees who are at the same time in charge of animal production and agricultural extension work in the narrowest meaning of the word, with what this implies in terms of lack of specificity and close targeting of the breeders' needs. Add to this the fact that the decentralised veterinarians are underequipped materially and even in terms of practical experience. On the other hand, extension work requires that extension workers should be equipped with advanced specialisation.

In the field of animal health and genetic improvement, the lack of high level veterinarians at present deprives the breeders of constant support, at a time when their cooperatives and professional organisations are almost still in their embryonic stages.

The distribution of inputs is inadequate for lack of operators who are actually involved in the upstream sector of production. The reasons for this are that, on one hand, there is no solvent market for the breeders (whose livestock activities are not sufficiently productive to pay for the services) and that, on the other, the cost of inputs is relatively high such that the remunerative margins obtained are in contrast with the breeders' purchasing power. As a result, the inputs are rare on the market, especially because the governement does not subsidise them any more due to the change in the strategic development policies which implies an increasingly strong liberalisation of the production, processing and marketing structures.

For a long time, the processing of dairy products has been in the hands of the breeders themselves (traditional processing of butter, ghee, curd and skimmed milk). But in recent years, plants supported and financed by the State have taken over before the private sector became half-heartedly interested in the field. Industrial processing concerned mainly making pasteurised curd, sometimes fresh pasteurised milk, yoghurt and cheese. The performance of the dairy plants has not always been up to the mission the Government has entrusted to them, and it is for this reason that there has been a tendency of privatising them. At the same time, there have emerged traditional processors who boil the milk before its delivery for consumption. The techniques used are not always well controlled although those who practise them are at present very active operators on the market.

2.2.5. Veterinary and animal production services

After the war and the genocide, much of the infrastructure was destroyed. Nonetheless, great efforts have been made to rehabilitate these facilities. With the establishment of the Projet d'Appui au Développement de l'Elevage Bovin Laitier, some of the installations have been completely rehabilitated and even strengthened. This is the case with the National Veterinary Laboratory, the National Centre for Artificial Insemination.

The widespread stalling zero grazing of cattle has however made some of these communal facilities which had been put in place by MINAGRI and decentralised structures less useful. This is particularly the case with veterinary dispensaries, spraying and cattle treatment races which are still found in rural areas with high concentration of cattle, while dipping tanks have been abandoned because of many reasons, one of which being the fact that these facilities are stressful to cattle which, after all, often have to make a long journey to reach them.

2.2.6. Supply and demand

Total milk demand can be measured through the consumption of households, which includes both consumption at home and outside.

Trend prospects in theoretical demand

In its reports, MINAGRI estimates the annual needs of the population based on the necessary protein requirements of the population at 0.04 tons/year/head. The following table provides the estimates in tons of the theoretical demand from 2008 to 2020.

Table 23: Evolution of prospects in theoretical demand of Milk Products

Year	Population	Needs in tons (Theoretical Demand)	National Production in tons
2008	9 674 975	386 999	364 084
2009	9 955 549	398 222	368 623
2010	10 244 260	409 770	379 642
2011	10 541 344	421 654	416 751
2012	10 847 043	433 882	489 961
2013	11 161 607	446 464	518 987
2014	11 485 293	459 412	551 150
2015	11 818 367	472 735	586 585
2016	12 161 099	486 444	625 538
2017	12 513 771	500 551	745 546
2018	12 876 671	515 067	798 901
2019	13 250 094	530 004	858 806
2020	13 634 347	545 374	924 288

Sources : - MINAGRI
- - Service National de recencement; Results of 3rd RGHI, August 2002
- Author

The following table reveals that up to 2011, the national requirements still show a deficit. However, starting from 2012, the requirements in dairy products are met, the surplus increasing from 55 974 t in 2012 to 378 914 t in 2020. These statistics may cheer us up in the knowledge that up to the year 2020, Rwanda will certainly be a country where the milk will flow and honey too probably!

Table 24: Evolution of supply of milk compared to national needs

Year	Population	National Needs	National Production	Importations			Total Supply	Surplus/Deficit compared to national needs
				Liquid Milk [UHT]	Powder Milk	Milk Products		
2008	9 674 975	386 999	364 084	500	100	5	387 604	-23 520
2009	9 955 549	398 222	368 623	250	50	5	398 527	-29 904
2010	10 244 260	409 770	379 642	125	50	5	409 950	-30 308
2011	10 541 344	421 654	416 751	75	50	5	421 784	-5 033
2012	10 847 043	433 882	489 961	50	50	5	433 987	55 974
2013	11 161 607	446 464	518 987				446 464	72 523
2014	11 485 293	459 412	551 150				459 412	91 738
2015	11 818 367	472 735	586 585				472 735	113 850
2016	12 161 099	486 444	625 538				486 444	139 094
2017	12 513 771	500 551	745 546				500 551	244 995
2018	12 876 671	515 067	798 901				515 067	283 834
2019	13 250 094	530 004	858 806				530 004	328 802
2020	13 634 347	545 374	924 288				545 374	378 914

Sources: - 2nd Conference of investors in Rwanda; Presentation of the sub sector of milk, Kigali 13-15 May 2004
- Author

In 2007, Rwanda produced about 160 millions of litres of fresh milk from an estimated population of 1 147 000 cows. Nearly 62 million litres were consumed on farm and almost 35% of the milk got spoilt before reaching the market or before being processed. At the same time, 450 tons of dairy products were imported.

In addition, it is observed that the rate of milk consumption per person is higher in urban than in rural areas. This is in reality due to the fact that demand is determined by the quantity that a given section of the population is willing to consume based on the income at their disposal. In other words, demand depends on the consumers' purchasing power. Now, this is lower in rural areas than in towns. This disproportion is a sign of serious deficiency in the diet of the rural population.

Considering that only a small part of the households consume milk, these dietary deficiencies become all the more worrying, especially in the rural areas.

Milk production

Since the end of the war, the national supply of livestock products is essentially limited to production by households and a few cooperatives. Milk supply can be assessed by its availability for human consumption. Another means of assessing total milk supply is by appraising the amount sold for money or in the form of batter, the amount consumed on farm and that offered as gift, adjusted by stock variations.

The following two tables provide the technical parameters used in the assessment of cattle population, milk production, development of the cattle population and milk production.

Table 25: Technical estimated parameters of statistics related to Milk Chain

Parameter **Breed**	Total Cattle Population	Nbr of adult cattle population	Nbr of lactating cattle	Total Milk Produced/day	Marketable Milk Produced/day
Local	X_l	$Y_l = 0.55\ X_l$	$Z_l = 0.55\ Y_l$	$V_l = 2.50\ Z_l$	$W_l = 0.60\ V_l$
Crosses	X_c	$Y_c = 0.60\ X_c$	$Z_c = 0.60\ Y_c$	$V_c = 7.00\ Z_c$	$W_c = 0.60\ V_c$
Pure	X_p	$Y_p = 0.60\ X_p$	$Z_p = 0.65\ Y_p$	$V_p = 13.00\ Z_p$	$W_p = 0.60\ V_p$

Source: RARDA

Table 26: Technical Parameters of evolution of cattle and milk production

Local												
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Birth ratio	55%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%	60%
Sex ratio	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Deaths ratio of calves	8%	8%	8%	8%	7%	7%	7%	7%	7%	6%	6%	6%
Deaths ratio of heifers	5%	5%	5%	5%	4%	4%	4%	4%	4%	3%	3%	3%
Deaths ratio of adult cattle	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Ratio of femelles in breeding [AI]	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%
Destocking	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Average Milk Production/day/Cow	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Duration of lactation [Days]	150	150	150	150	150	150	150	150	150	150	150	150
Marketable Milk	60%	60%	70%	70%	80%	80%	80%	80%	80%	80%	80%	80%
Crosses												
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Birth ratio	60%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%
Sex ratio	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Deaths ratio of calves	8%	8%	8%	8%	7%	7%	7%	7%	7%	6%	6%	6%
Deaths ratio of heifers	5%	5%	5%	5%	4%	4%	4%	4%	4%	3%	3%	3%
Deaths ratio of adult cattle	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Ratio of femelles in breeding [AI]	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%
Destocking	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Average Milk Production/day/Cow [kg]	7	7	7	8	8	8	8	8	9	9	9	9
Duration of lactation [Days]	270	270	270	270	270	270	270	270	270	270	270	270
Marketable Milk	60%	60%	70%	70%	80%	80%	80%	80%	80%	80%	80%	80%
Importations	10 000	15 000	5 000									
Pure												
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Birth ratio	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%	65%
Sex ratio	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%
Deaths ratio of calves	8%	8%	8%	8%	7%	7%	7%	7%	7%	6%	6%	6%
Deaths ratio of heifers	5%	5%	5%	5%	4%	4%	4%	4%	4%	3%	3%	3%
Deaths ratio of adult cattle	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Diffusion of males [9-12 month old]	100%											
Ratio of femelles in breeding [AI]	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%	55%
Destocking	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%	12%
Average Milk Production/day/Cow [kg]	13	13	13	15	15	15	15	15	17	17	17	17
Duration of lactation [Days]	300	300	300	300	300	300	300	300	300	300	300	300
Marketable Milk	60%	60%	70%	70%	80%	80%	80%	80%	80%	80%	80%	80%
Importations	3 000	7 500	5 000									

Sources : MINAGRI/RARDA
Memento de l'agronome

The following tables show the cattle population by the end of 2008.

Table 27: Cattle Population per Province

Province	Local		Crosses		Pure		Total	
	Number	%	Number	%	Number	%	Number	%
East	376 566	41%	61 823	31%	27 694	37%	**466 083**	**39%**
West	123 615	13%	43 014	22%	15 322	20%	**181 951**	**15%**
North	138 142	15%	22 870	12%	7 794	10%	**168 806**	**14%**
South	260 170	28%	61 777	31%	13 514	18%	**335 462**	**28%**
Kigali City	22 984	2%	9 086	5%	10 523	14%	**42 593**	**4%**
Grand Total	**921 477**	**100%**	**198 571**	**100%**	**74 847**	**100%**	**1 194 895**	**100%**

Table 28: Cattle Population per District

District	Race locale	Race améliorée	Race pure	Total	Percentage
Bugesera	31 905	1 100	979	**33 984**	**2.8%**
Burera	23 734	1 599	145	**25 478**	**2.1%**
Gakenke	23 853	3 230	413	**27 496**	**2.3%**
Gasabo	17 585	4 221	3 977	**25 783**	**2.2%**
Gatsibo	60 169	11 424	4 570	**76 163**	**6.4%**
Gicumbi	32 558	9 436	3 045	**45 039**	**3.8%**
Gisagara	23 363	3 119	219	**26 701**	**2.2%**
Huye	26 812	6 938	814	**34 565**	**2.9%**
Kamonyi	43 455	8 847	2 461	**54 763**	**4.6%**
Karongi	31 231	1 149	44	**32 424**	**2.7%**
Kayonza	56 287	6 267	2 506	**65 061**	**5.4%**
Kicukiro	1 704	3 872	5 829	**11 405**	**1.0%**
Kirehe	32 359	2 748	1 119	**36 226**	**3.0%**
Muhanga	46 588	5 529	947	**53 063**	**4.4%**
Musanze	23 006	6 673	2 669	**32 348**	**2.7%**
Ngoma	22 255	4 616	1 095	**27 965**	**2.3%**
Ngororero	20 971	2 269	3 003	**26 243**	**2.2%**
Nyabihu	18 114	18 965	5 573	**42 652**	**3.6%**
Nyagatare	151 113	30 165	13 441	**194 719**	**16.3%**
Nyamagabe	30 938	1 793	217	**32 948**	**2.8%**
Nyamasheke	20 461	3 120	295	**23 876**	**2.0%**
Nyanza	15 393	15 216	725	**31 334**	**2.6%**
Nyarugenge	3 695	993	717	**5 405**	**0.5%**
Nyaruguru	41 041	7 793	3 117	**51 951**	**4.3%**
Rubavu	10 745	5 872	2 174	**18 791**	**1.6%**
Ruhango	32 579	12 541	5 016	**50 137**	**4.2%**
Rulindo	34 991	1 932	1 522	**38 445**	**3.2%**
Rusizi	13 275	1 297	718	**15 290**	**1.3%**
Rutsiro	8 819	10 342	3 514	**22 675**	**1.9%**
Rwamagana	22 478	5 503	3 984	**31 965**	**2.7%**
Grand Total	**921 477**	**198 570**	**74 847**	**1 194 895**	**100.0%**

Table 29: Breed ratio of cattle population per province

Province	Local	Crosses	Pure
East	81%	13%	6%
West	68%	24%	8%
North	82%	14%	5%
South	78%	18%	4%
Kigali City	54%	21%	25%
Average	**72%**	**18%**	**10%**

The Northern and Eastern Provinces lead in terms of the number of local cattle breeds, followed by the Southern and Western Provinces, with Kigali City coming the last.

Concerning improved breeds, the Western Province comes first [certainly because of Gishwati Dairy Farming Area]. It is followed by Kigali City and the Southern Province, with the

Eastern and Nortern Provinces far behind.

Finally, in regard to pure breeds, Kigali City is far ahead of the Western, Eastern, Northern and Southern Provinces.

Table 30: Breed ratio of cattle population per Cattle Production Zone

The opposite table shows that local breeds are predominant in the new proposed dairy farming areas. With regard to the classical dairy farming areas, Gishwati counts less cattle of the local breeds, followed by Inyange, Nyanza and Nyagatare.

Cattle Production Zone	Local	Crosses	Pure
Karongi	90%	9%	1%
Nyirangarama	88%	10%	2%
Rusizi	86%	11%	3%
Ngoma	84%	12%	4%
Nyagatare	79%	15%	6%
Nyanza	76%	19%	4%
Inyange	75%	15%	10%
Gishwati	65%	26%	9%
Average	**80%**	**15%**	**5%**

Concerning the population of crossbreeds, Gishwati leads, followed by Nyanza, Inyange, Nyagatare, and then the four proposed new dairy farming areas.

And in regard to the population of pure breeds, Inyange and Gishwati are far ahead of the other dairy farming areas.

The following table shows the daily production of total milk, including that consumed by the calf, the household, friends, etc.

Table 31: Total daily milk production per province [L]

Province	Local		Crosses		Pure		Total	
	Number	%	Number	%	Number	%	Number	%
East	284 778	41%	155 794	31%	140 409	37%	**580 981**	**37%**
West	196 754	28%	155 679	31%	68 518	18%	**420 950**	**27%**
North	93 484	13%	108 396	22%	77 683	20%	**279 562**	**18%**
South	104 470	15%	57 632	12%	39 516	10%	**201 618**	**13%**
Kigali City	17 382	2%	22 897	5%	53 352	14%	**93 630**	**6%**
Grand total	**696 867**	**100%**	**500 398**	**100%**	**379 476**	**100%**	**1 576 740**	**100%**

Table 32: Marketable daily milk production per province [L]

Province	Milk Production	
	Number	%
East	348 588	37%
West	252 570	27%
North	167 737	18%
South	120 971	13%
Kigali City	56 178	6%
Total	**946 044**	**100%**

As shown in the opposite table, daily milk production available for the market in the whole country is estimated at 946 044 litres. The Eastern Province ranks first with 37% of the national production. It is followed by the Southern Province with 25%, then far behind come the Western Province with 18% and the Northern Province with 13%, and finally Kigali City with 6%.

Table 33: Marketable daily milk production per province and per cow [L]

Province	Marketable Milk	Lactating Cows	Average/Cow
Kigali City	56 178	14 328	3.9
West	167 737	58 854	2.9
South	252 570	106 212	2.4
East	348 588	146 968	2.4
North	120 971	53 061	2.3
Total/Average	**946 044**	**379 423**	**2.8**

As it can be seen, 379 423 cows are lactating with a daily production averaging about 2.8 litres per cow. Kigali City has the highest rate with 3.9 litres per day per cow.

Total milk production shows that it is far from meeting the needs and the demand of the population. FAO recommends 220 litres of milk per person per year. Milk supply has been increasing at the same rythm as the demand, but less than 56% of the milk reaches the market, with the selling price much lower than the price fetched by processed milk (200 RWF per litre of raw milk against 600 RWF per litre of milk processed in the dairy plants).

There are some specific constraints which impede the development of the dairy sector: deficient nutrition in terms of quantity and quality, low productivity of cattle breeds, shortage of veterinary services, low investment in livestock, etc. The high growth rate of the human population makes the demand higher than production.

The development of the cattle population and milk production at the national level is shown in the following tables. Milk production is expressed in thousands of litres [x 1 000 L].

Table 34: Evolution of Cattle Population at national level

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	921 477	895 507	801 317	759 168	719 934	683 819	649 136	616 212	584 958	555 289	528 483	502 683	478 142
Crosses	198 571	232 205	241 716	271 262	293 916	318 557	345 265	374 212	405 586	439 591	477 235	518 260	562 811
Pure	74 847	89 442	93 400	110 826	120 081	130 148	141 060	152 887	165 705	179 597	194 977	211 738	229 940
Total	**1 194 895**	**1 217 153**	**1 136 433**	**1 141 255**	**1 133 930**	**1 132 525**	**1 135 461**	**1 143 311**	**1 156 248**	**1 174 476**	**1 200 695**	**1 232 680**	**1 270 893**

Table 35: Evolution of number of lactating Cows at national level

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	278 747	273 172	256 285	242 804	230 256	218 356	207 281	196 768	186 788	177 314	168 486	160 260	152 436
Crosses	71 486	73 911	80 212	90 017	97 373	105 536	114 385	123 975	134 369	145 634	157 844	171 413	186 148
Pure	29 190	29 681	30 994	36 777	39 782	43 117	46 732	50 650	54 897	59 500	64 488	70 032	76 052
Total	**379 423**	**376 764**	**367 491**	**369 598**	**367 411**	**367 010**	**368 398**	**371 393**	**376 054**	**382 448**	**390 818**	**401 705**	**414 636**

Table 36: Evolution of total milk produced at national level

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	104 530	102 439	96 107	91 052	86 346	81 884	77 731	73 788	70 045	66 493	63 182	60 098	57 164
Crosses	135 108	139 692	151 601	170 132	210 325	227 959	247 071	267 785	290 236	353 891	383 561	416 533	452 339
Pure	113 842	115 755	120 877	143 430	179 020	194 029	210 296	227 927	247 037	303 448	328 889	357 161	387 864
Total	**353 480**	**357 887**	**368 585**	**404 613**	**475 690**	**503 871**	**535 097**	**569 500**	**607 318**	**723 831**	**775 632**	**833 792**	**897 367**

Table 37: Evolution of marketable milk produced at national level

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	62 718	61 464	57 664	63 736	60 442	65 507	62 184	59 030	56 036	53 194	50 546	48 078	45 731
Crosses	81 065	83 815	90 961	119 092	147 227	182 367	197 656	214 228	232 189	283 112	306 849	333 226	361 872
Pure	68 305	69 453	72 526	100 401	125 314	155 223	168 237	182 342	197 629	242 758	263 111	285 729	310 291
Total	**212 088**	**214 732**	**221 151**	**283 229**	**332 983**	**403 097**	**428 078**	**455 600**	**485 854**	**579 065**	**620 505**	**667 033**	**717 894**

Imports

According to official statistics, imports of livestock products in 1996 were valued at 1.374 billions RWF, representing less than 2% of the country's total imports. Historically, almost all of these

imports were milk powder, both commercial and non commercial. Since the end of the war, however, Rwanda has been importing significant quantities of fresh milk and ultra-high temperature milk from Uganda, but these imports were not distinctly recorded by the administrative authorities and do not appear in customs statistics.

To overcome these continuing difficulties and in order to give support to the operators in the development of livestock, the Government secured financing from the African Development Bank in 1999 which was invested in the development of dairy livestock through the existing Projet d'Appui au Développement de l'Elevage Bovin Laitier. It is from this project that the programme « one cow per poor household » was set in motion.

At the same time, the Government has been encouraging the private sector to invest in the livestock subsector. Although private enterpreneurs are reluctant to get involved, the private banks have responded positively to the Government's invitation.

This is a scenario creates many opportunities. But it has not been enough to meet all the demand in dairy products and put a stop to their importation as shown in the following table.

Table 38: Production and importations of milk 1999-2007

Year	Production in tons	Importation in tons
1999	55 577	1 280
2000	57 853	1 378
2001	63 484	1 687
2002	98 981	1 378
2003	112 463	720
2004	127 417	645
2005	133 612	500
2006	152 511	500
2007	158 764	450

2.3. Features, strengths and weaknesses

2.3.1. Milk Production

Agricultural regions and Food resources

Rwanda can be divided in ten agricultural regions with distinct ecological features (climate, fertility, acidity and slope). With regard to agricultural regions, there are two versions, namely the 18 agrobioclimatic regions proposed by Gasana (1991) based on inherent particularities of each area, particularly forest formations before their transformation by human activity, and the 12 agroclimatic regions of Delepierre (1974). In the definition found in the Agricultural Development Strategy in Rwanda (1997), a new version of the agricultural regions was adopted because it was more appropriate in pedological terms, in support of the Government policy advocating the regionalisation of enterprises and their specialisation. In fact, Rwanda's Pedological Map Project proposed 10 agricultural regions by combining together in one regional entity the traditional regions of the Central Plateau and the Granite Ridge on one hand, and the Mayaga-Bugesera regions on the other. These regions were grouped together because of their similarities in terms of pedological features and soil aptitudes. This recent classification of the regions will make it possible to define the most suitable areas for different types of livestocks according to the types of soil. The following are the main features of each one of these regions.

Imbo

This region is the extension of Burundi's Imbo in the plain of Rusizi (Rwanda side). Most of it is found in the former Bugarama commune, but touches slightly the lower parts of former

neighbouring communes of Gishoma, Nyakabuye and Karengera. The whole region, which comprises an alluvial valley bottom (slope less than 6%) surrounded by high abrupt slopes (1 400 m of altitude with a slope ranging from 13 to 55%), has an average altitude of 1 100 m (the valley bottom is less than 1 000 m) and receives an average rainfall of 1 200 mm per year, with an average temperature of 24°C. The soils are represented by vertisols in the valley of Bugarama and basalt-based soils on the heights surrounding the valley. From the agricultural point of view, there are, among other crops, irrigated rice, cassava, beans, maize, groundnuts, banana trees and fruit trees mainly in the plain of Bugarama. Other crops can grow there given the high agricultural value of the region. For example, irrigated sugar cane can grow there.

The presence of a rice-processing factory (irrigated rice) would increase the value of rice brans, and trading in animal products is not a problem given that the region is found in an area of intense trade between Burundi and South Kivu. Traditionally, this region which breeds many goats is suitable for stall breeding. Because of the shortage of pastures and the high density population, the types of livestock which could be intensified are those other than the « off-soil » type.

Impala

This region is also found in the south-western part of the country. The average altitude ranges from 1 400 m in Rusizi to 1 900 m on the edge of Nyungwe mountain forest, with a slope of between 6% to more than 50%. Rainfall varies between 1 300 m in the west and 2 000 m in the forest, and temperatures range from 22 to 19°C respectively. Basalt-based soils with a heavy texture and a high content of iron oxide have high agricultural productivity

The region, which is characterised by traditional crops (beans, banana trees, cassava, maize, sorghum) and coffee, is also suitable for tea and cinchona growing. It has a significant trade potential with Burundi and South Kivu. It can therefore develop stall farming of goats and pigs or poultry or rabbits along the Rusizi-Bugarama road.

Shores of Lake Kivu

The region extends along the shores of Lake Kivu from Nyamasheke in the South to Rubavu in the North. The altitude varies from 1 400 m at the level of the lake to 1 900 on the foothills of Congo Nile Ridge, which is at the East border of this region. The climate is temperate with temperatures varying from 22°C on the shores of the lake to 19°C in the mountains. Rainfall ranges between 1 150 and 1 300 mm per year. The limino-clayey superficial soils are derived from phyllite and granite in some places on the slopes of between 13 and 55%.

This is the top coffee growing area in the country, but the region grows also banana trees, beans, maize, sweet potatoes, cassava and soya beans. Trade between the Democratic Republic of Congo through Lake Kivu and through border towns (Bukavu opposite Rusizi and Goma opposite Rubavu), the presence of brewers' grains at Rubavu, the pastures in the massifs of Gishwati are all elements which can justify the breeding of pigs or poultry or rabbits around the towns of Rusizi, Karongi and Rubavu, and dairy cattle around the town of Rubavu and sheep for wool in the high altitude (from Rubavu to Rusizi).

Lava soils

This region has volcanic soils of former Rubavu and Musanze Prefectures and is bordered by volcanoes. The altitude varies between 2 500 m at the border of the Volcanoes Park to slightly less than 1 900 m at Musanze and 1 600 m at Rubavu. Slopes range from 6 to 25% and rainfall varies between 1 300 and 1 600 mm par year, while temperatures range from 12 to 18°C.

Banana trees, twining beans, peas and tobacco are grown in this region. However, Irish potatoes are the main commercial crop. The region has an important touristic potential (Volcanoes Park). Trade between this region and North Kivu and Uganda, the presence a flour milling plant at Musanze (wheat brans) and a brewery at Rubavu (brewers' grains) justify stall breeding of goats

or sheep for wool, pigs, rabbits or poultry around Musanze and along Rubavu-Musanze and Cyanika-Musanze roads, as well as dairy cows around the town of Musanze.

Nile Congo Ridge

This region stretches on the heights of the Nile Congo Ridge and encompasses from North to South, high altitude regions of Rubavu, Musanze (former Nyamutera commune), Karongi, Rusizi (former Kirambo and Gatare communes) and Nyamagabe. The altitude ranges from 1 900 m to more than 2 500 m with a very varying slope ranging from 2 to 55%. Rainfall is between 1 300 and 1 500 mm in Bushiru, 1 400 and 1 800 mm in Bufundu, and exceeds 2 000 mm on the heights of Nyungwe. Temperatures vary from 12 to 18^{o}C. Humic acidic soils developed on a granite (Bufundu, Bushiru) and schistose (Budaha) parent rock.

The region's crops are particularly those suitable for high altitude such as peas, maize, Irish potatoes and wheat. Tea is also suitable for the region from North to South (Delepierre sugggest the introduction of rape and sunflower). It is also suitable for forests (timber)

The region is characterised by mountain pasture on acidic soils which are suitable for dairy livestock. The fact that it is far from consumption centres and main service routes allows only enterprises whose production will be sent elsewhere for processing or which will be processed at least partly on the spot, sending out finished or semi-finished products. The following animal breeding can be considered: dairy cattle breeding (Gishwati, Nile Congo Ridge) and breeding of goats and sheep for wool.

Buberuka highlands

This region comprises the district of Musanze (in the East of Lakes Bulera and Ruhondo), a big part of the former communes of Byumba up to the border of the plains of Mutara, Ndiza mountains which stretch from the former Mukingi commune (Gitarama) to the extreme North of the former Nyakabanda commune, as well as the former communes of Kigali North (Rushashi, Mbogo and Tare). The altitude ranges from 1 800 m to more than 2 500 m. The slopes are from 0 to 2% in the swamps, and from 6 to 50% elsewhere. Average rainfall is 1 200 mm per year and temperatures range between 12 and 18oC. Highland laterite soils which developed from the schistose parent rock are prevalent in the region with, in some places, quirtzite soil ridges.

The main crops there are the Irish potatoes, wheat, maize, peas and tea. Banana trees, sweet potatoes and sorghum are also found where ecological conditions are favourable, but yields decrease as one moves to higher altitude. Improved feeding conditions in the region, particularly increased forage crops, would enhance dairy cattle and sheep for wool enterprises as well as stall goat farming.

Central Plateau/Granite Ridge

This region stretches in the centre of the country east of the Nile Congo Ridge from the border with Burundi to Musanze and Kigali, running along the west of Mayaga/Bugesera regions, and in the south of Buberuka highlands and the west of the Eastern Plateau. The average altitude varies from 1 650 to 1 700 m with slopes of between 13 and 55%. Average rainfall is between 1 100 and 1 1250 mm per year. Daily average temperatures vary from 18°C to 20°C.

The region's different humic soils are derived alternately from granite, gneissic granite and quartzite metasediments and quart-mica schists in its southern part, pelitic or quartzite rocks with a clayey texture in the central part, and various pelitic rocks in its north western part. The region is suitable for the growing of coffee, beans, sweet potatoes, sorghum, maize, banana trees, cassava, groundnuts and soya beans. Marsh rice also grows there.

There is a dairy (Nyanza) and the region is found in the centre of the country with important trading centres (Huye, Muhanga, Ruhango and Nyanza). The breeding of pigs, poultry and rabit

farming around the towns and along the main roads Akanyaru-Kigali, Musanze-Kigali and Huye-Nyamagabe are practised as well as goat breeding.

Mayaga/Bugesera

Mayaga stretches in a narrow strip from the Nyabarongo-Akanyaru confluence. It comprises former Kibayi, Muyaga communes from south to north, east of former Ntyazo and Muyira communes, and east of former Ntongwe and Mugina communes. Bugesera includes former communes of Kanzenze and Ngenda and former communes of Sake and Mugesera. The altitude ranges from 1 400 to 1 500 m, and rainfall is between 1 100 and 1 200 mm per year in the southern part, and between 1 000 and 1 100 mm per year in the northern part of the region. Soils are clayey and derived from schistose, but there are also histosols in Akanyaru valley. Slopes vary between 0 and 2% in the marshes and between 2 and 13% elsewhere.

Rice, beans, sorghum, maize, sweet potatoes, groundnuts, cassava, coffee and soya beans are cultivated in the region. The region is a potential producer of maize. Some of the former communes of this region are found in the collection area of Nyanza dairy, and this makes it possible to consider dairy cattle farming in this area and near Kigali. Goat farming is also practised there.

Eastern Plateau

This region stretches from Kigali to Rwamagana and former Kibungo. It is an extension of the Central Plateau but is more arid. Nyabarongo River marks the border of the two regions, while the 1 900 m contour line separates it in the north from Buberuka highlands. In the East, it is bordered by the shrub savanna of Kibungo while Nyabugogo and Lake Mugesera separate from Bugesera. It has an average altitude of 1 500 m, the rainfall is between 900 and 1 000 mm per year. Average temperatures run between 18 and 20°C. Soils are derived from pelitic rocks. The slope is between 2 and 13% in the lower basin of Lake Muhazi, between 6 and 25% on the hills and plateaux in Kigali East, and between 13 and 55% elsewhere.

Among the crops found in this region are beans, maize, sorghum, sweet potatoes, cassava, groundnuts, coffee, sugar cane, rice, soya beans and banana trees. Livestock is also important in this area. The fact that there are big trading centres such as Kigali, Rwamagana and Kibungo as well as communication routes and supply sources of cattle feeds favour the practice of the following animal farming activities: milk cows, pigs, poultry and rabbits around the towns and along the Kigali-Rusumo road, range cattle and, naturally, goat breeding.

Eastern Savannas

This region occupies the whole eastern part of the country from Mutara to Rusumo. It includes also the former Gashora commune of Bugesera. Average altitude varies from 1 250 m in Akagera swamps to 1 500 m at the western border and 1 600 m at Mubari heights. Daily average temperatures are 21^{o}C, and rainfal is less than 900 mm per year and irregular. Soils are derived from a combination of quartzite-schistose in the south of the region and in the north, they are from granite parent rock. Slopes vary between 0 and 2% in the shallow waters of Akagera River, between 2 and 13% in the savannas, the eastern part of Bugesera East (former Gashora commune) and the western border of Akagera Park, and between 25 and 50% elsewhere.

The region's crops include sweet potatoes, cassave, groundnuts, soya beans, rice, sorghum, beans and maize. The features of this region are suitable for range cattle and goat breeding.

Livestock feeding and watering

Generally, there are two types of feeding constraints: quantitative and qualitative. Quantitatively, the mountain and medium altitute pastureland has been overgrazed, leading to soil degradation (invasion by woody shrubs, ginger grass and other weeds which are not palatable to cattle). Forage shortage during the dry season is an annual occurrence and very significant in general. This

leads not only to considerable decline of milk production at the time when the demand increases in consumption centres, but also to significant increase in deaths, particularly cattle.

Qualitatively, animal nutrition in Rwanda experiences a big protein gap. On one hand, because of the degradation of grazing land and the relative weakness of the only available fodder grass, the feed value of pastures can be qualified as poor in most cases. As for planted fodder, which is not available in sufficient quantities, they are cut belatedly at the state of shrubs and are rarely associated to leguminous plants. On the other hand, the commercial concentrates are not only unbalanced, but also their high price affects seriously the yields of the farms where they are used.

In addition, there is poor adoption of fodder conservation techniques (silage or haymaking) which could help out during the dry season. In fact, there is a relative overproduction of fodder during the rainy season and the opposite in the dry season. This could be useful, except that for most of the family farms, the quantities produced are not enough to make silage possible. But haymaking can be done everywhere.

Breeders are aware of the importance of nutrition for livestock productivity, but their resources are limited while prices have soared at the same rythm as those of foodstuffs used as raw materials for making concentrates. A 70 kg bag which cost 7 000 RWF in April 2008 sold at 12 000 RWF in December 2008. This means that the price per kg rose from 100 to 170 RWF in just less than 8 months, representing an increase of 70%.

With the introduction of improved cattle, quality feed requirements have increased. For example, a cow with the potential of producing milk should be fed with a balanced diet on high quality fodder and concentrate and in sufficient quantity for it to give its full yield. Breeders should therefore improve their natural pasture land where necessary and develop fodder crops according to research guidelines. On the other hand, they should use balanced concentrates to supplement the feeding requirements of their animals. The manufacturing of animal feeds should therefore be developed in parallel with increase in milk production.

This is not the case today. At the moment, there is no industrial plant for producing these feeds. Those that are available are produced here and there in an almost cottage manner, and this has a negative influence on their quantity and quality.

Finally, it should be noted that in some regions of the country, particularly in Mutara and Bugesera, water availability in the required quantity and quality, especially during the dry season, continues to be a major problem for the development of livestock. And yet, milk production leads to increased water requirements of three litres of water for every litre of milk. Livestock development in these regions requires the construction of water dams or water wells for cattle watering throughout the year without having to travel too long distances.

In other regions such as the highlands, the widespread stall breeding has made the problem of water sensitive. Since cattle cannot drink from the wells or rivers any more, the water used is drawn outside the farm, generally carried on the head and from long distances. This chore is often done by women who are usually overworked in their households hence animals hardly have enough water to drink.

The recent efforts by PADEBL aim particularly at the improvement of the quality and the quantity of cattle feeds, the development of pasture land and popularization of fooder crops, the improvememnt of animal watering conditions and the establishment of animal feeds production units. ISAR has been concentrating on carrying out adaptability and production tests of basic fodder seeds appropriate to Rwanda's ecological regions, the evaluation of feed value of fodder, and the inventory of feed availability in the whole country. The former National Seeds Unit which is now the Seeds Production Unit in RADA deals with seed multiplication. PADEBL is also in charge of the rehabilitation of valley dams in Umutara region, but these efforts fall short of the needs.

Animal genetics

Genetic improvement is done in two ways: the introduction of imported improved herds and bull using improved dairy cross breeding semen. The objective is to have 38% of local breed, 54% of crossed breed and 8% of pure breed. Pure or improved cattle breed have been imported to increase milk production. The rate of improved livestock is thus on the increase as shown in the table below. At the same time, the Government has been encouraging farmers to become involved in the process and put at their disposal credit facilities.

In its attempts to integrate agriculture and animal breeding, PADEBL has focused its efforts on restocking agricultural regions which are poor in animals in order to contribute to the improvement of soil fertility and the quality of food ration of the population while inducing the increase of their incomes. In terms of strategy, it has established a guarantee fund of 300 million RWF meant to cover up to 50% of the financial risks of the loans given to agropastoral farms by financial institutions. A credit fund has also been established to the tune of 400 million RWF to finance small scale operators who need to purchase improve heifers. At the same time, artificial insemination activities continue to play a big role in upgrading cattle.

In addition to these efforts by PADEBL, other partners of the Government such as banks and non governmental organisations have been involved in providing support to the rural population with a view to the improvement of the livestock.

Table 39: Breed Ratio of cattle population per province

Province	Local	Crosses	Pure
North	82%	14%	5%
East	81%	13%	6%
South	78%	18%	4%
West	68%	24%	8%
Kigali city	54%	21%	25%
Average	**72%**	**18%**	**10%**

Available statistics show that the majority of Rwandan farmers keep « Ankole » long horn breeds. As indicated in the opposite table, the study mission in its census found that 72% of the cattle were of local breed. Another part consisted of exotic breed dominated by Friesians, Jerseys and Brown Swiss [10%]. The rest consisted of unidentified crossbreeds between these exotic breeds or between the local breed and those unidentified crossbreeds [18%]. Often, this lack of identification caused confusion among the peasant who took the crossbreeds for pure breeds.

But these efforts are not enough to ensure livestock milk production performance since there are other conditions that should be met such as improved nutrition. In addition, crossbreeding and importation of exotic breeds are carried out in a disorderly manner for lack of a coherent programme to monitor these activities.

Animal Health

Thanks to PADEBL and RARDA efforts, some diseases such as the contagious bovine pleuropneumonia [CBPP] have been brought under control. Other diseases are under control through vaccination campaigns. And when they break out, they are quickly contained, thanks to an efficient epidemiological monitoring system.

Presently the main livestock disease problem are the endemic infections such as ticborn diseases ecto, and endo parasites, productive and reproductive diseases like mastitisin milking cows and bovine brucellosis. These are usually exacerbated by poor management systems and malnutrition. They cause significant losses due to deaths especially in young stock, and reduction in reproduction levels.

Nonetheless, in the rural areas, veterinary services are considered inadequate. In case of diseases breaking up, there are not enough veterinarians to intervene everywhere and on time to save the animals. When the services of a veterinarian are required, he often arrives too late and/or without the necessary equipment or product. And due to the low purchasing power of breeders in

rural areas and the weak geographical concentration of the cattle population, private veterinarians and pharmacists prefer to settle in urban areas to the detriment of the rural areas.

In view of this situation, efforts have been deployed, particularly by PADEBL, to put in place a network for epidemiological surveillance, organising vaccination campaigns, getting the country to become a member of the International Office of Epizootics, rehabilitating and equiping of the National Veterinary Laboratory of Rwanda and 4 regional laboratories, putting in place a feed quality control unit, organising training and refresher course sessions for district and private veterinarians. Of course, some diseases such as the foot and mouth disease have been brought under control more efficiently, but there is still the threat of « igifuruto » because of the widespread stall breeding, and even other diseases are still rampant. In the meantime, each administrative sector has been given a veterinarian, but the services are still inadequate. One person alone cannot meet the demand of the breeders, especially because there is still lack of the necessary equipment.

Costs, productivity and yield

In order to expect increased productivity, the farmer must think and choose which livestock is more performing than the other.

Analysis of different specimens shows that improved productivity of animal breeds [whatever the breed or crossbreeds chosen by different breeders] should necessarily go hand in hand with improvements in feeding. In fact, apart from the fact that improved animals are demanding in terms of veterinary care (fragility of exotic animals in relation to environmental constraints), nutrition appears to be a limiting factor when one considers breeding animals with high production potential.

In particular, the high cost of concentrates limits the return of certain livestocks, notably pure breeds or crossbreeds. That explains how a 100% pure Jersey, though it produces 2 500 litres a year, is less profitable than its crossbreed with Ankole whose production is 1 500 litres only per year. But if the price of concentrates were reduced by 25%, the Jersey becomes more profitable than its cross counterpart. Increased animal productivity and particularly the breeding of high performance exotic animals will therefore require finding an affordable balanced diet.

With regard to cattle raising, the analysis of specimen enterprises highlights also another constraint: the burden of manpower in total operating costs. In fact, manpower can amount to between 30 and 42% of variable expenses. Its control improves very significantly livestock return. In this way, the use of mechanisation (animal traction or tractor) will lead to savings at a valuable scale since a pair of bulls is likely to till one hectare of land in 40 hours when a tractor would till it in one to three hours.

Finally, it should be recognized that the « land scarcity » constraint which is rather structural should be resolved if we want to produce as much as possible. Considering that land is the backbone of production, it should be used intensively and, because of this, breeders who own land should be encouraged to develop it optimally. In this perspective, models should take into consideration this need by including land use charges.

Organisation of production

State disengagement from production, processing and marketing activities requires breeders and other actors to take over most of the services which used to be provided by the government. This is the case with animal health services, supply of animal production and veterinary inputs, processing and marketing of animal products, etc. All this requires some kind of organisation of the industry and a redefinition of the role of those involved in the subsector.

The ownership by breeders of actions undertaken for their benefit involves the establishment of peasant structures representing other partners (in relation to the government authorities, the

suppliers of inputs and other service providers such as as animal health officers). In this context, the government has promoted the formation of groupings or associations, professional cooperatives or organisations bringing together crop-dairy farmers. These groupings participate in the management of certain activities (acaricide treatment, sale of veterinay products, sale of concentrates, etc.).

The list of breeders' cooperatives/associations appears in Annexes 19, 20 and 21.

The veterinary profession too has started getting organised so as to promote veterinary medicine private practice. In fact, in view of the inability of public services to provide all animal health care services, the development of animal production lies on the involvement of the professionals in the field in the provision of health care services and technical advice to breeders who have decided to develop their animal breeding systems. The partnership to be established must take into account the interests of each stakeholder since their development activities are interdependent.

The Government has been involved in encouraging economic operators in order to create synergies in the subsector (dairy plants, feed plants, breeding stock multiplication centres, etc.).

For example, Banque Rwandaise de Développement [BRD] intervenes significantly in the agricultural sector in general and in the livestock subsector in particular.

Concerning dairy cattle breeding, BRD grants loans for livestock projects (purchase of improved cow breeds, development of grazing land, purchase of equipment) and projects in any other segment of the dairy chain, including the establishment of dairy plants, milk collection centres and cooling system equipment.

The amount of loan granted depends on the capacity of the applicant (pasture and other facilities). Generally, the minimum amount to be applied for cannot be less than 10 000 000 RWF, except in rare cases where it was 8 000 000 RWF.

For loan applicants who qualify for the Agricultural Guarantee Fund, they must have a guarantee whose value is equal to 50% at least, and the guarantee fund covers the remaining 50%.

The repayment period is long term (7 years) with a preferential interest rate of 13%.

As at 31 October 2008, the accrued loans granted since 1997 amount to 1 720 102 655 RWF, and for the year 2000 alone, 2 000 000 000 RWF have been set aside for loan grants.

BRD offers also technical advice to its clients and each beneficiary of a loan is given a guide on animal nutrition aiming at increased milk production.

Banque Populaire du Rwanda is also a partner in the Government programme of « One cow per every poor familiy ». It offers a good interest rate of 13% and collaborates with the Agricultural Guarantee Fund. The accrued loans amounted to 1 062 199 650 RWF as at 30/9/2008.

The following table provides the geographical distribution of purchased cows through the loans granted under the BPR programme.

Table 40: Cows purchased through BPR loans

Districts	**Province**	**Number**
Muhanga	South	498
Nyamagabe	South	334
Nyanza	South	420
Huye	South	475
Kamonyi	South	84

Districts	Province	Number
Bugesera	East	103
Nyagatare	East	6
Ngoma	East	96
Gakenke	North	31
Rulindo	North	5
Karongi	West	7
Rubavu	West	1
Rusizi	West	63
Total		**2 122**

Concerning Credit and Savings Services (CSS)-Zigama, although it is difficult to obtain specific statistics for dairy cattle breeding, estimates show that out of an average total of 80 000 000 RWF of loans granted daily, between 8 and 10% go to agriculture and livestock breeding. It is estimated that 30% of this amount meant for agriculture and livestock is invested in livestock only.

CSS envisages that these rates could increase as long as the Agricultural Guarantee Fund will continue to support agropastoral investments.

Besides these financing actions of the dairy sector, the Centre for the Support of Small and Medium-scale Enterprises in Rwanda (CAPMER) is involved in prefeasibility and feasibility studies in high benefit fields to encourage serious entrepreneurs to undertake profitable projects in the subsector by providing them with reliable information.

Non Governmental Organisations participate also in the Government programme for the development of the dairy chain.

As an example, this study has covered Send A Cow Rwanda which has already distributed 450 dairy cows of improved breed in the Eastern Province, Kigali City and Southern Province; Heifer Project International (HPI) which, since March 2000, has given out 1 670 heifers to crop-dairy farmers; and Lutheran World Federation (LWF) which has distributed more than 200 improved dairy cattle breeds to small-scale peasants in the districts of Nyagatare, Kayonza, Ngoma and Bugesera.

As for the State, its role in this new context is to plan development programmes, monitor different interventions undertaken by development partners, ensure compliance with laws and standards, and legislate if need be.

2.3.2. Research, supervision and extension services

Organisation of agricultural research

Agricultural research is carried out mainly by ISAR through its stations spread all over the country. It is also carried out by among others NUR, ISAE and Mutara Polytechnic.

Research carried out by RARDA covers four programmes: namely (i) cattle selection and improvement; (ii) selection and improvement of small ruminants; (iii) animal nutrition and (iv) animal health.

Concerning animal production and animal health, the number of research staff is very limited (it was so even before the war) both in terms of ISAR stations and agricultural projects. Lack of human resources is such that the conduct of tests in station does not allow ISAR researchers to deal with the relations which they are supposed to have with specialised technicians who are involved in the bulk of research/development in agricultural projects. These technicians have

generally a role to play in the promotion of research/development, which is understood to mean carrying out experiments in rural areas about solutions identified in research stations with a view to their possible adoption by the peasants. As such, this research/development should involve the researcher, the extension worker and the farmer in a relationship based on everybody's active participation, at the level of both the identification of constraints and the search for the solutions. The monitoring of these tests carried out in agricultural farms is a real headache, especially in regard to animal production tests which require skills that are rare in that environment.

During the war, research facilities were seriously damaged and most of the animals disappeared as well as a significant part of the documents on the findings of researches carried out before and during the events. It should however be said that rehabilitation efforts have been undertaken and the stations have resumed the former activities.

Findings of animal research

Research on cattle began in the 1930s, and it concerned selection of Ankole and crossbreeding using jersey and sahiwal bull semen leading to production of 1/8 Ankole 2/8 Sahiwal 5/8 Jersey, and 1/8 Ankole 2/8 Jersey 5/8 Sahiwal. Crossbreeding activities with other breeds, particularly Friesian, were not scientifically monitored.

The selection of Ankole, which focused initially on meat animals with mixed results (the research could not improve weighted performance of Ankole) was refocused to dairy selection in 1974. The results obtained show that dairy production of Ankole tops 6 to 7 litres a day, including consumption by the calf of 3 litres per day. Consequently, increasing milk production for cattle could only be possible through crossbreeding and/or the development of exotic pure breeds.

Among the types of crossbreeding carried out, ISAR findings show the superiority of the triple crossbreeding 1/8 Ankole, 2/8 Sahiwal, 5/8 Jersey. It is superior to its conterpart 5/8 Sahiwal 2/8 Jersey 1/8 Ankole in terms of « its milk production and dry period ». This period is 102 days for the predominantly Sahiwal crossbreed against 68 days for the predominantly Jersey. The findings show that the ½ blood Jersey produces 1 500 litres against 1 400 litres for the ½ blood Sahiwal and that there is no difference in terms of hardiness between the two cross breed until further information is obtained.

According to the research work by ISAR, in all logic, the crossbreeding to propose is the one which involves successively the Jersey bull or seed, then Sahiwal bull or seed and Jersey again in order to obtain the triple JSA crossbreed. From this moment, the selection is made inside the F3 population by using the best triple crossbred bulls. It is therefore this crossbreed which should be aimed at in all crossbreeding operations for distribution to the rural areas where it is adapted, considering its size and its hardiness.

Obviously, this does not prevent the development of other breeds or crossbreeds, particularly pure breeds (Friesian, Brown Swiss, Jersey) and upbreeding with Ankole according to the level of the technical knowledge of the breeders and the local bioclimatic conditions.

These findings obtained by ISAR could not actually be disseminated in the rural areas because of the limited number of available specimens. This is certainly one of the shortcomings of the research system adopted until now which limits interventions on a very restricted number of animals which can be accommodated in the different stations of ISAR. It would have been useful to carry out the same crossbreedings in the rural areas, which would have the advantage of comparing the findings in station and those obtained in the real environment of the breeders.

Findings of agrostological research

ISAR has put in place agrostological collections for observing the behaviour of several species and their clones. In this regard, fodder grasses as well as leguminous plants were introduced and were

compared in terms of productivity, nutritional value and behaviour in relation to diseases, adaptability to different agroecological regions and the option of haymaking and/or silage.

Grasses

Pennisetum purpureum French Cameroun variety was considered the best grass because of its sustainable successive annual yields, the possibility of successfully ensiling it and its palatability. It can produce 40 tons of dry matter per ha in 9 cuttings per year, representing a production of 200 tons of green matter on appropriate soils (rich and deep soils).

Setaria sphacelata Kazungula variety is considered excellent in terms of soil recovery, but because it is not palatable for cattle makes variety 1191 preferred since it is more leafy and less ligneous, and all the more since the yields between the two varieties are not significantly different.

Trypsacum laxum is very suitable on deep soils with deep water reserves. It is not suitable in regions with marked dry seasons such as the savannas of Eastern Rwanda (Bugesera, Mutara). It produces about 30 tons of dry matter per ha per year, or more or less 110 tons of green matter in a favourable environment. In the conditions of Bugesera, it produces only 20 tons of green matter per ha per year.

Andropogon gayanus is a grass which prefers deep soils with positive moisture balance during a good part of the dry season. It is recommended for fodder fallows, permanent pasture land and anti-erosion hedges. It can be used in several ways:

- Rainy season feed with 30 day rest and up to a load of 500 kg per ha during this season.
- Feed during the first half of the rainy season and hay after the end of the rains (it is easy to wither with well palatable hay).
- Feed during the first half of the rainy season and uneaten feed and new growth during the dry season.
- Silage in the middle of the rainy season and new growths during the dry season.

It is said from the literature that its production is estimated in general at 10 tons of dry matter per ha per year, or about 45 tons of green matter. But the selection carried out at ISAR made it possible to obtain clones whose yields range between 120 and 143 tons of green matter per ha and per year in 6 cuttings. For this to be possible, several clones were selected on the basis of the ratio stalks/leaves, tillering, width of leaves, length of the cycle and drought resistance. In this way, clones 2, 8, 9 and 13 were selected as being the most productive in the region of Bugesera.

Leguminous plants

To resolve the problems of Nile Congo Ridge (very high acidity with aluminium toxicity), ISAR introduced several leguminous plants for cutting as fodder. The findings of the observation show that *Desmodium intortum cv Greenleaf* is suitable in high altitude (2 300 m), while for medium altitude (1 800 m), *Desmodium intortum cv Greenleaf, Macrotyloma axillare cv Archer, Neonotonia wightii cv Tunnaroo, Stylosanthes guyanensis cv cook* and *Stylosanthes scabra cv Fitzroy* can be recommended.

For the dry regions (Mutara, Bugesera), ISAR recommends the use of *Chamaecrista rotundifolia* and *Stylosanthes scabra*, the first for grazing and the second to be cut for distribution in trough. In the same conditions, *Stylosanthes guyanensis* is suitable only on silt soils and colluvium where it produces up to 32 tons of green matter per ha per year.

The Australian variety *Desmodium* has proved more productive in terms of green matter on three ISAR stations (Karama, Rubona and Rwerere) where it produced 116 tons, 124 tons and 36 tons per ha and per year respectively in 5 cuttings. *Desmodium intortum, Desmodium distortum* and the local variety *Glycina javanica* were compared at Karama and Rubona, and it was observed that the best yields are obtained, for Karama, when cuttings are done at the frequency of three months (117 tons, 70 tons and 92 tons respectively of green matter per ha per year), while for

Rubona, the best results appear with 2, 3 and 4 cuttings which produce the same results (not significantly different) with an average of 45 tons for *Desmodium distortum,* 51 tons for *Desmodium intortum* and 28 tons for the local variety *Glycina javanica*. It should be added however that the cutting carried out at 4 month produces the highest rate in terms of gross proteins per kg of dry matter.

Shrub leguminous plants were also introduced to be used for both fodder and staking wood supporting anti-erosion hedges, or else as green manure (hedgerow farming). This is particularly the case with *Leucaena leucocephala cv Cunigham, Sesbania sesban* and *Calliandra callothyrsus.* Finally, other leguminous plants are kept in ISAR's collections in agrostological gardens. These could be suitable for farming for this or that agricultural region, either grown for cutting or within the framework of improved grazing land. They include the following:

- *Stylosanthes hamata.*
- *Stylosanthes capitata.*
- *Medicago sativa.*
- *Medicago peragio.*
- *Medicago Hair Peruvian.*
- *Trifolium spp.*

It should be observed that despite the interesting products obtained from the research (though one would have liked to have a greater number of and more coherent tests in this field), the popularization of the leguminous plants has remained very marginalised because of a clear absence of collaboration between research, extension and the rural areas.

Supervision and extension services

Current situation

Until the beginning of the 1990s, supervision and extension of livestock and veterinary services activities were carried out by Veterinary Nurse Aids (VNA) and, recently, by grassroots supervisors. This situation was no longer bearable in that the most delicate tasks were entrusted to the less qualified employees while the true professionals were busy with administrative functions. In such conditions, one can understand the reaction of the cattle keepers for whom livestock breeding was and continues to be like a poor relation of the agricultural sector.

MINAGRI has proposed a new strategy for extension services. This involves a system based on participation, research-development which is also participatory in the sense that all the partners will henceforth be involved in the process of the transfer of technology in the rural areas, from the diagnostic survey till the adoption of the themes of extension by the beneficiaries. But there are constraints related to the extension services in the field of animal production and supervision of breeders which are the consequences of the following situations:

- Shortage of veterinary and animal production personnel;
- Insufficient means of travel for technicians and extension workers;
- Inadequate training level for extension workers;
- Inappropriate extension themes to the breeders' needs;
- Insufficient and/or high cost of veterinary and livestock inputs (animals, veterinary products, cattle feeds, etc);
- Inadequate coordination among different public actors in the outreach of production and animal health themes;
- Inadequate structuring of the environment which could be used as the framework for extension intervention and the support point for service providers (care, inputs, etc,);
- Insufficient technical and logistic resources put at the disposal of extension workers.

Objectives of extension in the field of livestock

The following are the objectives of the extension services in the field of livestock:

- Idenfifying the constraints encountered by the breeders.
- Trying out the findings of research in operational conditions.
- Proposing techniques appropriate to the constraints of breeders which are economically viable in terms animal nutrition, animal care, herd management, improved animal productivity and production development.

Approach method for supervision and extension in the field of livestock

MINAGRI has developed an extension strategy which is in reality the platform for all the extension interventions. Extension in the field of livestock should simply adapt its intervention methods on the basic principles of the developed strategy. The following paragraphs will therefore explain the aspects of the extension strategy adopted by MINAGRI which are likely to enhance efficiency in the livestock extension. Reference will also be made to past experience both in extension and supervision as and when it will be necessary to underline specific aspects related to livestock development.

In addition, issues regarding supervision and extension of livestock activities are in line with the Government's policy of privatization which enhances the effectiveness of the production programs in this sector.

Formation of breeders' associations

The document on MINAGRI's extension strategy underlines the need to integrate peasants' professional associations into extension activities so that, eventually, the bulk of extension tasks are handed over to them. In fact, the promotion of producers' associations must make it possible:

- to build on the needs, interests and priorities of the producers, their families and their associates in order to decide and implement actions relevant to them;
- to promote the organisation of « a grassroots animal health structure » as an intermediary between animal health services and extension services on one hand and the producers on the other, which is capable of expressing and meeting the needs of the latter;
- to gradually introduce ownership by the beneficiaries of the actual costs of intervention in order to improve the viability of the activities undertaken for their benefit.

In the current state of affairs, the immediate usefulness of the breeders' organisation is that it enables to resolve some problems related to the scattered nature and the size of the herds (the association is a focal point for the service provider – veterinarian and/or extension worker) and the insufficient human, material and financial resources at the disposal of veterinary and extension services. It enables also not only the beneficiaries taking ownership of some actions and facilitates their dissemination and sustainability, but also the easing of the extension mechanism (elimination of individual visits which require many officers at a time) and, hence, its cost (remuneration and logistics).

From this perspective, for the various actors involved in livestock, the promotion of associations is a valuable strategic tool which facilitates the formation of a preferred intervention framework, a consultation structure and a development tool. For the cattle keepers themselves, in particular the members of the association, forming associations enables them to benefit from a better focused framework, appropriate technical advice, training services and supply of veterinary inputs.

Concerning the implementation methodology, there are three important steps to take in order to make « the process of taking ownership » successful by the producers' organisation, steps which

PADEBL went through in organising the cattle keepers [see annexed list of associations/organisations] include.

1. Informing and sensitising dairy farming peasants in meetings during which the following activities are carried out:

    - Identifying major problems and major needs expressed by interested parties;
    - Identifying possible solutions and the necessary resources (technical, material and financial) and informing the parties of these solutions;
    - Informing the parties of the opportunities, the objectives and the advantages for them taking ownership (conscientisation, accountability);
    - Decision of putting in place an adequate intervention structure, the « Association ».

2. Promotion of associations and training of their leaders:

    - The association is formed initially around one or several activities depending on the stated priorities by the breeders themselves: this could begin, for example, with the fight against ticks and continue with genetic improvement (management of a bull or artificial insemination); other activities should be able to develop around these « rallying » actions;
    - The launching of the associations' technical activities requires immediate training of the operators (operators of spray races, those in charge of deworming);
    - The management of associations by their appointed leaders requires also the training of Board members by specifying and describing their responsibilities.

3. The supervision of the existing or recently formed associations is often essential for:

    - Ensuring a smooth technical implementation of activities undertaken by the cattle keepers whose training was initially quick and quite succinct;
    - Organising and maintaining the producers' « interest level »;
    - training and keeping the producers always updated with new information;
    - Possible refocusing of activities with time.

During the establishement of associations, it may be necessary to constantly help by providing some incentives in general which would be limited in time but sufficient to promote the viability of the associations (provision of veterinary products to form an initial working capital, free provision or subsidised provision of some materials, equipment, facilities or products and various livestock inputs, etc. to the members of associations only).

Considerations on the process of extension itself

While looking at the steps recognised as being essential to the extension process, the strategy document stresses the need for « a research-development which guarantees the contents of the extension » and which includes the following steps itself: participatory diagnosis, research and development of solutions and experimentation to confirm the validity of the envisaged solutions.

Though the participatory diagnosis and even the research and development of solutions do not raise any specific difficulty in regard to livestock, particularly when associations are being formed (facilitating effect of the association), it is not the same with experimentation and confirmation, especially for animal species with relatively long reproduction cycles (dairy cow). The problem raised by this particularity of livestock is that the breeder's interest to continue experimentation should be maintained for a long time (it will take four or five years before convincing the breeder that, even though it is demanding, a Jersey crossbreed is more productive than an Ankole cow.

For this phase of extension of new livestock technologies, it will be necessary to combine several methodological tools to bring the breeder to maintain the required effort. Priority will be given to paying visits to success stories of more advanced breeders in terms of intensification both inside and outside the country, illustrated technical sheets, television and/or rural radio programmes, video shows during training sessions if possible, etc.

Concerning the choice of themes or enterprises to be brought into general use, another specificity of livestock activities which the extension worker should take into consideration is that investments in this field are of a medium and long term nature. This means, among other things, that the aspects of management and profitability of animal enterprises acquire special importance and should receive at least as much attention as that given to the purely technical aspects of extension. In such conditions, not only enterprises should be chosen on the basis of their financial returns, they should also be based on the existing or potential capacity of the cattle keeper in terms of management.

Considerations on the producers' supervisory system

The extension system advocated by MINAGRI is based on the principle that the disengagement of the State from activities which can be performed by the private sector is a major policy option. The same goes with animal health services. Even though the principle of the privatisation of veterinary medicine has been accepted, its implementation will take time due to the fact that the producers are not yet able to pay for the services of private practitioners. It is therefore necessary to have a transitional organisation of public veterinary services in charge of the supervision of breeders before the emergence of an actually operational private sector. In addition, the number of Government employees themselves is not enough and they cannot cover the whole national territory. Thus, the supervision of the producers both in health services and extension work will continue to be inefficient due to the shortage of the staff.

One of the possible solutions would be to organise mobile clinics such that animals can be assembled at a chosen specific point after consultation with the producers, whether in associations or not. In this way, the veterinarian would go to where the animals to be treated are instead of having to move the animals to a dispensary which is not always near all the farms. The selected place could have cattle crush built by the breeders themselves, as the case may be. In any case, it will be necessary to speed up the privatisation process.

To contribute to extension and supervision work, PADEBL has included in its supervisory actions of model farmers, the supervision of milk vendors, the provision of motorcycles to the extension workers, the training of the managers of veterinary outlets and livestock aids, the translation of technical manuals in the national language, the construction of a demonstration complex at Songa dairy farm which includes a centre for the training of producers, a model stable, and pilot field for fodder crops. PADEBL has also included in its programme the distribution of 300 stud bulls to the farmers, the organisation of study tours inside the country for farmers in the fields of fodder crops, conduct of dairy farming, production, collection and marketing.

Non Governmental Organisations too are involved in the supervision of cattle keepers. Thus, **Send A Cow Rwanda** is involved in genetic improvement through the distribution of cattle and the provision of equipment and necessary products for artificial insemination. It is also involved in the technical training of small scale breeders and the organisation of the community to ensure the sustainability of interventions. Thus in 2008 and within the framework of PAPSTA, SACR trained 345 farmers (48% of whom were women) in the district of Kirehe, 347 farmers (49% women) in the district of Bugesera, and 206 farmers (51% women) in the district of Nyanza.

Heifter Project International (HPI) has been involved in genetic improvement in the districts of Gicumbi, Gakenke and Bugesera. From 2000 to 2003, it distributed heifers in the former provinces of Byumba, Ruhengeri and Kigali Ngali.

In 2007, HPI extended its activities to the Western Province (Ngororero), the Southern Province (district of Nyamagabe) within the framework of PAPSTA and Muhazi project with the distribution of 17 Jersey and 50 Friesian-Ankole crossbreeds in the districts of Ngororero, Nyamagabe and Gakenke.

It has also been involved in artificial insemination through the training of inseminators and the provision of equipment, semen and related inputs.

To ensure the sustainability of its interventions, HPI trains also the breeders. Thus within the framework of its partnership with PAPSTA in 2007 and 2008, it trained 517 breeders (44% of whom were women) in the district of Ngororero and 607 (32% women) in the district of Gakenke.

Lutherian World Federation (LWF) is also involved in the training of breeders. In addition to distributing improved breed cows, LWF provides technical training in the care and breeding of cattle in the Southern Province, particularly in the districts of Nyanza, Nyamagabe, Kamonyi and Ruhango. Under its integrated rural development project, LWF intervenes in the districts of Nyagatare, Kayonza, Ngoma and Bugesera.

Animal and agrostological research reached interesting and useful findings which can be proposed for dissemination in rural areas. This is the case with the triple crossing Jersey/Sahiwal/Ankole with the predominance of Jersey blood (62.5%) and different fodder grasses and legumes.

Though they are likely to improve significantly animal productivity in Rwanda, these findings did not unfortunately produce the desired impact. In fact, their dissemination has been encountering considerable difficulties which are attributable to the poor functional link between research and extension, or more generally, to the lack of a strategy to monitor crossbreeding programs and other innovations and technologies introduced in the field, a strategy that was to be part and parcel and the master piece of an overall plan for the improvement of animal productivity. The same omission exits in regard to the relationship between extension services and the National Centre for Artificial Insemination for products obtained from insemination.

One of the biggest weaknesses in the process of the transfer of new technologies in the field of livestock is the absence of multiplication nuclei of recognised highly progressive initiatives in the field of animal genetic improvement. It is the same with the introduction and multiplication of leguminous plants where ISAR has become an « extension agent » since it has most often distributed seed plants of legumes directly from its research stations.

Finally, within the research itself, it has often worked on the basis of restricted selection so much that in some cases, the findings are not themselves representative.

In order to obtain conclusive results quickly, ISAR must therefore improve the representativity of its selection basis for animal research, improve its relationship with extension services, and develop in collaboration with extension and the National Centre for Artificial Insemination, close monitoring mechanisms of research and/or artificial insemination results. Multiplication centres of sires and fodder leguminous plants should take over its role from ISAR.

However, all these recommendations cannot really improve the dissemination of research products and, hence, their extension if the production environment is not ready for real ownership taking. This point to the great importance of structuring the production environment. Breeders' organisations will therefore enable the following:

- Identifying the needs, interests and priorities of the breeders (diagnosis of breeders' constraints in a participatory relationship between researchers, extension workers and breeders) and getting them closely involved in the whole process of finding appropriate solutions to their situation.
- Facilitating the monitoring of technological innovations introduced in the rural area and feedback of related information either towards the extension workers or, more interesting still, towards research.
- Acting as the basis of ownership structures for the promotion and improvement of different domestic animals (breeding unions or society for this or that species or breed).
- Acting as the representative of different actors in the field of livestock, etc.

2.3.3. Dairy Technologies

Background information

The term milk means the fresh and clean lacteal secretion obtained by the complete milking of a healthy cow, not containing any amount of colostrum. This term is usually applied to cow's milk as other types have to be specified.
Milk is a very important component in the diet because:

- It is easily digestible.
- It is an exceptionally good source of protein, which is of high biological value.
- It is the best source of calcium in the diet and consequently encourages sound bone and tooth development.
- It contains a useful variety of vitamins including vitamin A, E, D and vitamins of the B group. Therefore milk being a very important component of the diet, it is recommended that one should take at least half litre of milk per day. However due to latest technology one takes milk in different forms such as cheese, butter and yoghurt. Milk is also an excellent culture medium for many kinds of microorganisms hence it is important for one to take processed milk. Milk is prone to adulteration, the chief adulterations are:

1. Reduction of fat by
   a) Addition of water
   b) Skimming of milk
   c) Both skimming and watering
2. Addition of thickening agents to restore consistency, viscosity and solid content
3. Addition of colouring matter to restore colour lost by skimming or diluting or to make naturally poor-looking milk appear richer
4. Addition of preservatives
5. Accidental adulteration

Dairy technology

Milk can be transformed into various milk products to increase its shelf life such as UHT treated milk which shelf life can go up to several months. The following are some of the milk products:

Fermented milk

Fermented milk is a cultured milk product formed through the transformation of lactose to lactic acid by the use of selected microorganisms with the formation of other metabolic by products which are important in aroma and flavor development. Fermented milk has a pH of less than 4.6 and this can be a means of preservation for the milk product. Lactic acid in the fermented milk has two roles:

- For the development of the characteristic sour taste of fermented milks;
- As a preservative for the product.

Two main fermented milks are:

Curd milk (Ikivuguto)

This is skimmed or whole milk fermented by a mixed starter cultures of *Streptococcus cremoris, streptococcus diacetylactis and Leuconostoc citrovorum.* The fermentation process is started by S.cremoris which makes the conditions anaerobic for L.citrovorum, then followed by S.diacetylactis which converts citric acid to acetic acid, acetaldehyde, CO_2 and diacetyl which is an important aroma compound. This culture has advantages in that:

- It is high in aroma compound and low in CO_2 production
- The optimum temperature range is 15 - 25^{o}C i.e. ambient implying that fermentation process can be carried out at ambient temperature without the need for incubators.

- Fermentation stops when the lactic acid concentration is 1%.This means that there is no need to store the product at low temperature to stop fermentation and therefore the product can be stored at ambient condition.

Manufacturing process

1. Milk is pasteurized and cooled at 20 - 25^{o}C and inoculation with 2 - 3% starter culture.
2. Then the pasteurized milk is incubation at ambient temperature for 15 - 20 hours. The time depends on aroma development which depends on the activity of the microorganisms.
3. Short stirring to a smooth consistency and retail packaging. The keeping quality of curd milk at ambient temperature is in the order of 4 - 5 days but the keeping quality under refrigeration can extend to 2 - 3 weeks.

Yoghurt Manufacture

The raw materials generally include milk, skimmed milk; in addition other food materials such as sweeteners, stabilizers, flavor and fruit preparations are required as components of yoghurt mix. These materials are blended together in proportions to obtain a standardized mix conforming to the particular product to be manufactured.
The yoghurt mix is pasteurized and homogenized then the product is cooled at 40 - 45^{o}C. The mix is inoculated and temperature is maintained throughout the incubation period to achieve the desirable titratable acidity. The incubation period is usually 2 - 3 hours to achieve a TTA of 0.8%. Then the yoghurt mix is taken into cold room to stop further fermentation.

Cheese manufacture

There are several types of cheese depending on the manufacturing process. Example Cheddar Cheese:

- Milk is pasteurized and cooled to 31^{o}C
- Then 1 – 2.5% of its volume of starter culture is added in order to obtain a growth lactic acid forming bacteria
- After attaining an acidity of 0.2% enough rennet solution is added so as to coagulate milk in about 30 minutes. After the curd has formed it is cut with curd knives to small cubes and allowed to settle for few minutes. It is then stirred gently to keep the cubes floating. The cutting of the curd has two purposes:
  - To speed whey expulsion
  - To assist in uniform cook of the curd by increasing the surface area
- The temperature of the curd and whey is then slowly raised at about 1^{o}C in every five minutes to 38^{o}C - 39^{o}C through indirect heating to avoid dilution of whey so that it increases in acidity fast.

Continuous stirring should continue. This is called cooking the curd; its aims are:

- It makes the curd particles more resistant to damages as they shrink in size and become tougher
- There is effective expulsion of whey through shrinkage
- There is development of texture
- There is establishment of moisture control
- Suppresses spoilage organisms

The whey is then drained off a process called dipping, as the whey is drained one half of the curd is pushed to each side of the vat in order to form a trench or ditch a long which the whey escapes. Then the curd is pilled up, the piled curd is then cut into strips or slabs. These are moved slightly

apart to allow drainage of whey between the slabs. During the pilling of curds they are held at 35 - 38^{o}C and turning them every 10 - 15minutes.The curd is well pilled and become quite plastic. The curd is then milled and spread at the bottom of the vat. Salt is then mixed thoroughly with the curd pieces. The amount of the salt will depend upon the market preference but is usually 2 – 2.5% NaCl. The salt added influences flavor, body and moisture. The salting stage halts the acid production and so the pH of the curd does not decrease further after salting. Then the salted curd is transferred to the hoops for pressing; the aim of pressing is:

- To form the loose curd particles into shape which is compact enough to be handled
- To remove additional whey
- To arrive at the final desired moisture content

The temperature of the cheese is maintained at just above 21^{o}C during pressing.
The cheddar cheese is then ripened at 10 - 15^{o}C, the ripening usually 3 to 12 months. The longer the storage time the stronger and sharper is the flavor.

Butter manufacture

- Cream is pasteurized
- Then it is cooled rapidly and age in cold room overnight
- Then the cream is put in a mixing bowl
- Beat the cream at a high speed until butter granules are obtained (Inversion occurs)
- Drain the butter
- Wash the butter granules with chilled brine (for salted butter) until brine washing is clear
- Pack the butter into the sterile containers
- Store butter in the cold room

Ice cream

Ice cream is a food produced by dynamically freezing a pasteurized mixture of milk, cream, skimmed milk powder, sugar and stabilizers combined with flavourings that may be added before or after pasteurization. However fruits, nuts, candies, syrups and fudges may often be added to semi frozen ice cream to create different flavors and taste impact. An ice cream is manufactured under the following steps:

- Milk is heated to 45°C
- Then a mixture of sugar, SMP (skimmed milk powder) and stabilizer is added to the heated milk
- The mixture is filtered and cream is added
- Then the mixture is heated at 60°C and blended (Homogenize) for five minutes
- Then the mixture is heated again to 65°C hold for 30 minutes or 72°C for 1 - 2 minutes
- Then the mixture is cooled in a water bath to room temperature rapidly
- Then the mixture is kept in a cold room overnight (againg)
- An appropriate flavor is added.
- Freeze the ice cream mix in the ice-cream freezer
- Pack the soft ice cream in the sterile containers
- Harden the ice cream in the deep-freezer

Type of milk products

They are several products derived from milk some of them are as follows:

- Fresh pasteurized milk
- Curd milk
- Yoghurt plain, flavoured and layered
- Cream
- Butter

- Ice cream
- Milk powder
- Ghee
- Cheese
- Flavoured milk
- Skimmed milk
- Sweetened condensed milk
- Ultra-Heat Treatment (UHT) milk.

2.3.4. UHT Milk

UHT

Ultra-High Temperature processing or (less often) Ultra-Heat Treatment (both abbreviated UHT) is the partial Sterilization of food by heating it for a short time, around 1-2 seconds, at a temperature exceeding 135°C (275°F), which is the temperature required to kill spores in milk. The high temperature also reduces the processing time, thereby reducing the spoiling of nutrients. The most common UHT product is milk, but the process is also used for fruit juices, cream, yoghurt, wine, soups, and stews.

Since early times, humans have sought to find solutions to prolong the shelf life of various kinds of food. In these efforts, people learned to use preservatives such as salt and sugar to preserve the food, and also to use natural bacterial fermentation processes as for example in processing cheeses and yogurt.

Commercialization

With the understanding of microbiological processes, and the development of food processing industries and technology, techniques for the production of long shelf life products, using the freezing, drying, pasteurization and sterilization technologies were developed and commercialized.

Records show surplus milk production in different parts of the country during rainy seasons, and scarcity of milk in the dry seasons. The first scenario puts dairy producers at loss and the second one makes milk too expensive for consumers. The combination stagnates milk production and dairy development in general.

There have been significant milk imports over the years, depriving the country meager foreign currency required for other development sectors

UHT milk does not need cold chain, i.e. no need for refrigerated trucks, no need for refrigerators in milk outlets, and processed milk can be stored at room temperature for about 6-9 months. The product favors the current infrastructure limitations in the country.

Classic UHT System

In UHT processing, the milk and the package are sterilized separately and then the milk is filled into the container and sealed in an aseptic zone which is under positive pressure of sterile air. The latter requirement significantly increases the cost of the filling machine and subsequently the production cost of the final product.

UHT processing is ideal for large capacity plants and as a general guideline; a plant should process not less than 40 000 litres/day in order to achieve financial equilibrium. UHT processing, which is a continuous process, enables high throughputs.

Limitations of UHT milk processing

- High investment cost
- Requirement for high quality raw milk

- Electricity stability
- Expensive packaging materials
- High technical maintenance costs
- The cost of packaging is controlled by the supplier and there are no other alternative suppliers.
- Large volume of raw milk required to make the initial investment viable.

Sterilization

- Sterilized milk is processed by filling the milk into a container which is then sealed and autoclaved
- They are no special requirements
- The lines can process a wide range of products
- A wide range of packaging can be used- from different un-related supplies.
- Low cost equipment and processing costs
- Suitable for small, medium and large processors
- The shelf life of sterilized milk in Doy-Pack pouches is 3 -6 months at room temperature.

Why Sterilization technology?

- It is affordable (20%) of classic UHT
- Feasible return on investment
- Proven in Russia, Eastern Europe, Africa and Caribbean
- Can use relatively low quality milk compared to classic UHT
- The minimum volume required for investment can be as low as 1 000 litres per day!
- Low cost and affordable packaging materials

System [10 000 L/day]

- Tanks (receiving and balance tanks)
- Chilling system
- Pasteurization system
- Cream separator & pasteurization unit
- Packing system for pasteurization milk
- Bottle making unit
- Sterilization unit
- CIP
- Compressors, steam boiler and standby generator
- Waste management Unit
- Laboratory Equipment (microbiological)
- All pipes, electronic units and valves
- Spare parts

Investment for a 10 000 L/day Plant [x 1 000 RWF]

	Local	Foreign	Total
Land & Buildings	71 792		**71 792**
Milk Processing Plant	28 000	224 000	**252 000**
Vehicles	21 168		**21 168**
Office Equipment	2 912		**2 912**
Pre-operating Expenses	15 008		**15 008**
Initial working Capital	45 920	-	**45 920**
Total	**184 800**	**224 000**	**408 800**

Proposed financing Plan [x 1 000 RWF]

	Local	Foreign	Total	Percentage
Equity	184 800		**184 800**	45%
Term Loan (5 years)		224 000	**224 000**	55%
Total	**184 800**	**224 000**	**408 800**	100%

Assumptions and basis of financial projections [RWF]

Year	2009	2010	2011	2012	2013
Plant Capacity [Litres/Day]	10 000	10 000	10 000	10 000	10 000
Days per year [Days]	350	350	350	350	350
Production Capacity (x 1 000) [Litres/year]	3 500	3 500	3 500	3 500	3 500
Production Loss [%]	2%	5%	5%	5%	5%

Projected economic rate of return [x 1 000 RWF]

Year	2008	2009	2010	2011	2012	2013
Revenue						
Total sales	-	499 168	641 634	802 043	802 043	802 043
Direct Costs						
Raw Milk		242 021	312 816	391 020	391 020	391 020
Salaries	-	26 342	26 342	26 342	26 342	26 342
Admin Costs	-	10 080	13 440	16 800	16 800	16 800
Sub-total		**278 443**	**352 598**	**434 162**	**434 162**	**434 162**
Gross margin		220 725	289 036	367 881	367 881	367 881
Capital Expenditure	362 880	-	-	-	-	-
Incr. W/Capital	45 920	13 505	16 960	19 096	-	-
Residual Values						280 371
Sub-total	**408 800**	**13 505**	**16 960**	**19 096**	**-**	**280 371**
Net Benefits	**(408 800)**	**207 220**	**272 076**	**348 784**	**367 881**	**87 510**

Loan amortization schedule [x 1 000 RWF]

Year		2009	2010	2011	2012	2013
Loan Amount		224 000				
Principal Payment		-	74 667	74 667	74 667	
Interest Payment (p.a.)	*12%*	26 880	22 400	13 440	4 480	-
Loan Balance		224 000	149 333	74 667	-	-

Note: Grace period on principal only

Proposed ownership structure

1. Private

This is a scenario where a Private company/Individual selects an appropriate site in any part of Rwanda, installs a UHT plant, buys milk from surrounding areas, processes and sells:

Advantages

- No bureaucracy, decisions are swift
- Less administrative costs
- No ambiguity in price setting of raw milk

Disadvantages

- No ownership by farmers, which results in lack of milk during dry season.
- No market security for raw milk especially in the wet season
- No value addition to farmers' efforts

2. Cooperative

A Cooperative organization gets a bank loan, invests in the UHT plant, members deliver milk to the plant, process the milk, sells the milk through different market outlets.

Advantages

- Direct benefit to farmers through milk value addition
- Milk availability in all seasons
- Opportunities for soft loans and grants

Disadvantages

- Weak management
- Bureaucracy

3. Private-Cooperative Partnership

This scenario is normally the best and it is the one **recommended** for this project. It is however important to separate the mode of ownership from management routines. Every party does what it does best. Farmers do produce milk, and the private runs the dairy plant. One produces a raw material, another add value to it. They apportion the profit according to the cost of input. A formula for that can be established.

Advantages

- Input supply to farmers can be accessed due to their equity in the dairy plant.
- Knowledge inflow is high through the private sector

Disadvantage

- Continuous negotiations on the milk price, which is a healthy process, but consumes time.

SWOT analysis

Strengths

- The Government of Rwanda has put in place enabling environment for empowering the poor to keep dairy cattle.
- Rwandan people have a long culture of milk consumption
- Rwandan temperature and altitude favor dairy production
- There is a growing demand for milk and other dairy products
- The small size of the country makes possible to transport milk from one corner of the country to the other in one day
- Strong telecommunication industry have a great positive effect on communication for input and services delivery
- UHT is a known product in Rwanda

Weaknesses

- Low milk supply to most collection centres and hence to processing plants.
- Low milk supply to processing plants (operating at about 20% of installed capacity.
- Poor hygienic handling of milk
- Poor infrastructure
- Lack of input and service providers
- The milk value chain stakeholders not linked
- Lack of local qualified dairy technicians

Opportunities

- Increasing production goes hand in hand with increase in demand.
- Dairy farmers are demanding for services and inputs

- Harmonization of quality standards will increase trade
- Input and service providers will have more clientele because of increased dairy cattle population.
- A big number of donor support in the dairy industry
- Rwanda's climate favors dairy production

Threats

- Disease from neighboring countries through different boarders.
- Insufficient recognition of adherence to quality standards might hinder trade and reduce profits to farmers
- Micro-finance Institution still resistant to provide loans to agricultural/dairy related projects.
- Insurance companies resistant to insure cattle
- Strong habit of consumption of raw milk will hinder processing and industry could stagnate
- Less expensive packaging materials as plastic sachets are not allowed due to environmental concerns/still allowed by our neighbors-hence limited export market.
- Poor organizational and management capacity of dairy cooperatives hindering milk supply to dairy plants.

Conclusions

- The project is geared towards supplying the market with UHT milk, a product that is considered a basic human necessity that is currently imported and under-supplied. The private importers are unable to meet the demand and such a project would benefit from the situation.
- The project would create employment and would be particularly sensitive to gender equilibrium as the raw milk is handled by women.
- The project would contribute positively towards the incomes of the project promoters, farmers in Rwanda and the Government Exchequer.
- It is a project that would also contribute towards the sustainability of the Dairy industry in Rwanda while at the same time enhancing the transfer of technology to the country.
- The project would stimulate development of rural infrastructure.

2.3.5. Processing of milk and dairy products

Milk processing

Processing of dairy products often concerns milk. The production of cheese, yoghurt, butter and cream is marginal.

In the field of milk processing, PADEBL has included in its programme the financing of small scale producers, the construction of milk collection and cooling units, the upgrading of the road infrastructure, the training of the operators of the milk chain and the financing of promotion activities of livestock products, including milk.

Industrial dairy plants

Before the events of 1994, there were four operating dairy plants with a total production capacity of 25 000 litres of milk per day. They all belonged to the State, except Rubirizi dairy plant which the State owned in partnership with a Libyan state enterprise (70% of share capital). They delivered between 15 000 and 18 000 litres of milk per day to the market, representing about 85,000 litres per week. The rate of capacity utilisation averaged slightly more than 50%. Nyanza dairy plant was the most important in terms of quantity and diversity of products delivered to the market. It was also one whose capacity was the best utilised at almost 80%.

At that time, apart from imports of powder milk and high quality cheese, these dairy plants offered practically all the dairy products consumed on the Rwandan market: curd milk was the most sold, followed by fresh milk and cheese produced mainly at Gishwati. Most of the plants standardised the milk and used the fat supplement for other processed products (butter, cheese, cream, etc.). They all got their milk supplies from neighbouring producers, but Rubirizi plant owned also a dairy farm nearby. No fresh milk was imported from the neighbouring countries. All the dairy plants had sales counters for their products in Kigali and carried out distribution to the consumers. The private sector played a secondary role in the chain.

During the war, all the dairy plants in the country were looted. After the war, Gishwati and Rubirizi plants reopened but shut again after three years. Since the closing of Gishwati and Rubirizi plants, only Rwanda dairy plant at Nyanza continued to operate until the birth of the private dairy, INYANGE INDUSTRIES.

Nyanza dairy plant

After the 1994 events, Nyanza dairy plant was rehabilitated with own funds. It is the only operating dairy in the country since September 1997. It produces curd milk (ikivuguto) only. With a nominal production capacity of 10 000 litres per day, it processes to day between 2 500 and 3,000 litres per day on average. The greatest part of its production (1.56 million litres in 1996) is packaged in 500 mL boxes in compliance with the market requirements. It does not standardise milk any more and it has discontinued producing yoghurt, butter and cheese.

The plant sells and delivers almost all its products to five wholesalers in Kigali who, in turn, distribute them to the market in Kigali, some of them supplying to other towns in Rwanda. Other customers (small wholesalers, retailers) have to get their supplies directly from the plant.

Formerly, fresh milk was supplied by almost 170 producers. Some did this directly, others through milk collectors. There were some collection centres in Butare and Nyamagabe, but none of them had milk cooling facilities. Milk quality tests were carried out mainly at the plant, though organoleptic tests were done during collection. Some collectors or producers were therefore denied milk after travelling long distances. Since October 1997, the plant gets its supplies wholy from a cooperative of milk producers at Kabale in Uganda. A thermally insulated truck makes the journey every day. The cooled milk at 4°C at the cooperative reaches Nyanza at about 6° to 7°C.

At the technical level, Nyanza dairy plant owns equipment which has largely paid for itself but which would not be suitable for significantly increased volumes. Financially, its situation is still precarious even if it recorded profits in 1996.

Capacity of the plant

The plant has the capacity of receiving and processing 10 000 litres per day, but due to limited number of manufactured products and old processing equipments, the plant can only make use of 2 500 to 3 000 liters as it has already mentioned above.

Future of Nyanza Dairy Plant

The proposed expansion is fourfold, as it involves the expansion of the production and packing capacity, the enhancement of the suppliers' quality and productivity, improvement of the distribution capability as well as replacing old equipment.

There is a need to expand Nyanza Dairy plant due to the following reasons:

- The milk production is predicted to increase in quantity given the Government policy to provide every family with at least one cowmunder "Gira inka munyarwanda" program initiated by H. E. the President of the Republic of Rwanda.

- As a consequence, there is need to introduce new products such as UHT milk, cheese, butter and cream, in order to meet the market demand given the regional blocks we have joined [East African Community, COMESA, etc.].
- The consumption of milk and its derived products will increase as the population is increasing and many people are getting aware of convenient food products.

The expansion of the production capacity will include civil works and equipments, it is aimed at reaching 50 000 litres of milk processing capacity per day from a current level of 10 000 litres. In addition, there will be a purchase of other equipments such as packing equipments for yoghourt and curd milk.

Enhancement of quality and productivity at the supplier level implies adequate equipments at milk collection centres by providing farmers with milk cans, and other elements necessary to improve their practices and reach levels of quality. This calls for availability of veterinary pharmacy as well as technical advice.

Premises and Machinery

It is obvious that for the UHT milk, new building and a complete installation of equipments including spare parts are a vital part of the project.

For butter, cheese and cream, available equipments are old and some parts are either lacking or not functioning. Therefore, Nyanza Dairy cannot rely on their service ability in the coming days.

Similarly, the same problem occurs for curd milk and yoghurt products.

As Nyanza dairy plan to manufacture new products, It needs new and appropriate premises dedicated to host the equipments and machinery necessary for the production.

The design and layout of the plant must respond to general milk processing plants and must take into account building materials, ventilation, water supply, lightening, fencing, hygiene and sanitation plan and environmental issues by managing the wastes.

Each product has got its own requirements in terms of processing equipments, packaging materials and ingredients such as additives.

Processing and packing equipments differ in costs depending on the size of the plant (simple, medium to large scale), types, manufacturers, energy efficiency and maintenance.

Laboratory requirements

Milk is one of the most two carriers of diseases (water being the other one), that is why processors must conduct stringent quality checks at each and every stage of production to ensure the quality of each and individual products.

The laboratory will enable the plant to carry out necessary tests that fall under the following categories: microbiological, chemical and physical,

Laboratory analyses are aimed at checking the microbial quality, freshness, handling practices, detecting unsanitary processing and packaging conditions, prediction of shelf life, chemical composition and so forth. All this is done in order to meet the minimum quality standards set up by national, regional and international institutions or agencies. The laboratory facilities and necessary chemicals will depend on available funds as adequately equipped laboratory requires huge capital.

Distribution network/Logistical support

The distribution network will require refrigerated trucks in order to supply all corners of the country timely and steadily. It is in this regard that Nyanza Dairy wished to get 4 refrigerated

vehicles. In addition Nyanza Dairy would need 3 other cooling vehicles for transporting fresh milk from collection centers.

The following tables show the developments of the cattle population and milk production at Nyanza dairy farming area.

Table 41: Evolution of cattle population in Production Zone of Nyanza

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	198 438	192 845	172 562	163 485	155 036	147 259	139 790	132 700	125 969	119 580	113 808	108 252	102 967
Crosses	50 138	72 721	95 879	113 508	122 987	133 298	144 474	156 587	169 715	183 944	199 696	216 863	235 505
Pure	10 986	18 142	30 656	42 954	46 542	50 444	54 673	59 257	64 225	69 609	75 570	82 067	89 121
Total	**259 562**	**283 708**	**299 097**	**319 947**	**324 565**	**331 001**	**338 937**	**348 543**	**359 909**	**373 134**	**389 074**	**407 181**	**427 593**

Table 42: Evolution of number of lactating cows in Production Zone of Nyanza

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	60 027	58 827	55 190	52 287	49 585	47 023	44 638	42 374	40 224	38 184	36 283	34 512	32 827
Crosses	18 050	23 147	31 817	37 667	40 745	44 161	47 864	51 876	56 226	60 940	66 049	71 727	77 892
Pure	4 285	6 020	10 173	14 254	15 419	16 712	18 113	19 631	21 277	23 061	24 995	27 143	29 477
Total	**82 362**	**87 994**	**97 180**	**104 208**	**105 749**	**107 895**	**110 614**	**113 881**	**117 727**	**122 185**	**127 326**	**133 382**	**140 196**

Table 43: Evolution of total milk produced in Production Zone of Nyanza

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	22 510	22 060	20 696	19 608	18 594	17 633	16 739	15 890	15 084	14 319	13 606	12 942	12 310
Crosses	34 114	43 748	60 134	71 191	88 009	95 388	103 385	112 053	121 448	148 083	160 499	174 296	189 279
Pure	16 710	23 479	39 674	55 591	69 385	75 203	81 508	88 341	95 748	117 612	127 473	138 431	150 330
Total	**73 334**	**89 288**	**120 505**	**146 390**	**175 989**	**188 224**	**201 632**	**216 284**	**232 279**	**280 014**	**301 577**	**325 668**	**351 919**

Table 44: Evolution of marketable milk produced in Production Zone of Nyanza

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	13 506	13 236	12 418	13 725	13 016	14 107	13 391	12 712	12 067	11 455	10 885	10 354	9 848
Crosses	20 468	26 249	36 080	49 833	61 606	76 310	82 708	89 642	97 158	118 467	128 399	139 437	151 423
Pure	10 026	14 088	23 805	38 914	48 570	60 162	65 206	70 673	76 598	94 090	101 978	110 744	120 264
Total	**44 000**	**53 573**	**72 303**	**102 473**	**123 192**	**150 579**	**161 306**	**173 027**	**185 824**	**224 012**	**241 262**	**260 534**	**281 535**

The business plan for the dairy plant of Nyanza dairy farming area is found in a separate document.

Rubirizi dairy plant

This plant was rehabilitated after the war with funds from the Government's partner in this company. Since 1986, Rubirizi farm (including the dairy plant) is owned (70%) by LAAICO (Libyan Arab African Investment Corporation) and 30% by the Government of Rwanda (MINAGRI).

This plant was technically well installed. From 1994, it was the only one to standardise milk. It had the machinery for producing pasteurised milk, curd or not, butter, cheese and yoghurt. It had also a complete laboratory for analysing milk on its arrival, a supporting generator with a capacity of 155 kW which can meet fully its requirements (about 70 kW) in case of electricity failure from the national grid.

The plant attempted to restock its herd before the war, but it had to abandon the idea due to drought, lack of pasture and diseases. Besides its own herd, the plant got its supplies essentially from an important farmer operating at about 1.5 km from the plant and from Uganda, notably from the producers' cooperative in Kabale. In May 1997 for example, the plant bought 11 000 litres of milk from Uganda (at 165 RWF/litre) and 2 000 litres from a local producer (100 RWF/litre), while it produced 3 500 litres on its own farm.

Before its closure in September 1997, the plant produced about 1 000 to 1 200 litres of pasteurised fresh milk per day for a nominal capacity of 4 000 litres per day. The whole milk was standardised at 3.5% of fats and the additional cream at 10% of fats was sold in its state or used to produce butter. The plant was profitable, but it was liquidated because of the financial problems faced by the mother company, SODEPARAL.

SODEPARAL finally privatised the plant in July 2000, and it is Mr Polycarpe Gatete and his wife who have been managing it since. The plant produces mainly pasteurised milk and yoghurt. Its current capacity is around 1 000 litres per day. Milk is brought by individuals of all types at the price of 220 RWF/l.

Mukamira dairy plant

Mukamira dairy plant was able to resume its operations after the war through an investment of 1.5 million RWF by the Cooperative of milk producers in the region, and this contributed to the rehabilitation of about 30% of its nominal production capacity (6 000 l/d). It operated somehow until August 1997 when it had to stop due to the insecurity prevalent in the whole North Western region of the country. In the meantime, it was bought back by a private operator for 47 million RWF under its privatisation plan.

Before the plant was shut, producer membres of the cooperative used to bring milk to the plant on foot. On its delivery, the milk was checked for organoleptic, qualitative and quantitative aspects. It was immediately boiled on wood fire and then cooled with spring water. Out of 2 000 litres of milk received daily, 500 litres were processed in Gouda cheese, and the rest was poured in cans and delivered to wholesalers in Musanze, Rubavu and Kigali. The cheese made in Mukamira dairy plant is liked up to Burundi.

Since the closure of the plant, all the milk produced in this important dairy farming region is no longer sold. Out of 15 000 heads of cattle in the region after the war, less than 4 000 remained by the end of 1997 due to cattle thefts (more than 5 000 heads) and the transfer of the animals to other more secure regions.

Cattle Production Zone of Gishwati

Animals

According to recommended stocking rate of two adult animal units per hectare, Gishwati should be holding 2 676 animals. Apparently there are far more than this number. This explains why the whole area looks over grazed. The order restricting farmers to stock to recommended rate and remove excess animals needs to be enforced.

Breeds include mainly grade Friesian cows which owners consider pure exotic and many cross breeds of Friesian, brown Swiss and Jersey. A few indigenous breeds are kept for cross breeding purposes.

Interviews

Many individual farmers and farming association/cooperatives were interviewed following a prepared questionnaire. According to answers obtained from all farmers similar farming practices are used. In fact the whole of Gishwati can be considered as one huge farm with same management system except minor variations depending on the location of individual farmers. All

farms are mainly on hill slopes some of which are steep. Quite appreciable proportion of Gishwati farm land has poor soil types which cannot support good pasture. So the generalized recommended stocking rate of 2 per hectare is unrealistic.

All farmers claim to stock according to recommendations so individual farms have 10 and groups 20 adult animals per farm. Animals owned are grades crosses and a few indigenous. All use bulls for breeding. Inseminators are not available. Production and reproduction parameters don't vary much among farms. Milk yield, range from 3-5 liters for crosses and 6-8 liters for grade cows. Age at first calving range from 24-30 months and cows are culled after 10-12 calvings.

Management

All animals graze and pastures are Gikuyu (mainly Gikuyu grass, some Gikuyu grass interplanted with white clover-uruzi). Clean water (springs) is available on most farms. All farmers claim to practice clean milk handling methods and milk is delivered within 30 minutes to one hour, on head and in plastic jerry cans. Milk is delivered at the small centers which make cheese. These receive milk in the mornings only so milking for commercial purposes is done in mornings only. Efforts should be made to improve the nutrition status of Gishwati pastures. When this is done milk yield per cow will increase and the holding capacity might rise to two and half animal units per hectare. Well managed Gikuyu can supply sufficient energy requirements for grazing animals. The protein part however needs to be improved. Adaptable legumes, despodium, alfalfa and white clover (uruzi) species can be introduced. Uruzi is easy to interplant with Gikuyu, as is the case in some farms. Desmodium and alfa alfa require establishment of separate lays which may not be practical considering the inadequacy of the sizes of farms. Initially trials will have to be carried out in different locations of Gishwati. Regular application of pasture fertilizers is highly recommended.

Gishwati pastures were established quite a long time ago and some are exhausted. There is therefore need to revitalize them by digging fertilizing and replanting. This will have to be done in small lots at a time since farms are small and must support animals at the same time.

Problems

All farmers voiced similar problems. Milk prices paid to farmers are very low. There is lack of veterinary services, veterinaries are not available and drugs are obtainable from far off distances hence very expensive. Supplementary feeds and animal salt are not in reach.

Solutions

To address these problems there is need to set up the following services. A milk processing plant to handle all milk from both Gishwati area and its neighboring villages should be established. When management and farming systems are improved, this region is able to produce enough milk to feed a big processing plant. In addition to the four milking/cooling centers already constructed in Gishwati (not functional yet) there is need to construct at least four more, two for Ngororero and two to serve Rutsiro of Gishwati areas. When such centers are in place and functional then milk prices (200-250 FRW) per liter proposed by all farmers may be applicable. In order for these centers to offer efficient services all feeder roads connecting them to main roads should be rehabilitated to all weather standards.

Veterinary services are required as suggested:

Nyabihu: 2 veterinaires/inseminators

Ngororero: 2 veteriniaires/inseminators

Rutsiro: 2 veterinaries/inseminators

Rubavu: 1 veterinaries/inseminator

One vet pharmacy at Gatindori is to be set up. To modernize, all farms should be pad docked preferably in contours conforming to the hilly terrain. Informed and interested businessman could reopen the existing store house at Musenyi, near Gatindori and stock animal feeds and other farming inputs.

Type de laiterie

A modern milk plant with a capacity to process 200 000 liters of milk a day should be established to handle milk from Gishwati geographical base. It is proposed that the plant be equipped with lines to make these products:

- Pasteurized cuddled milk (Ikivuguto)
- Sterilized milk (UHT)
- Half skimmed UHT milk (for the elderly)
- Yoghourt
- Cheese
- Butter (fat from skimmed milk)

In addition a medium sized plant to make cheese should be established, preferably to be located in Ngororero/Rutsiro zone of Gishwati from where transportation of milk might prove difficult especially during heavy rain seasons. Ample facilities to process milk are proposed considering the fact that milk production will have increased tremenderously within 12 years (Vision 2020) following developments in the milk chain. Since most of the milk types and milk products to be made have long shelf life, they will be less cumbersome to market.

The following tables show the developments of the cattle population and milk production in Gishwati dairy farming area.

Table 45: Evolution of cattle population in Production Zone of Gishwati

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	115 003	111 762	100 007	94 746	89 850	85 343	81 014	76 905	73 004	69 302	65 956	62 736	59 674
Crosses	45 884	68 150	91 700	108 987	118 088	127 989	138 720	150 350	162 955	176 617	191 742	208 225	226 125
Pure	16 783	24 614	36 351	49 115	53 217	57 679	62 515	67 756	73 437	79 593	86 409	93 837	101 904
Total	**177 670**	**204 526**	**228 058**	**252 849**	**261 155**	**271 011**	**282 248**	**295 011**	**309 396**	**325 512**	**344 108**	**364 799**	**387 702**

Table 46: Evolution of number of lactating cows in Production Zone of Gishwati

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	34 788	34 093	31 985	30 303	28 737	27 252	25 869	24 557	23 312	22 129	21 028	20 001	19 024
Crosses	16 518	21 692	30 430	36 167	39 122	42 402	45 957	49 810	53 986	58 512	63 418	68 870	74 790
Pure	6 545	8 168	12 063	16 299	17 631	19 109	20 711	22 447	24 329	26 369	28 580	31 036	33 704
Total	**57 852**	**63 953**	**74 478**	**82 768**	**85 489**	**88 762**	**92 537**	**96 814**	**101 627**	**107 011**	**113 025**	**119 907**	**127 519**

Table 47: Evolution of total milk produced in Production Zone of Gishwati [L]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	13 046	12 785	11 994	11 364	10 776	10 219	9 701	9 209	8 742	8 298	7 885	7 500	7 134
Crosses	31 219	40 998	57 513	68 355	84 504	91 588	99 267	107 590	116 610	142 185	154 106	167 353	181 740
Pure	25 527	31 856	47 045	63 565	79 337	85 989	93 198	101 012	109 481	134 481	145 756	158 286	171 893
Total	**69 792**	**85 639**	**116 553**	**143 283**	**174 617**	**187 797**	**202 167**	**217 811**	**234 833**	**284 965**	**307 747**	**333 140**	**360 766**

Table 48: Evolution of number of marketable milk produced in Production Zone of Gishwati [L]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	7 827	7 671	7 197	7 954	7 543	8 175	7 761	7 367	6 994	6 639	6 308	6 000	5 707
Crosses	18 732	24 599	34 508	47 848	59 153	73 271	79 414	86 072	93 288	113 748	123 285	133 883	145 392
Pure	15 316	19 113	28 227	44 495	55 536	68 791	74 559	80 810	87 585	107 585	116 605	126 629	137 514
Total	**41 875**	**51 383**	**69 932**	**100 298**	**122 232**	**150 238**	**161 733**	**174 249**	**187 866**	**227 972**	**246 198**	**266 512**	**288 613**

The business plan of the dairy plant of Gishwati dairy farming area is given in a different document.

Nyagatare dairy plant

This plant has been affected by the repercussions of the war and has never resumed its operations. Everything or almost everything was looted. The building was quite damaged and in 1998, there were only a few bashed stainless steel tanks which could be repaired and reused.

In the same year, the plant was sold to COABOMU cooperative under the privatisation of public companies. The cooperative failed to pay the price agreed with the Privatisation Secretariat and did not manage the plant smoothly. It was then taken back from COABOMU and the privatisation process was relaunched. In 2005, the plant was sold to UMUTARA DAIRY MARKETING COOPERATIVES (UDAMACO) with the support of PDRCIU project.

In 2009, Nyagatare Dairy becomes state property with partners shares as following:

- State: 68.32%
- BRD: 20%
- RBI: 10%
- UDAMACO: 1.68%

The following tables show the developments of the cattle population and milk production in Nyagatare dairy farming area.

Table 49: Evolution of cattle population in Production Zone of Nyagatare

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	218 309	212 156	189 842	179 856	170 561	162 005	153 788	145 988	138 584	131 555	125 204	119 092	113 278
Crosses	40 419	62 278	86 330	103 179	111 795	121 168	131 327	142 337	154 271	167 205	181 524	197 128	214 074
Pure	17 543	25 463	37 098	49 923	54 092	58 627	63 543	68 870	74 644	80 902	87 830	95 381	103 580
Total	**276 271**	**299 897**	**313 270**	**332 958**	**336 449**	**341 801**	**348 658**	**357 196**	**367 499**	**379 662**	**394 558**	**411 600**	**430 931**

Table 50: Evolution of number of lactating cows in Production Zone of Nyagatare

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	66 038	64 718	60 717	57 523	54 550	51 731	49 107	46 617	44 252	42 008	39 916	37 968	36 114
Crosses	14 551	19 823	28 648	34 239	37 037	40 142	43 508	47 156	51 109	55 394	60 038	65 199	70 804
Pure	6 842	8 450	12 311	16 567	17 920	19 423	21 051	22 816	24 729	26 803	29 050	31 547	34 259
Total	**87 431**	**92 991**	**101 676**	**108 329**	**109 508**	**111 297**	**113 667**	**116 589**	**120 091**	**124 205**	**129 004**	**134 714**	**141 177**

Table 51: Evolution of total milk produced in Production Zone of Nyagatare [L]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	24 764	24 269	22 769	21 571	20 456	19 399	18 415	17 481	16 595	15 753	14 969	14 238	13 543
Crosses	27 501	37 466	54 145	64 712	80 000	86 707	93 977	101 856	110 396	134 608	145 893	158 435	172 054
Pure	26 683	32 954	48 012	64 610	80 642	87 403	94 731	102 673	111 282	136 693	148 153	160 889	174 719
Total	**78 948**	**94 689**	**124 926**	**150 894**	**181 099**	**193 510**	**207 123**	**222 011**	**238 272**	**287 054**	**309 015**	**333 561**	**360 316**

Table 52: Evolution of marketable milk produced in Production Zone of Nyagatare [L]

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	14 859	14 561	13 661	15 100	14 319	15 519	14 732	13 985	13 276	12 602	11 975	11 390	10 834
Crosses	16 501	22 480	32 487	45 299	56 000	69 366	75 182	81 485	88 317	107 686	116 715	126 748	137 643
Pure	16 010	19 772	28 807	45 227	56 450	69 923	75 785	82 139	89 025	109 354	118 523	128 711	139 776
Total	**47 369**	**56 813**	**74 955**	**105 625**	**126 769**	**154 808**	**165 699**	**177 609**	**190 617**	**229 643**	**247 212**	**266 849**	**288 253**

The business plan of the dairy plant of Nyagatare dairy farming area is given in a separate document.

Inyange dairy plant

Inyange dairy plant was installed with a capacity of 5 000 litres of milk per day.

It produces pasteurised milk and yoghurt. In the prospect of its extension, Inyange dairy has just installed a very modern plant with a capacity of 100 000 litres of milk per day which will produce UHT products for the market.

Strengths

- Management support on project implementation
- Competitive labour availabilty
- Unexploited market and high demand for Inyange products
- Good will on the part of farmers as stakeholders in the project value

Challenges and opportunities

Team management should do the possible to turn challenges into opportunities.

Challenges	**Opportunities**
INcosistent power supply	Install own 750 kVA generator
Inadequate production, warehousing and cold room capacities	Source of a higher production capacity line and construction of storage areas as per remodeling design
Competency skills gaps in Financial services, Supply chain, Engineering, Quality Assurance, Sales & Marketing departments	Close the gap through recruitment, on the job training, external exposure and mentorship programmes
Unreliabile supply of inputs and spare parts	Develop an efficient supply chain capability and long term direct relationship with suppliers to manage lead times
Short shelf life of dairy products	Buy new equipment with the capability of producing and conservation
Lack of a proper distribution system and capacity	Develop an efficient and effective distribution system

Threats

The following are the threats that could pose challenges to the project:

- Insecurity in target regional export markets
- Unfavourable tariffs or lack of authentic systems in the target regional markets
- Volatile foreign exchange markets
- Drought which could destroy crops and pasture

Constraints

The main constraints of the dairy subsector are related to the following:

Nutrition

- Modern techniques for the conservation of fodder are unknown in the subsector
- Some soils are poor
- Drinking water is of poor quality in some areas
- Lack of technical knowledge by the breeders is the source of errors in the nutrition system
- There is confusion between quantity, quality and yield
- The low purchasing power of the peasant does not allow him to buy appropriate inputs for the nutrition of the dairy cow

Animal health

This is dependent on:

- The persistence of some epizootic and enzootic diseases due to inefficient control of cattle movement
- Weaknesses in the implementation of disease control policies and prevention strategies specific to each disease
- High cost of drugs, vaccines and other veterinary products

Genetic improvement

The bulk of the cattle herd is of the local breed, which is characterised by low productivity.

Research

Research is limited by lack of financial and human resources in ISAR stations and in the agricultural projects, which explains the poor performance, the destruction of infrastructure, the disappearancce of animals and inadequate extension.

Marketing

Lack of a well equipped and well structured collection network impedes the marketing of production and demoralises producers; poor hygienic standards starting from the farm to the retailers affects milk preservation and causes economic losses.

Loans

Access to loans is very limited and the high interest rates are prohibitive to the producers.

These constraints should not however shadow the potential of the subsector which has considerable capacity to produce and enjoys a favourable social and cultural context.

The national strategies which have been adopted for the development of the dairy subsector are the results of the above mentioned constraints and are coherent with the diet requirements of the population. These strategies aim at removing the main constraints to the improvement of milk production, making the breeders accountable and increasing their incomes. The following complementary measures should be concomitant:

Planned measures

Sales and marketing

The challenge will be to grow sales volumes over the next five years through the execution of marketing plans.

Table 53: Quantity of milk sold [Millions de L]

Year	Year 1	Year 2	Year 3	Year 4	Year 5
Quantity	1.1	1.4	1.5	1.7	1.8

The following tables show the developments of the cattle population and milk production in Inyange dairy farming area.

Table 54: Evolution of cattle population in Production Zone of Inyange

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	163 811	159 194	142 450	134 957	127 983	121 563	115 397	109 544	103 988	98 714	93 949	89 362	84 999
Crosses	33 682	55 040	79 711	96 019	104 037	112 760	122 214	132 460	143 565	155 602	168 927	183 448	199 218
Pure	21 538	29 923	41 023	54 169	58 693	63 614	68 947	74 727	80 993	87 783	95 300	103 493	112 389
Total	**219 031**	**244 157**	**263 184**	**285 145**	**290 713**	**297 936**	**306 557**	**316 731**	**328 546**	**342 099**	**358 176**	**376 303**	**396 607**

Table 55: Evolution of number of lactating cows in Production Zone of Inyange

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	49 553	48 562	45 560	43 163	40 933	38 817	36 848	34 979	33 205	31 521	29 952	28 489	27 099
Crosses	12 126	17 519	26 452	31 863	34 467	37 357	40 489	43 883	47 562	51 550	55 872	60 675	65 891
Pure	8 400	9 930	13 613	17 976	19 445	21 075	22 842	24 757	26 832	29 082	31 520	34 230	37 172
Total	**70 078**	**76 011**	**85 625**	**93 002**	**94 844**	**97 249**	**100 179**	**103 620**	**107 600**	**112 153**	**117 344**	**123 394**	**130 162**

Table 56: Evolution of total milk produced in Production zone of Inyange

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	18 582	18 211	17 085	16 186	15 350	14 556	13 818	13 117	12 452	11 820	11 232	10 684	10 162
Crosses	22 917	33 111	49 994	60 221	74 449	80 690	87 456	94 788	102 735	125 267	135 769	147 440	160 115
Pure	32 759	38 726	53 092	70 105	87 501	94 837	102 788	111 406	120 746	148 318	160 753	174 572	189 579
Total	**74 259**	**90 048**	**120 170**	**146 513**	**177 299**	**190 084**	**204 062**	**219 311**	**235 933**	**285 405**	**307 754**	**332 696**	**359 856**

Table 57: Evolution of marketable milk produced in Production Zone of Inyange

Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Local	11 149	10 926	10 251	11 330	10 745	11 645	11 055	10 494	9 962	9 456	8 986	8 547	8 130
Crosses	13 750	19 867	29 996	42 155	52 114	64 552	69 964	75 830	82 188	100 213	108 615	117 952	128 092
Pure	19 656	23 236	31 855	49 074	61 250	75 869	82 230	89 124	96 597	118 655	128 603	139 658	151 663
Total	**44 555**	**54 029**	**72 102**	**102 559**	**124 109**	**152 067**	**163 249**	**175 449**	**188 746**	**228 324**	**246 203**	**266 157**	**287 884**

The business plan of the dairy plant of Inyange dairy farming area is given in a separate document.

The study mission proposes that MINAGRI should have business plans made for the four proposed new dairy farming areas of Ngoma, Nyirangarama, Karongi and Kigali.

Small-scale processing

The difficulties encountered by industrial dairy plants have encouraged small-scale processing which takes up a big part of Kigali market. The techniques used vary from one operator to another. In most cases, milk is brought to a boiling point on wood fire sometimes for three consecutive times. Most of these operators curdle the milk at this stage, although it is sometimes sold as it is and curdled subsequently by the buyer who most often is a small retailer. The product is then sold in bulk to the retailer in 20 litre jerrycans or directly to the consumer in 1.5 litres

empty water bottles, or less often, in small cans of 3 to 5 litres. Often, milk is sold in measured quantities depending on the pocket of the customer in glasses at a cost of between 100 and 300 RWF a unit.

All these processors have the same characteristics. They buy raw milk which can be very highly contaminated at that point, have it boiled for more or less a long time depending on what they feel is necessary to have it preserved as long as possible, and then sell it in bulk to the customers, either hot or cool. In fact, surveys have revealed that small-scale processors have no idea of which standards to apply for pasteurising milk and that there is no common practice in this field.

Concerning the dairy industry, analysis has highlighted the difficulties in the collection of locally produced milk, and these difficulties hinder seriously the development of this chain. The development of industrial units can only be strengthened on the basis of regular and reliable local supply. In view of the competition from imported UHT milk, the competitiveness of the local industry is weak and it is only through a significant reduction of the selling price that it can regain its share of the market inside and outside the country.

In addition, since milk is a highly perishable and potentially dangerous product to public health, it is essential that the Government ensures that standards of hygiene are complied with at all the levels of the chain, by both small-scale and industrial units. First, the legislation in force – which dates as far back as the colonial era – should be reviewed and standards which are more appropriate to the context adapted. These standards could, among other things, distinguish between industrial and small-scale activities.

2.3.6. Marketing of milk and dairy products

The marketing of dairy products was spontaneously restructured after the war in the light of the new market demand, milk supply opportunities and the numerous difficulties encountered in the rehabilitation of the existing dairy plants. The obstacles of bringing the local supply together played in favour of milk enterprises in Uganda whose distribution networks were better structured. However, some operators developed circuits for the collection of raw milk in areas with cattle concentration for supplying wholesalers or retailers in urban centres, mainly in Kigali. Rwanda dairy plant in Nyanza had brought its own collection circuit back in operation in the region of Gitarama to meet its demand. Some producers operating near these urban centres and mainly around Kigali developed their own customer base made up of small retailers or consumers. Finally, COABOMU Cooperative, with assistance from UNDP, established some milk collection and cooling centres in the former Umutara Prefecture. INYANGE dairy plant was put in place to establish also its own marketing circuits.

There are practically several intermediaries involved in bringing supply together and in the distribution of milk according to the products: at the local level, there are peddlers, Rwanda dairy plant, wholesalers and retailers; at the level of imports, there are importers, Rwanda dairy plant, wholesalers and retailers. Local raw milk and imported milk follow parallel circuits to reach the same consumers: dairy plants, wholesalers and retailers. On the other hand, local and imported industrial production is of concern to the wholesalers. The role of the different intermediaries is described in details below.

Peddlers

Peddlers collect milk from individual cattle keepers and carry it to the informal collection points where collectors pick it. Most often, they move on bicycles, carrying one or two plastic jerrycans of 20 litres according to the season, which they generally buy from several producers. Peddlers play a crucial role in bringing supply together, especially in the regions where agricultural farms are scattered and where production is fragmented.

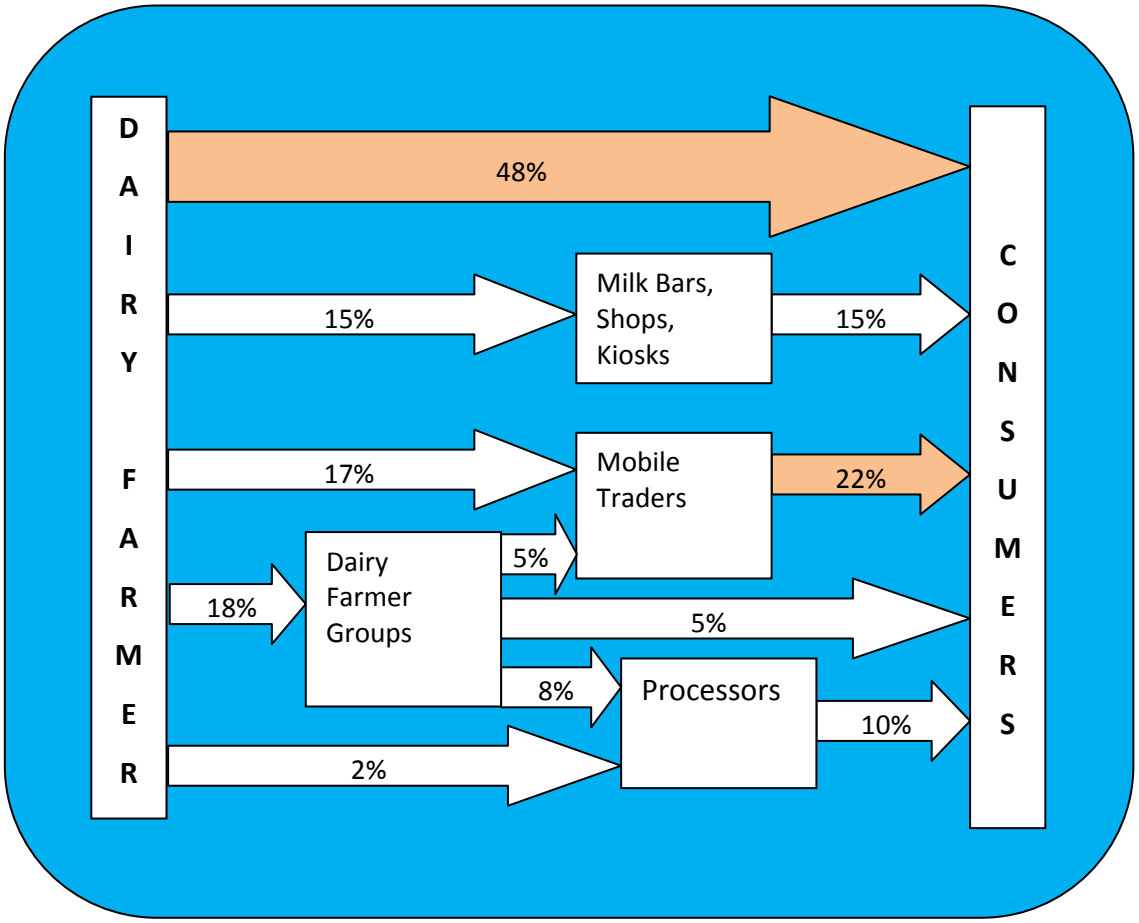
Collectors

According to given circuits, collectors travel daily to the main production areas to buy milk brought together by cattle keepers and/or peddlers in informal collection points which are in general along the main roads or in small regional small centres. The amounts bought can vary from a few litres to 500 or even 1 000 litres, and milk is generally paid for by cash. Some collectors check the quality of the milk through testing, but this is done in isolated cases and the bulk of the milk is simply bought as it is. Milk in its natural state is carried in open pick ups in 20 litre plastic jerrycans and delivered to wholesalers or retailers depending on established customers or to Rwanda dairy plant. But this system is very detrimental to milk quality.

To resolve this problem, PADEBL decided to establish scattered collection centres all over the country. It should be noted however, that many of these collection centres operate below their capacity while many areas do not have adequate resources to collect their production. This contributes to the reduction of milk quality.

Ideally milk should be transported from farmers to the collection centres in Aluminum or stainless steel cans and it must reach the cooling point not more than two hours after milking. Also milk should be transported by milk tanker (with chilling facility) from the collection centre to the processing plant. This is to avoid temperature raise during the course of transportation. Finished products from the plant can be transported by refrigerated truck for pasteurized and any other closed door truck for long life milk products to the sales points.

How milk gets to consumers from farmers



Under the better-run schemes, milk is collected both in the morning and evening and rapidly transported to the Milk Collection Center. This prevents the problem of preserving evening milk overnight.

If it is not possible to collect milk twice a day, the milk drawn in the morning should reach MCCs by 11 hours at the latest, when the cooling vehicles from the dairy plants should start loading this milk.

Evening milk should stay overnight in MCCs and be collected by vehicles from the dairy plants at 11:00.

Presently over 70% of milk reaches the consumers through informal traders. It is important that all the stakeholders sensitize the public on the importance if drinking processed milk.

In Rwanda we have to come up with what we call Rwanda Dairy Board where all the processors can come in one voice and express their concerns to the relevant authorities. Through that board they can come up with school feeding programme, they can put billboard on the roads to sensitize population the importance of taking processed milk, the same board can negotiate with the associations of people living with HIV virus and AIDS to sell milk to their members. The Board can negotiate with the media institutions such as RTV and Radio at relatively lower cost to make shows and broadcasts on the importance of taking processed milk. We are now in the region integration and the processors has to analyze why milk produced in Rwanda seem to be more expensive than other milk products from neighboring countries, otherwise local products will not be competitive due to high price. The processors have to plan production of long life products such as UHT treated milk which does not need to be refrigerated, and can be sold far away from the processing plant.

Processors

There are two operational dairy plants in Rwanda to day: Nyanza and Inyange dairy plants. Nyanza dairy plant is an outlet for part of the milk from local producers in Southern Province. Inyange dairy plant receives part of the milk produced not only in Kigali periurban but also part of the milk produced in Northern Province, especially in the districts of Gakenke, Rulindo and Gicumbi. Bugesera and Rwamagana, two districts in Eastern Province, supply also Inyange dairy plant. The same goes also for the district of Kamonyi in Southern Province.

Though on the basis of the concentration of cattle keepers and produced milk one can distinguish four traditional high concentration areas (Nyanza, Kigali, Nyagatare and Gishwati dairy farming areas). There are also satellite concentration areas which, because of the quality of produced milk and their long distance from the traditional dairy farming areas, can be raised to the status of autonomous dairy farming areas. These are Ngoma, Nyirangarama, Karongi and Rusizi.

Wholesalers

Although they all do retail selling, wholesalers are recognised by the higher volumes of their sales and their customers who consist mainly of small retailers. Wholesalers sell UHT milk and milk from dairy plants only.

Retailers

There is a big number of retailers in Kigali. The network is fragmented and, therefore, competitive. Consumers can choose their suppliers. However, in residential areas where there are not many retailers, milk sells generally higher.

Almost all the retailers sell three main types of milk (raw milk, curd milk from Rwanda dairy plant and imported UHT milk).

Almost all the traders have small refrigerators, and this limits their storage capacity, forcing them to get fresh supplies every day. Given the very poor quality of dairy products (milk is rarely preserved for more than 2 days), one should not aim at incresing the preservation capacity.

Conclusion

Although urban markets are relatively well supplied, the selling of local milk comes up against lack of a well structured collection network. This is in fact a major constraint for the development of the milk chain since it handicaps the sale of local milk and, hence, does not encourage either cattle keepers to increase their production. In addition, the problem of hygiene is serious at all the levels of the chain, from the farm to the retailer. This is also a problem which the authorities should consider seriously due to zoonotic diseases affecting a big part of the cattle population in Rwanda. By affecting the duration of milk preservation, lack of hygiene causes also significant economic losses.

2.3.7. Marketing of milk basic principles

Marketing System

The ultimate aim of every collection system is to provide regularly “safe” milk for processing units and/or customers, according to their demand and minimal costs. If costs are high, the costs of the resulting dairy products may go beyond the reach of the most needy consumers. A point of emphasis is that regardless of the production system, hygienic handling of milk is essential if it has to reach consumers in an acceptable form, while the range and duration of markets for milk products is extended by processing.

Milk Marketing Approach

The exploitation of the potential to produce milk through organizing production, processing and marketing needs what is essentially known as Integrated Dairy Development. This approach requires a comprehensive plan to identify and describe the wide variety of activities, which need to be coordinated in order to ensure that the total system forms a viable dairy industry. Proper co-ordination and full commitment of all participants is essential if the planned objectives are to be achieved. Organized processing and marketing improve the producer’s bargaining power, encourage better planning to exploit the markets identified and will ultimately increase income for the farmers. Interaction with the market creates an awareness of the importance of quality and shelf life and promotes interest in technology transfer.

On the processors side, the provision of milk cooling facilities in the rural areas will solve the problem of availability of milk both in terms of quality and quantity. With that prices will fall enabling plants to buy milk straight from producers or agents. The price of milk will also improve at collection point, as middlemen will be eliminated to the benefit of the producer.

Producers in the rural areas should be trained to raise the level of skills and knowledge to ensure the consistent production of quality milk to enable them to compete with commercial milk producers. In addition, to providing the necessary training and advice, milk plants must establish a suitable quality payment schemes to stimulate the production of quality milk. Emphasis should be placed on preventing adulteration and improving microbiological quality.

Training

Training for production of quality milk starts at the farm, collection and reception at the milk plant. Milking staff, milk vendors and traders and the staff at reception both at the milk collection centres and milk plants should be the main focus of both the informal and formal training programs. Truck drivers and their assistants should also be trained in milk handling and hygiene as they form an important link in the milk chain from the collection point or centre to the consumer or milk plant. Any mistake by any of the groups in the chain will cancel the benefit of the whole

training program. Cleanliness of the equipment used in collection of milk and personal hygiene should be emphasized and routinely enforced.

Farmers and vendors need to be trained on the proper milking 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

The training needs at factory marketing levels 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.

Theoretical knowledge should be complemented with practical experience.

Milk Marketing in Rwanda

The target milk market for all producers is the urban consumer, especially Kigali city. Vendors and traders and/or farmers sell most of the milk in the raw or as fermented form. Processed milk (pasteurised and yoghurt) is sold in supermarkets and shops or directly to consumers (in case of Nyabisindu dairy). However, the majority of milk plants do not operate to full capacity due to lack of enough quality milk, high production costs including a variety of taxes and stiff competition from milk vendors and traders who offer better prices to milk producers and milk imports especially powder milk.

In some areas of Rwanda, crop and animal husbandry systems have synergistic complementary roles in the provision of food and are important primary links in the food production marketing chain. However, the livestock production systems in areas of Kigali urban and others provinces are different and being based respectively on the zero and small scale extensive grazing management mono-culture systems. These systems therefore, need to be assessed in light of their particular farming circumstances relative to the targeted market i.e. the consumer in urban areas.

The problems and needs of dairy marketing in Rwanda are well summarized in a recent report on the production of quality milk in Rwanda (Chemonics International, 2002). The main points raised in this report are 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 and the needs of new trade avenues with other countries in the region.
- Increased efforts should be directed toward the construction of new milk collection and cooling centres as well as the revival of unused collection centres and equipment respectively especially in the rural areas of Rwanda.

- The extension system needs to be strengthened up to village level and out of office if the livestock industry is to be modernized. Outreach programs have to be revitalized.
- Quality control and assurance measures have to be put in place and enforced throughout the milk chain and
- Sustainability of the technologies and interventions in the industry will only be achieved if farmers are well organized and empowered.

2.3.8. Consumption

Behaviour of urban consumers

Strictly speaking, the study mission did not carry out a survey, but it discussed with a number of individuals it met randomly. Thus the findings, though they do not have the accuracy of a real survey, they all the same help to assess the significance of livestock products in household budgets.

Table 58: Preference of urban consummers of milk products

Milk Product	Raw Milk	Boiled Milk	Pasteurised Milk	Curdled Milk	Cheese
Percentage	1%	43%	13%	38%	5%

The previous table gives the proportion of the households which consume dairy products. Thus, in the feeding habits of Rwandan consumers, boiled milk comes first, followed by curdled milk, pasteurized milk, then cheese and finally raw milk.

Table 59: Reasons for preference

Reason	**Not available**	**Too costly**	**Do not like**	**Other**
Raw milk	14%	17%	59%	11%
Boiled milk	24%	29%	38%	9%
Pasteurized milk	18%	37%	32%	13%
Curdled milk	19%	52%	15%	14%
Cheese	23%	44%	26%	7%

Table 60: Places where consumed

Place	**Home**	**Restaurant**	**At friends' home**	**Elsewhere**
Raw milk	94%	0%	6%	0%
Boiled milk	89%	8%	10%	3%
Pasteurized milk	68%	19%	7%	6%
Curdled milk	69%	21%	8%	2%
Cheese	73%	9%	11%	7%

Most of milk products are consumed at home, in the restaurant, then at friends' homes and finally elsewhere [in supermarkets, kiosks, pick nick, the office etc.]

2.3.9. Formation of prices and profit margins

In Rwanda, the analysis of the distribution of value added between the different economic operators is difficult to establish because of the absence of written documents on transactions, the multiplicity of intervening parties and the often "hidden"nature of the commercial activities. It is however possible to examine the process of price formation of different livestock products and to determine raw margins on every link of the chain. These margins vary according to the

products and are influenced by various factors acting on supply and demand and determining the negotiating capacities of the parties, notably the season, the origin of the production, the distance, the knowledge of the market, etc. Consequently, the calculated margins should be considered as variable in time and according to concerned operators.

An analysis of marketing margins enables to determine the level of competition between economic operators on each link of the chain. A healthy competition in the marketing network of dairy products implies that any growth in productivity and therefore of supply from the producer will eventually be reflected at the consumer's level by a lowering of prices.

The price of milk at every link of the chain varies significantly according to the type of product, its origin and the season. Besides, in each case there exists a large diversity of situations which largely influences the level of margins recorded by economic operators. Although wholesale and retail prices reflect a healthy competition on consumer markets, the prices to the producers reflect individual situations of each region. Thus, diaries offer a relatively high price to their suppliers, while in Mutara region for instance, difficulties encountered in selling tend to lower the prices offered to farmers. Similarly, gross margins of collectors depend on specific circuits they follow, just like the margins of retailers depend on specific circuits they follow and on the role played in the supply and the local competition.

In areas around Kigali, the farmer is paid about 150 RWF per litre. The litre of milk is sold by the collector for between 200 and 250 RWF, generally directly to retailers or to the diary which sells it to the consumer at 300 RWF and 600 RWF per litre respectively.

The price of a product on the market is an important factor which influences the consumer's demand. This implies that the costs involved in the supply of raw materials, in the processing, in packaging, the marketing and the distribution must be kept at the lowest possible level.

Generally, the price of a dairy product will comprise of:

- The cost of fresh raw milk
- The cost of the collection and transport of raw milk
- The cost of processing
- The cost of packaging
- The cost of marketing and distribution
- Taxes
- Profit margins of each channel of marketing (collection, processing, marketing)

The price of milk to the final consumer depends on the channels followed. The number of middle persons involved will have an implication on the prices asked by the producer and by the consumer. The shorter the channel, the lower will the prices be to the consumer and the producer will have more profit.

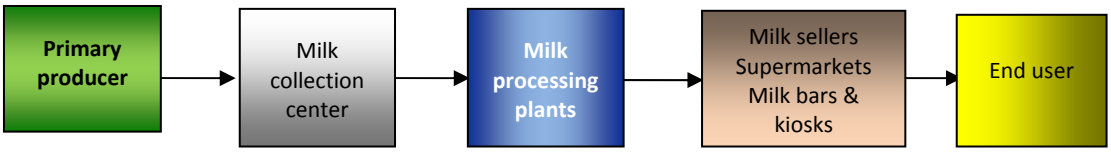
From the consumer's point of view, the shorter the chain marketing, the lower and more affordable the retail price will be. This explains why direct raw milk sales from the producer to the consumer or via hawkers have increased despite the risks associated with the consumption of raw milk and dairy products. The milk producers prefer selling it to hawkers because of various factors such as inaccessible formal markets and long distances to dairies. The biggest problem remains health risks due to lack of quality control and the frequent tampering milk is subjected to on the way to the market. An efficient marketing chain is the one that would enable the farmer to receive at least 50% of the milk's retail price.

2.3.10. Social and environmental issues

E1. General view

This section cover environmental issue ranging from benefits of activities involved in milk chain from cattle keeping (primary producer to the final consumer). It specifically focuses on 2 stages on the common milk chain as shown on the diagram below:

Figure 1: Flow diagram of the common milk chain



The main focus was on primary producer (cattle keeping) and its impact to the environment (forest, water resources, land and agriculture) and the milk processing plant mainly on its impacts on the environment due to wastes produced and resources required in the whole processes such as water and energy use.

The general objective was to identify the possible impacts that may result from milk chain project and to recommend on possible measures to mitigate or alleviate the impacts for sustainable uses of our resources for economic development.

The methodologies used to achieve the objectives mentioned includes but not limited to

- Site visit coupled with discussion with cattle keepers and plant operators and managers, unstructured interviews and site observations clearly to observe the current impacts and be able to discuss with cattle keepers and neighboring community on the existing conflicts within communities.
- The laboratory tests for the influent and effluent of wastewater from milk processing plants with the objective to identify the main parameters of concern to the environment and the performance of the existing treatment systems available. However, due to time and financial constraints the sample size was not enough to represent the required information but at least would give the idea on the characteristics of the milk processing plants of the same nature.

E2. Primary producer (cattle keeping)

E2.1. General Impacts

These are general impacts of cattle keeping to the environment however the significance depend on the site characteristics (available vegetation cover) the surrounding environment (available water resources and the receiving environment) and the uses of the surrounding environment) including the land use planning of the area.

Although the Government of Rwanda (GoR) is emphasizing on livestock production in its economic development strategy the challenge is to reconcile two conflicting demands: for animal food products and environmental services. Livestock production is one of the major causes of the world's most pressing environmental problems, including global warming, land degradation, air and water pollution and loss of biodiversity[1]. It is true that cattle keeping are entering into direct competition for scarce land, water and other natural resources in Rwanda.

The livestock sector is usually driven by diverse policy objectives, and decision-makers find it difficult to address economic, social, health and environmental issues at the same time. The fact

[1] http://.fao.org/ag/magazine

that so many people depend on livestock for their livelihood limits the policy options available, and leads to difficult and politically sensitive trade-off. General environmental impacts are described below.

Watercourse pollution

It has been proved that cattle keeping affect heavily the world's water supply, accounting for more that 8 percent of global human water uses. Evidence suggests that it is the largest sectoral source of water pollutants, principally animal wastes, antibiotics, hormones, chemicals from tanneries, fertilizers and pesticides used for feed crops, and sediments from eroded pastures.

More specifically, livestock management on land adjacent to watercourses has several direct and indirect impacts:

- Feeding livestock may results into manure waste which can be brought out into watercourse when there is rainfall. This will automatically increase the amount of BOD into the watercourse, and from the decomposition of that manure, there will be a high amount of oxygen use. This will particularly impact on the slow moving streams where oxygen supply is in limited supply, which if not well controlled may result in fish kills.
- Destruction of riparian area along with degradation of the watercourse has a direct and negative impact on the site and on downstream water users. There may be noticed a reduction in water quality which may also impact heavily water supply industries, recreational users, fish and fish habitat and impair natural beauty.
- Beside that, the stream-bank vegetation is removed gradually. Most of the vegetation serve as food, provide cover and shade to the fish; and it also provide stream-banks stabilization and act as a defensive barrier by protecting the watercourse from disturbances and by filtering out harmful substances.

Deforestation and Greenhouse gases

Livestock sector is by far the single largest anthropogenic user of land. Grazing occupies 26 % of the Earth terrestrial surface, while feed crop production requires about a third of all arable land. Expansion of grazing for livestock is a key factor in deforestation. Besides that 70 % of all grazing areas are considered degraded, mostly because of overgrazing, compaction and erosion attributable to livestock activity. At the same time, the livestock sector has assumed an often unrecognized role in global warming as it has estimated by scientists (see the paragraph below):

"Scientists usually tie their estimates of the greenhouse gas emissions responsible for global warming to sources such as land use changes, agriculture (including livestock) and transportation. It was found that through aggregating emission throughout the livestock commodity chain – from feed production (which includes chemical fertilizer production, deforestation for pasture and feed crops, and pasture degradation), through animal production (including enteric fermentation and nitrous oxide emissions from manure) to the carbon dioxide emitted during processing transportation of animal products (e.g. milk)."

www.fao.org/ag/magazine

Biodiversity loss

The sheer quantity of animals being raised for human consumption also poses a threat to the Earth's biodiversity. Livestock accounts for about 20 percent of the total terrestrial animal biomass, and the land area they now occupy was once habitat for wildlife. In 306 of the 825 terrestrial eco-regions identified by the worldwide Fund for Nature, livestock are identified as "a current threat", while 23 of conservation International's 35 "global hotspots for biodiversity"- characterized by serious level of habitat loss- are affected by livestock production.

E2.2. Specific Impacts due to Cattle keeping

Kigali area

- Pollution for water bodies

In the few areas visited, wastes from the cattle though some are kept and solid as composite manure, urine flows to surface water bodies found near the cattle keeping area and this contributes much on nutrients and Biochemical oxygen demand (BOD) that eventually flows into the receiving water bodies and this is considered to be the main cause of eutrophication in the receiving water bodies and consumes a lot of oxygen in the surface water bodies respectively and cause the great harm to aquatic life.

- Soil erosion

It was also found that in many areas visited, the number of cattle kept per hector exceeds recommended standard as a result they are seem to be overgrazed and during dry season when the feeding materials are not enough the cattle seem to be unhealthy in addition to significant decline of milk production[2]. The overgrazing is the major sources of soil erosion and if no measure are put in place the overgrazing may lead to desertification and also contribute much to silting of surface water bodies.

Comparing two people located in the same area the one with few cattle seem to have a well organized system with good milk production and healthy cattle compared to the one with many cattle not fed well because of lack of enough feedings.

Gishwati area

For the case of Gishwati area; almost every farm has a small spring passing within the farm and it is used as a source of water for cattle to drink. It is said that even for the few farms that do not touch on water resources the neighboring farm owner must provide the access to the water sources to his neighbors.[3] Although it is believed that there are different water sources used for human consumption in many cases the same sources are used for all purposes (cattle feeding and human consumption) considering that the majority that are cattle keepers (abashumba) are illiterates that do not understand the effects of polluted water to the human health. There is a need to sensitize cattle keepers for protection of their health. The serious concern is that almost all interviewed people have no farm for their cattle. They rely on hiding their cattle and use the protected forest as pastures for their cattle at night or when they are not seen.

The available cattle exceeds the allocated land and for that case encouraging the overgrazing in the area

The main environmental problems in Gishwati area are and will continue to be if no measures are taken:

- Deforestation: because the available land allocated for cattle keeping do not match the number of available cattle.
- Pollution of water sources: although Gishwati area is rich in terms of water resources, the pollution of water resources should not be undermined since it is a finite resource and should be well managed in an appropriate manner. People take their cattle to the flowing streams for drinking water. Another sources of pollution is human wastes where people have no toilets and use open places for defecation and this flows to water bodies that is used again for cattle as well as human consumption in some cases
- The issue of conflicts should be pro-actively looked at. Some of the people interviewed have no farm for their cattle. These are poor people that depend totally on their few

[2] Discussion with cattle keepers
[3] Discussion with local people (cattle keepers)

cattle for their living and majority of people with farms are rich people not even staying in Gishwati, for that case the poor will continue in poverty crises since have no even a good market to sell their little milk they produce "I have been selling one liter of milk for 100 RWF but now because I keep moving with my caws all over to look for pastures I sell one liter of milk for 80 RWF"[4]

- Collective measures the Government has put up should be implemented.

iii) Mutara Area

Mutara area in known to have a great number of cattle; However, experienced with couple of environmental problems ranging from soil erosion to desertification and water pollutions. The main causes being the lack of enough water for human and animal use where the same water sources are used for all purposes and the available land can not suffice to feed the number of available cattle as it leads to overgrazing. Although the GoR has been trying to sensitize local people to move from tradition ways of cattle keeping to modern ways; challenges are still there. The notable examples are as indicated in the figure below:

Figure 2: Soil erotion in mutara area due to overgrazing Figure 3: Dessertification in Mutara area

Soil erosion and desertification in Mutara area are due to overgrazing and tradition way of cattle keeping that still exists.

Figure 4: Cattle drinking water along Muvumba River

Pollution of water resources: such as Muvumba River as seen in the figure 4 feeding cattle in the river causes high turbidity and affect other water uses and this has led to conflicts among different users.

In summary the impacts are summarised as:

- Soil erosion as the major concern;
- Deforestation omit expansion of grazing land for cattle is a key factor in deforestation mostly due to overgrazing;
- Pollution of water resources due to soil erosion and animal wastes as explained earlier;
- Conflicts as social impacts due to scarcity of resources both water and land;
- Carbon dioxide and nitrogen, gases emitted by livestock contribute to global warming.

[4] This is the common statement given by the majority who keep their cattle hiding places such as protected areas.

Nyanza area

Nyanza like other areas also have the same impacts, however, the significance of the impacts might differ depending on the existing environment as well and the intensity of the cattle per available pasturing land.

Many areas in Nyanza cattle keepers have controlled their ways of cattle keeping except few who are still practicing the tradition way of cattle keeping. The major concern is that majority still take their cattle to rivers and streams for drinking water.

There pollution of water resources is of much concern. There is a need to sensitize all stakeholders to manage their water resources in an integrated manner.

E3. Milk and milk Products Processing Plants

E3.1. General Impacts

The major concerns in milk processing industries are wastes and emission produced during the processing operation and resources required.

The general wastes produced depend on the type of milk products produced, process involved, packaging systems and material; and also on the source and nature of the waste. Source of Waste in a dairy plants are:

- The washing and cleaning out of product remaining in tank trucks, cans, piping, tanks, and other equipment performed routinely after every processing cycle.
- Spillage produced by leaks, overflow, freezing- on, boiling- over, equipment malfunction, or careless handling.
- Detergents and other compounds used in the washing and sanitizing solutions that are discharged as waste,
- Entrainments of lubricants from conveyors, stackers and other equipment in the wastewater from cleaning operations.
- Waste constituents that may be contained in the raw water which ultimately goes to waste.
- Processing losses include:

a) Sludge discharged from clarifiers,

b) Product wasted during pasteurizer star t- up, shu t- down, and product change- over;

c) Evaporation entrainment,

d) Discharges from bottles and case washers,

e) Splashing and container breakage in automatic packaging equipment and;

f) Product change- over in filling machines.

Diary waste parameters which has a great significance include BOD, Chemical Oxygen Demand (COD), suspended solids (SS), pH, temperature, phosphorus, nitrogen, chlorides, fat, oil greases (FOG) and sludges. Negatives environmental impacts will therefore result in the release of high amount of one of these parameters (BOD, COD, SS, P, N, Cl, and FOG) in the environment.

Negative impacts which are generally observed due to the above pollutants are:

- Eutrofication of the water bodies: the eutrofication of water bodies will be caused by the high content of nutrients(N,P) present in untreated water, this will lead to plant growth and toxic algae blooms which can disrupt fisheries and recreation;

- Toxicity: the toxicity may be caused by toxic substances present in the channel of milk production , which will lead to harmful effects to animals and marine organisms living in water;
- Deposits into water bodies , which may result in high amount of suspended solids leaching water bodies, and they can be harmful to plants and animals living in water;
- Oxygen depletion: oxygen depletion will be caused by high amount of oxygen demanding pollutants mostly organic matter and ammonia nitrogen.
- Odor problems: may be generated while treating wastewater from the dairy plants;
- Excess nutrients and organic matter can be harmful to vegetation when treatment is not efficient (Agency, 1997),
- Contamination and degradation of soils by pollutant present in dairy wastewater which may lead to unsightly conditions which will make the soil less productive in agricultural purposes. Mostly those pollutants are FOG and sludge.
- Emissions of gases during dairy wastewater treatment which may be harmful to all living organisms and beside that there are contributing to global climatic change. Gases which are classified as pollutants to air from wastewater treatment in general are:
    - Carbon dioxide (CO_2): powerful greenhouse gas which is emitted from wastewater treatment plant, thus contributing to global climatic change, (Engineers, 2006)
    - Methane gas (CH_4), sulfur dioxide (SO_2), and nitrates compounds (NOx): these gases when uncontrolled in wastewater treatment plant have negative effects on air quality, and they are also contributing to global climatic change. (K.Biswas and S.B.C. Agarwala, 1992)

E3.2. Specific Impacts

Specific impacts are discussed here basing on Nyange milk processing plant, and Nyanza that are in operations and the Eastern province Quality dairy plant.

When conducting this study few samples from Inyange plant were analysed as seen in the table below.

Inyange Plant

Inyange started to operate since 1999 as indicated in the previous sections. The main processed milk products are: Fresh milk, Yoghurt (flavored and plain) and Cream. However the expected production in the new constructed plant at Masaka area will be five times more than the existing plant.

- Liquid wastes

The current wastewater source is from the processing of pasteurized milk and yoghurt. However, because the plant is involved in processing of other food products such as fruit based juice and water the wastes tested should not be specifically for milk products

Figure 5: Existing flow diagram of wastewater treatment at current Inyange plant

The current wastewater treatment plant is a simple aeration closed tank with aerator inside. Only BOD is removed to a certain percent as it was also observed in the samples analyzed where removal of BOD was 66%.

Table 61: Inyange Wastewater Analysis Results

Parameters	**In let**		**Out let**	
	A	B	A	B
BOD_5 (mg/L O_2)	680	760	252	240
	720		**246**	
Calcium (mg/L Ca^{2+})	46.5	47.2	50.5	52
	46.8		**51.3**	
Ammonia Nitrogen (mg/L N)	29.5	26.5	81	96
	28		**88.5**	
Total Phosphorus (mg/L P)	4.6	4.8	5.5	6.3
	4.7		**5.9**	

The BOD discharged to the environment was 246 mg/L while the allowable discharge should not exceed 30 mg/L and even for controlled water courses should not exceed 20 mg/L as per WHO standards and allowable limits for trade effluent discharge to sewer/watercourses/controlled water courses. Other parameters were not affected by the treatment plant as seen on the results table. However according to the discussion with the operation manager, there is a high improvement since the installation of that system, previously wastewater used to flow in the open channel along side the main road and that wastes used to smell all over the place. This is absolutely true because of reduction of BOD which undergoes biodegradation process and produce foul gases.

Other parameters like ammonia nitrogen, the value of 88.5 mg/L seem to be higher compared to allowable 20 mg/L for controlled watercourses. Other parameters like total phosphates and calcium seem to be low but with no effects due to treatment process.

Rain water and cooling water is recycled and reused in the cooling system especially in bottles processing and other processes requiring cooling systems

- Solid wastes

Major sources of solid wastes are packaging materials for yoghurt and pasteurized milk. Management of these wastes is by damping. They are collected and then transported to Nyanza – Kicukiro at the common dumping site.

- Future plans

Inyange is planning to move its operation to a new plant constructed at Masaka; bigger than the current one. Before the construction of the plant Environmental impact Assessment was conducted and among the measure is the provision of wastewater treatment plant and rainwater harvesting that seem to be a good environmental management practice.

Basing on the plan the wastewater treatment plant will separate wastes from human wastes and from processing wastes and there is a provision of pre-treatment before joining for final treatment unit which also seem to be a good environmental management practice.

Generally the impacts of the liquid and solid waste at Nyange plant is due to high discharge of nutrients which is about 89 mg/L and 5.9 mg/L Ammonia nitrogen and total phosphorus respectively. Even for the BOD removal is not promising since the effluent quality does not meet the required standard which is > 30 mg/L BOD. Therefore measures to all parameters should be put in place and this will be addressed in a new plant.

<u>Nyanza Dairy Plant</u>

Nyanza dairy plant produces milk in the form of pasteurized cuddled milk (ikivuguto) and yoghurt however it aims to include sterilized (UHT) milk and cheese in the near future. The factory has been in operation for over 70 years old and most of its equipments are outdated and not well functioning hence more wastes are emitted due to material loss.

Eastern Province Quality Dairy Plant

This plant is new and is expected to start its operation this coming year and will be processing fresh pasteurized milk, cream fresh, Curd milk and yoghurt however, the future plan is to increase the production by adding more products such as cheese, butter UHT milk and milk powder.

Being a new plant, consideration of environmental law (Organic law) determining the modalities of protection, conservation and promotion of environment in Rwanda of 2005 was considered and the environmental study was done to take all the necessary precautions to protect the environment.

The current wastewater treatment system is two tanks with ventilation pipes followed by a filtration system open on the surface but filled with sand. Then the final is another closed tank with a vent pipe. The flow diagram is as shown in figure below:

Figure 6: Wastewater treatment plant for Eastern province quality dairy plant

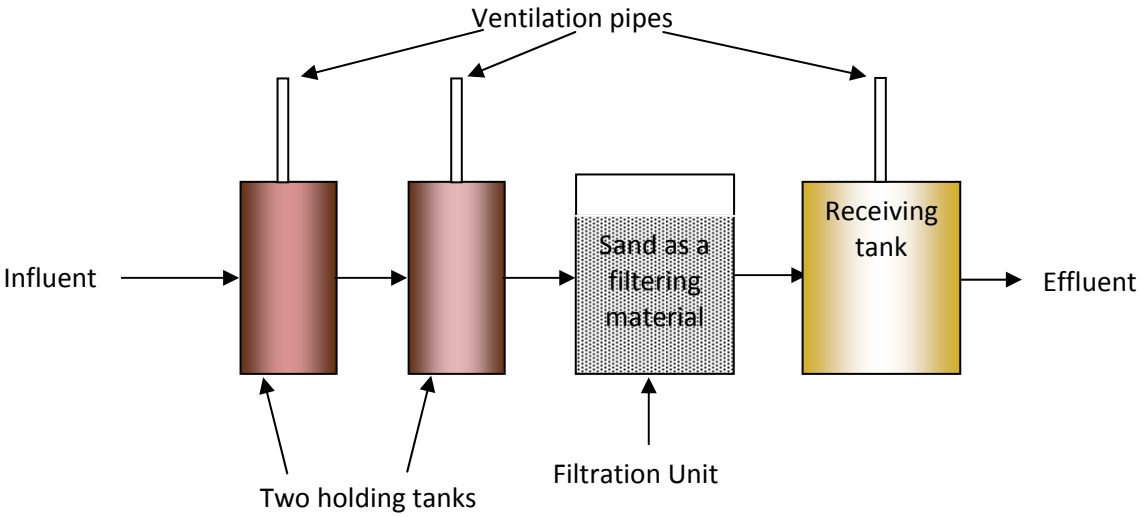


Table 1: Products, processes and materilas required in EPQD

SN.	Product	Process	Materials Required
1	Fresh milk	Pasteurization & Homogenization	Packaging material, milk & machines
2	Curd milk	Pasteurization, Homogenization & Fermentation	Packaging material, milk, machines & culture
3	Yoghourt	Pasteurisation, Homogenization & Fermentation	Packaging material, milk, milk powder, sugar machines & culture
4	cheese	Pasteurization, Cooling & fermentation	Milk, culture & press
5	Butter	Pasteurization, cooling & fermentation	Cream, salt & churn
6	UHT milk	Pasteurization & Homogenization	Packaging material, milk & machines
7	Milk powder	Spray dray	Milk & packaging material

Basing on the processes involved and material requirement the major environmental concern will be liquid waste and solid wastes that may affect the environment especially water resources.

The provided wastewater treatment plant may be efficient in the removal of SS solids but not much removal of BOD, nutrients and fats which are the major concern in the milk processing plant.

Solid wastes management should also be considered in the environmental management plan and should be well monitored and evaluated.

E4. Recommendations

Recommendations given in this report take into consideration of the existing milk processing plants and the proposed milk processing plants whenever necessary. It also includes any activities on cattle keeping as primary production.

E4.1. General Recommendations

Primary Producers

- Land degradation: restoring damaged land through soil conservation, better management of grazing systems and protection of sensitive areas
- Greenhouse gas emission: sustainable intensification of livestock and feed crop production to reduce carbon dioxide emission from deforestation and pasture degradation, improve manure management to cut methane and nitrogen emission
- Water pollution: better management of animal waste in industrial production units, better diets to improve nutrient absorption, improve manure management on croplands.
- Ministry in charge of environment to approve application for livestock keeping after a submitted property management plan which demonstrates the pasture improvement, farm planning, nutrient and waste management methods.
- Information, communication and education will play critical roles in enhancing a "willingness to act". With their strong and growing influence, consumers are likely to be the main source of commercial and political pressure to push the livestock sector into more sustainable forms.
- Current prices of land, water and feed resources used for cattle production do not reflect true scarcities, creating distortions that provide no incentive for efficiency resource use. "This leads to the overuse of the resources and to major inefficiencies in the production process,"[5] "future policies to protect the environment should have to introduce adequate market pricing for the main inputs"
- In the case of land, suggested include grazing fees, and better institutional arrangements for controlled and equitable access.
- Livestock's long shadow says environmental externalities, both negative and positive, need to be explicitly factored into the policy framework

Dairy Plants

Control of Dairy wastes

There have been a number of ideas about the need for waste prevention in the dairy industry (McKee, 1965). The most important reasons given were mainly:

- Direct money savings and

[5] Ibid 1

- Compliance with regulations.

Money saving have been reported to result from water use reductions, energy reductions, reduced losses of product and raw materials.

Compliance with regulations would include discharge to receiving streams and rivers.

Measures which have to be adopted to improve or reduce the environmental impacts from any dairy processing industries include:

In plant control measure: the control of dairy wastes requires many in- plant measures which combine to effectively reduce wastes:

1) See that the entire program has the active support of the management,
2) Install modern equipment and piping in order to reduce wastes,
3) the people working in the plant with the importance of reducing wastes
4) Secure the proper separation of wastes into process wastes, sanitary wastes and clean water,
5) Provide for recovery of by- products,
6) Select and install the waste disposal system best suited to the plant,
7) Follow through with good operation and maintenance in both the dairy plant and wastewater treatment plant.

Plant Management Improvement: Management is one key to the control of water resources and waste within any given dairy plant. It has been proven that a clear understanding of the relative role of engineering and management supervision in plant losses is needed by management. Management has to their part to have an effective water and waste control program in dairy processing. Management roles include:

1) Understanding water and waste control in dairy processing including the need of such program, the economic benefits that can be accrued and being cognizant of all interrelated factors,
2) Developing job descriptions for all plant personnel,
3) Providing an environment that permits supervisors to supervise waste management and
4) Utilizing a continuing education program.

Employee education program: an education program to employees is necessary to improve the water and waste management into a dairy processing industry. This program must emphasis on management knowledge and action by all employees. This also complies with Organic law of 2005 article 42 "*All public administrative organs, private institutions and individuals are obliged, in their capacity, to sensitise the population on environmental problems and to incorporate environmental educational programmes into their activity plan***"**

Segregation of dairy wastes: when planning renovating existing facilities, consideration should be given to the segregation of those sewers expected to receive high BOD wastewaters. These wastewaters could be restored to a tank for waste load equalizations or subjected to pre-treatment. These wastes include lubricants, milk from filling areas, solid particles from cottage and cheese operations (if applicable).

i) **By product and waste product utilization**: the dairy industry must be aware of the significance of using whey as a food or feed product to minimize pollution and to gain a profit from such operations.

ii) **Water use reduction**: the amount of water use will simultaneously reduce wastewater discharge. Among techniques used to reduce the amount of water there are:

1) Controlling water use at those stations with shut- off nozzles,

2) Water regulating valves used for refrigeration system where the volume of water needed can be influenced by the system head pressure.

3) Use of evaporative condensers for refrigeration systems to achieve as much as 95% water reduction when an evaporative condenser replaced a shell and tube condenser.

iii) **Proper design and utilization**: proper design of the plant and processes can afford material reduction in waste loads.

iv) **Environmental impacts Assessment (EIA) and Environmental Audit (EA)**

For the new plants to be constructed there is a need to conduct an EIA prior to plant construction as indicated in the organic law article ***67: "****Every project shall be subjected to environmental impact assessment, before obtaining authorisation for its implementation. This applies to programmes and policies that may affect the environment. An order of the Minister having environment in his or her attributions shall determine the list of projects mentioned in this organic law****"***

E4.2. Specific Recommendations

Existing Plants

In addition to the general measures recommended above the additional measures should be also taken into account.

- For Inyange plant: The new plant at Masaka after being operational it is necessary to undertake the environmental audit after at least 6 months to measure its performance so that any correction required can be addressed at the earliest stage as possible. Since the provided treatment units may sometimes not treat well the produced wastes.
- For Nyanza plant: Since the management has a plan to rehabilitate, modernize and expand the plant it will be necessary to conduct an environmental audit so that appropriate measures will be included in the rehabilitation plans.
- For Eastern province Quality Dairy plant: The proposed plant seem to be much based on filtration process and removal of BOD, COD, fats and nutrients may not be effectively removed hence there is a need to conduct an EA in at least 6 month after operation to make the necessary corrections whenever required at the earliest stage possible.
- It is necessary to take into account that treatment processes may differ depending on the processes and products produced in the diary plant but the main consideration should be on requirement for discharge standards and requirement for the receiving water standards which need to be developed at country level by Rwanda Bureau of Standards [RBS] in collaboration with Rwanda Environmental Management Authority [REMA].

2.3.11. Role of women in the development of dairy cows

After war and genocide of 1994, the number of women in the Rwandan population has increased significantly. This has a practical impact in terms of family farms, where many farms are now run by head of household females, and among these, about 95% depend on agriculture and livestock as principal sources of income.

Rwandan women now play a significant role in agricultural production for consumption and sale as well as in pastoral exploitation. This is in line of the national policy of food self-reliant by the Government of Rwanda. Although there are changes in the relationship between man and woman, in most cases, the man on his side remains the chief of cash crops (mainly represented by the coffee, tea and pyrethrum), the beans and banana (grown mainly for the production of banana wine), the woman do participate in these activities.

The woman is concerned first and foremost on the production of the basic elements of household food (beans, sweet potatoes, etc.), and directed the activities of clearing, plowing, sowing, weeding, harvesting, manuring the fields, etc. She also contributes to the maintenance of coffee or banana (weeding, mulch) and their harvesting and preparation.

Where women are sole heads of households, they organize and take charge of all agricultural activities. Thus, in recent years, new women's groups have emerged with a view to learn and develop skills to manage and control milk production.

In households with a man as a head, women still spend more time than men carrying out activities related to livestock production. They feed clean kraals, care for calve and clean up milk containers.

Regarding livestock, the women contribute mainly by the maintenance and care, they provide feeding, cleaning to livestock, etc. In case of efforts and hours spent, the woman is much more than the man in livestock associated activities. In peak cropping seasons, the workload of women increases further, apart from time they spend with animals, there is an additional long hours of work devoted to agricultural activities in the fields. In highly agricultural production areas which are advantaged in terms of good weather, areas of North West in particular, women on average spend 10 hours per day working throughout the year, besides time they spent serving livestock.

All the work related to crop production, weeding, hervesting, threshing, winnowing, all backbreaking tasks, rest on there shoulders.

Under the generally “enforced” stable feeding further more increase disadvantages experienced by rural women.

Importance of Rwandan women in farming activities

Shortly after the war and genocide, although a significant number of rural households were headed by a female, the number of cattle owned by these households was lower. Women were initially encouraged to participate in the farming of goats and poultry.

Thereafter, the Government of Rwanda came up with important steps in the context of gender balance, and women now occupies a privileged position in policy and development programs in the country in general and in the development of the dairy cattle in particular.

Thus, in the context of ensuring women's access to information on production techniques, PADEBL and its partners have paid special attention to women's participation in technical training to small farmers as well as to the community to ensure sustainability.

Women associations have been formed and supported on new methods of cultivation and grazing, which could enable them increase the yields.

As part of enabling women to access to factors of production, women and their associations have received particular attention in the distribution of livestock in the program "One cow To Every Poor Family" and in granting of bank loans.

All these efforts have increased the importance of Rwandan women in farming activities.

Nevertheless, there are challenges that limit women to maximize their integration into development of the dairy sector.

Persistence of restrictions on access to productive activities

The role of women in Rwandan livestock development has been dependent on the relationship with the land and material ownership, which is also determined by the deep cultural traditions although a law on succession and matrimonial property regimes to correct this situation has been enacted and implemented. According to custom, the husband remains in most cases the master of the family patrimony and the woman has no right of control over the assets of the household.

In this situation, married women rarely own land and animals, and the two are the principal agricultural and pastoral resources.

In terms of access to credit, the financial situation of rural women do not allow them to make themselves savings or income to manage the fruits of their work because only the husband has power over family income. In addition, the woman cannot claim to access credit without the consent of her husband.

Difficult access to information

The married women's responsibility also restricts them in terms of development. Indeed, they give themselves body and soul in order to care for their children and husbands.

The result is an overload that prevents them from getting time to participate in activities and training. This therefore limits their access to essential technical information.

In addition, the low level of education of most rural women is the limiting factor which should be addressed.

In the context of increasing women's participation in the development of the dairy sector, efforts must continue to be made because if the legislative and policy have changed in favor of women's right, the mentality has not followed with the same speed. Efforts should continue to sensitize the Rwandan society and to alleviate the overload of rural women (technical management of water, fodder and energy, etc.).

2.4. Orientations, policies and strategies

2.4.1. Constraints and measures to be taken

Even though the dairy industry has been growing for the past few years, it faces a number of constraints which are major challenges to development in general and to productivity in particular. This study has made it possible to sum up such constraints as follows:

Weak mastery of livestock keeping norms in livestock management and feeding

A lot of livestock keepers maintain their cows on basis of the traditional knowledge and hardly think about improving the techniques. It is a problem in that those who invest in dairy livestock are not always professional breeders. Some of them own a lot of farms but they leave the farms to the care of the herdsmen and they rarely make a follow-up, as if for them, it is simply enough to give fodder to livestock. This lack of mastery of the norms is found especially in livestock feeding.

First of all, in most cases, the food ration is insufficient. Many are small breeders who associate livestock breeding with agriculture. In order to feed their animals, they use residues of their harvest and the grass grown on erosion control bankers due to lack of sufficient land to grow fodder. The problem of quantity worsens during the dry season especially as the farmers have not mastered fodder conservation techniques.

In addition to the insufficient quantity of fodder, there is also the problem of its quality so that the food ration of livestock is rarely balanced, the breeders feed their animals only with gramineous grass. The result is that the milk produced is not only of poor quality but of little quantity as well.

In general, the breeders do not have food concentrates that are found in rural areas and very expensive in towns. Indeed, the prices of these products are affected by the generalized inflation in the sector of food commodities for human consumption. This has a negative impact on the productivity of cattle. Even if the quantity of milk produced in the country has increased considerably, the production per animal has not increased at the same rate.

Poor performance of dairy cattle

The quality of cows that were bought by farmers or received from donors does not always conform to their expectations. Quite often, a farmer thinks (s)he has acquired a high performance cow but without being sure of its genetic potential or its origin. In many cases, it is for instance difficult to distinguish a cross-breed from a pure breed. And even when one knows that a cow is a cross-breed, one does not know the breed involved in the crossing. In addition to this there is the poor performance by artificial insemination services. Not only the inseminators are insufficient in number but the rates of successful insemination are still too low. On the whole, out of of 100 inseminated cows, less than 50% conceive at first service.

Efficient access of milk to the market

The reality is that all the milk produced in Rwanda doesn't reach the market. A small quantity reaches the market whereas the largest proportion is consumed on the farm or is thrown away after it has gone bad. This is in part due to the fact that farmers live far from the consumption centers and to the insufficiency of means of transport from the production areas to the market. In most cases, the transportation of milk is done by peddlers who use bicycles as a means of transport and who often buy milk at a very low price. Under such circumstances, there is no way the farmer can appropriately benefit from his/her work.

Poor quality of milk

It has been observed that the milk supplied to the consumer by the farmers and by the dairies rarely meets the required quality standards. Often, the farmers ignore the required standards of hygiene under which they must handle milk, maybe due to ignorance or to lack of means. That is the case of those who lack clean water for personal hygiene and for the cleanliness of the containers destined for the conservation or the transportation of milk. The quality of milk also deteriorates due to bad transport conditions over very long distances under high temperatures and on very poor roads.

It should equally be noted that the quality of milk is poor in dairies which lack the required technology to guarantee such quality.

Besides the quantity of micro organism which can be found in milk, some producers deliberately change the composition of milk by adding water of flour.

Insufficiency of veterinary services in the vicinity

In rural areas, veterinary services are inadequate. In case of disease, there are not enough veterinarians to intervene timely to save the animals. When one calls a veterinarian, he/she often arrives too late and/or without equipment or the necessary material. But, due to the farmers' weak purchasing power and to the weak geographical concentration of the livestock, the veterinarians and private pharmacists prefer settling in urban areas to the detriment of the rural areas.

Insufficiency of milk for the dairies

The dairies (for example Inyange) function below their capacities. The managers explain that this is because they often lack raw milk in sufficient quantity and of good quality. This situation worsens during the dry season whereas milk is abundant during the rainy seasons. Livestock food decreases during dry season. The insufficiency of milk at the dairies is also due to the fact that the cost price they offer is often low. But, during the dry season, raw milk is supplied to the small distributors. The latter have more room for maneuver to ask for a more interesting price since they meet lower costs in deciding the cost price of milk.

Illiteracy and weak organization among farmers

The rate of illiteracy limits the effects of popularization and coordination of the farmers.
This problem is made worse by the low level of organization of these breeders. Whereas there should be an intermediate structure that facilitates communication between the providers of popularization services and the ineptude of farmers, the latter are poorly organized and have not yet properly grasped the management of the professional or cooperative organizations. The few farmers' organizations and cooperatives still need organizational backing.

2.4.2. Strategic Choices

In an economic liberalization context, it is first of all up to the farmers and their economic backers in the sub-sector to pinpoint the constraints they are confronted with. However, the privatization policy which the state has embarked upon did not entirely mean it abdicated its responsibility towards livestock development which, under the present development conditions, goes beyond merely setting up a favourable legislative environment. Thus, the state played a major role among the farming populations, through popularizing the practices necessary for the improvement of productivity and supporting the setting up of the vital infrastructures for enhancing production and marketing. Usiing the available resources, the state concentrated its efforts towards removing the major bottlenecks that affect the sub sector's development and against which it could act efficiently, rather than trying to intervene indiscriminately into all identified constraints.

But the findings of this survey show that a lot of constraints do exit and point out the correct direction to follow to ensure a maximum of impact on the development of the milk chain.

Improvement of dairy productivity

The intensification of livestock farming therefore remains [not] only an essential condition for the sub sector's survival but also the way to ensure its involvement in meeting the population's needs within the framework of food security. Conscious of this reality of conception in livestock development, the state opted for the specialization that dictates that the bovine livestock development must be oriented towards dairy production.

Genetic improvement proved a must for improving the output of the dairy cattle. In order to concretize this genetic improvement, cross-bred and pure stock cattle have been imported and bulls of those breeds have been crossed with local cattle.

Nevertheless, this was done haphazardly and there is no criterion that can prove the quality of imported cattle called "pure breed" and that of "cross-breeds" because before importing them, the importers did not care to verify the birth certificate of the heifer or the bull. The same can be said of the crossing. To remedy this situation, RARDA should intensify the follow-up and the evaluation of the activities of artificial insemination as well as those of the importation of animals meant for genetic improvement. All records of these activities should be kept as management necessity and for the future selection tool.

Another finding is that among the main factors limiting animal production in Rwanda is feeding both quantitatively and qualitatively. Therefore, some special programmes should be supported to remove this constraint and increase the productivity of the subsector. Thus, in order to improve the animals' feeding conditions, there should be no let-up in an intervention at least at four levels: management and improvement of grazing areas, intensification of the fodder cultivation, and production of concentrates at affordable prices and provision of water.

It is also necessary to concentrate on the improvement of animal health, on the control of dieases if one wants to promote the breeding of highly productive animals through genetic improvement or the full exploitation of exotic and pure breeds. Indeed, the animals are as sensitive as they are productive and the loss of one among them constitutes an important opportunity cost. Programmes for combating all animal diseases must be reinforced in order to protect the

livestock and to improve their productivity. There is need for more and better equipped veterinarians. Support to the privatization of the veterinary medicine must be assured. RARDA should also ensure the full functioning of the satellite laboratories equipped by PADEBL in order to ensure the efficiency of the teams working with the farmers. RARDA must also assure a continuous and efficient training in epidemiological control at sector and district levels.

Complying with the potential capacity of bovine population

The llivestock master plan elaborated in 1998 had recommended that the Rwandan bovine population should not pass 500 000 heads. However, this survey shows that following the country's different development programmes, the number of heads of cattle currently stands at more than one million. This means that the Rwandan territory already supports twice more than its potential capacity.

That seems a paradox when one knows that the scarcity of arable land constitutes a major constraint to agricultural development in general, and to livestock development in particular. That requires rather a genetic improvement in order to have more productive animals rather than relying on growing numbers that will lead to a less productive livestock. According to this scheme, MINAGRI projects the bovine population to 752 558 heads in 2005, 680 253 heads in 2010 and 505 816 heads in 2020 respectively. For milk production, this projection will enable the country to attain production of 483 693 tons in 2010.

Integrating livestock farming into the market economy

The viability of the intensification measures is only possible within the framework of integrating livestock farming into the market economy and therefore, of the availability of well structured marketing networks. Such networks will encourage the farmers currently involved in autoconsumption and are no longer stimulated into increasing milk production. It will be necessary to encourage the multiplication and the equipment of milk collection and cooling centers that are easily accessible to the majority of the producers and easy to manage. These centers will also serve as support points for the setting up of services to the farmers, such as the distribution of inputs and artificial insemination facilities.

These centers are not only going to serve as milk collection points, but they will also serve as quality control units for the milk from the farm. It will enable to control the price according to this quality. By paying the producer according to the quality of his/her milk, she/he will be motivated to taking greater care of his/her product.

Improving the quality of milk

As mentioned above, more than 90% of milk produced in Rwanda is sold through informal circuits. The norms of hygiene of the milk sold on the local market often leave a lot to be desired due to bacterial contamination. This poor quality is the result of the bad conditions of production, of the climatic conditions favorable to a fast multiplication of bacteria, of lack of power for cooling milk, of the lack of suitable facilities for pasteurization and neglect of measures of hygiene.

The complexity existing in the dairy sub-sector and its links with public health risks remains a source of great concern for East Africa in general, and of the Rwandan authorities in particular. Lack of knowledge of basic hygiene is also a major constraint to an increase in quality in the milk trade. These constraints are linked to the socioeconomic and natural environment in which the milk industry in Rwanda evolves.

Faced with such a situation, it is not only important to establish a national system of quality control but also it is necessary to carry out education campaigns for all intervening parties on the improvement of the quality of milk and dairy products.

Reinforcing the organizations of milk producers

The mastery of livestock norms by the producers, on caring for and feeding livestock is a factor for success and development of the milk chain.

This mastery implies information to the producers on all the necessary conditions for carrying through a productive livestock. But when the State is not involved, an efficient popularization campaign can be possible only if there exist communication structures between the producer and the structures of popularization.

Otherwise, solving various problems met by the producers is only easy in a context of solidarity between these producers. It is within this spirit of solidarity that professional organizations and producers' cooperatives were put in place and are increasing in numbers. However, all these organizations need various kinds of support to reinforce their organizational and institutional capacities, making them more efficient.

Abiding by the country's natural and social environment

The recommendations related to the social and environmental issues, join in part or in totality, the "technical" recommendations formulated in the Master Plan. They all aim at achieving a better productivity and management of resources, and in the process, link up the livestock activities with the country's natural and social environment. Therefore, the environment cannot be approached separately and achieving a specific aspect designed to implement various recommendations on the environment, in isolation, could only have a very limited impact on the chain.

In fact, environmental issues must be approached in a global way and should be integrated transversally into the definition and the execution of the various interventions recommended in the field. To "think globally, to act locally ", such should be the approach to recommend. Thus, the adoption of new practices, norms and realistic and practical regulations will at a go, provide a setting for "technical" and "environmental" intervention. The content of this setting should be the subject of a communication plan for the local intervening parties to ensure its transmission to the farmers.

2.5. Proposal Project

2.5.1. Justification of the Project

90% of Rwanda is made up of agricultural households and about 60% of these households practice one type of livestock keeping, meaning that the subsector is very important and that it occupies the second place after agriculture. It is a country that is suitable to livestock keeping in spite of the high occurence of tick-linked diseases and there is a diversity of quite favourable bioclimatic zones. Besides, the Rwandan populations have know-how in the management of pastoral resources.

In the area of animal production, the milk chain could meet at the same time the needs of domestic consumption and be helpful in the reduction of poverty. This rich chain generates a lot of income and jobs.

In Rwanda, despite the serious consequences of wars and the genocide on various rural production systems, the livestock production sub-sector remains traditional. The Ankole cattle, which is said to be a cross-breed between the Zebu (bos indicus) and taurine races (bos taurus) is among other things one of the important proofs of the pastoral history of the region. Rwanda is a country with a strong agro-pastoral tradition and the pressure of modern techniques of intensification of livestock production recommends that the essential should center on humans for economic development.

Since 1994, MINAGRI has put in a lot of effort through some projects and institutions, so much so that the livestock production sub-sector is doing fairly well both at beef and milk production. The

extent of the activities of the new project whose approach is « make or buy » must aim at the development of the milk chain in general, and the processing of milk in particular, through the gradual and realistic transformation of extensive and semi-intensive systems into sustainable intensive production systems, taking population pressure into account.

The project would be an important tool in up-grading the value of milk and milk products, but also in integrating livestock production into monetised economy. Economically, this project should contribute towards improving producers' incomes while lowering consumer prices due to productivity profits at all levels of the milk chain.

All that will be made easier by a gradual change of mentality among concerned economic operators who are already facing the challenges imposed by economic liberalization and who no longer rely on the State to solve all their problems.

The proposed project will involve a series of concrete actions designed to remove all the bottlenecks which hamper the development if the milk chain. It will take into account all the considerations expressed, especially on animal production, research and extension, and marketing. For this reason, the development of this chain will be possible only if these considerations will have been achieved globally and together.

The proposed interventions aim at removing the main obstacles to animal productivity, at speeding up the integration of the milk chain into the market economy and at empowering the farmers. To achieve this, emphasis must be put on the following:

- Developing food resources
- Creating livestock watering points
- Access to private veterinary services
- Improving the performance of breeds
- Improving the quality of milk
- Strengthening producers' organizations
- Strengthening the guarantee fund

2.5.2. Project Objectives

According to the stated orientations in the up-dated master plan, the project's main objective is contributing to the improvement of food security and poverty reduction by first of all supplying 6 grammes of protein per person per day by 2020, then by increasing livestock's contribution to the GDP by at least 8% also by the year 2020.

Its specific objectives are:

- To enhance quality of dairy culture in the country;
- To avail animal feeds in terms of quality and quantity at affordable prices;
- To enhance promotion of farmers' organizations;
- To enhance production of high quality milk;
- To create awareness among the farmers with regard to milk handling;
- To reinforce the marketing of milk and milk products;
- To integrate environmental conservation in the milk chain;
- To create conducive environment for investors;
- To integrate gender issues in the milk chain;
- To enhance capacity in terms of Human resource.

This project must first of all contribute in reducing by half the number of the poor in Rwanda by the year 2015, and then lead the livestock sub-sector into contributing in earning foreign exchange through the exportation of beef and bovine products, notably milk and milk products.

The proposed project will fist sustain the gains made by PADEBL, then focus its activities on the processing and marketing of milk and finally get fully involved in the « Girinka » programme.

2.5.3. Description of the Project

This project has to be realized to ensure that the activities of PADEBL are continued. The experience indicates that some of the activities in the milk chain are initiated and entirely depending on PADEBL. The objectives of the project are described below.

To enhance quality of dairy culture in the country

Genetic improvement

The genetic improvement programme has been essentially hinged on artificial insemination but the latter's rate of success is thought to be too low. In order to improve the succes rate, the activities of CNIA will be reinforced, notably through a better technical and practical training programme of inseminators in Rwanda and abroad and the supply of the necessary supplementary equipments. It also inherited poor technical technical means at the disposal of inseminators. Moreover, the project will particularly emphasise the sensitization of livestock breeders to the new technology through information sessions at peasant groupings.

On the practical side, insemination services will be organzied around milk collection and cooling centres, which will be the focal points of dairy farmers. In order to lower the costs, the insemination shall be carried out when the cows will be on heat naturally, but vasectomized bulls shall be used to detect cows on heat that would not be detected visually. The follow up in the field will enable to verify the competence of inseminators and to proceed to the laying off of those whose rate of success will be too low. Besides, the CNIA will ensure the follow up of artificial insemination products in order to maximize their impact on the milieu.

Besides artificial insemination services, a system of genetic control must be set up in order to make a record of identification of imported animals thereby gurantee sufficient information to the farmers wishing to acquire high performance animals.

Control of the main animal diseases

Thanks to the efforts executed, diseases such as the foot-and-mouth disease seem to have been controlled. However, Rwanda bovine livestock is affected by several diseases which lead to an important lowering of productivity and hence considerable economic loss for the breeders and the national economy at large. Such diseases also constitute factors that limit the breeding of exotic species, which are more productive but also more sensitive. That is why their control is a must, if high performance livestock is to be developed in Rwanda.

In order to ensure the modernization of animal breeding, the project will emphasize the maintenance of the following measures:

- Organizing vaccination campaigns against rinderpest, contagious bovine pleuropneumonia (excluding the taurine which are too sensitive to the vaccine presently in use); brucellosis, anthrax and avian diseases.
- Reinforcing the anti-tick campaign programme with the collaboration of peasant groups.
- Setting up quarantine stations.

In order to eradicate pleuropneumonia and brucellosis, and avoid the reapperance of rinderpest, the participation of animal breeders in vaccination campaigns shall be compulsory and their financial contribution shall be required. The intervention strategy shall emphasize the sensitization of breeders on the merits of the measures that have been recommended as on their obligations thereto. The vaccinated animals shall be nicked and heavy sanctions including

slaughter of animals shall be taken against non-compliance. It is indeed necessary to apply strict measures if such diseases are to be eradicated.

Sector and district veterinarians should be sufficiently equiped to give them sufficient mobility and adequate and effective capacity of intervention.

Access to private veterinary services

The privatization of veterinary medicine is conditioned by the opportunity for veterinarians to live off their profession decently. At present, the profitability of animal breeding is not sufficient to meet the costs of interventions by competent professionals. On the other hand, the development of profitable animal breeding requires the services of competent veterinarians.

In order to break the vicious circle in which privatization finds itself, the project will subsidize partially and degressively veterinary activities carried out within the framework of the recommended activities. That kind of subtle subsidy will contribute towards (i) developing business links between practitioners and animal breeders or groups of animal breeders, the latter having to contribute to the costs, (ii) provide to the breeders quality services which the State is no longer in a position to offer, (iii) ensure the practitioners an income that enables them to live off their profession long enough so that the breeds (especially the bovine) may generate adequate profit and (iv) ensure a sustainable privatization process.

The subsidized services will cover not only care for the livestock itself but also certain extension and training activities of highly productive peasant groups and livestock breeding. The preparation of the list of veterinarians who can participate in the project will be given to the Rwandese Association of Veterinary Doctors (RAVD) which will accredit the candidates and control the veterinary practice of their choice, thereby maintaining a healthy competetition within the profession.

For zero grazing and semi grazing it is at least four cows per hectare and two cows per hectare respectively. However, the range in savanna regions is one cow per hectare. High altitude like Gishwati, two cows per hectare.

To avail animal feeds in terms of quality and quantity at affordable prices

Animal feeding constitutes the main limiting factor to the intensification of animal breeding, especially during dry season. To counter this constraint, the project should continue to support the breeders on a national scale in the production of forage crops and in stocking fodder, either by haymaking, or by ensilage. It will therefore consist of:

- Sensitizing the breeders on the animals' feeding needs;
- Popularizing pasture improvement techniques and fodder cultures by the breeders organized in groupings (or individual large scale breeders);
- Availing the latter with fodder seeds adapted to their zone of production; and
- Counselling and training individual producers in the execution work to be undertaken.

In large pastureland zones allocated beforehand, the popularization efforts will first consist in improving pastures, notably through the eradication of weeds and sowing forage legumes. Thereafter, the efforts will be concentrated on the feeding of ruminants with cultivated fodder, a necessary stage for stabled management. It will be necessary to teach the breeders the techniques of fodder conservation since there is overproduction during the rainy season which would be better conserved for distribution during dry season. The quantities produced by exploitation are often too limited to be stored but one can make hay from excess fodder produced. Demonstrations shall be organized in peasant environment during the initial years in order to convince the breeders on the merit of these techniques. Finally, the project will be in charge of some tests on the conversion of rice straw and roughages by urea treatment.

Besides the improvement the feed ration, some strategies must be adopted to encourage the production of concentrates. These strategies must be centered on the availability of the raw materials, the setting up of production units with a large capacity of production, the setting up of the facilities to lower the price of the food stuffs.

Creation of livestock watering points

In the dry areas, the insufficiency of water points constitutes a major bottleneck neck to the development of animal breeding, particularly cattle breeding. During the dry season, livestock must often cover very long distances to drink, which increases stress on the animals that are already confronted with lack of fodder resources and provokes more or less important mortalities depending on seasons. The intensification of dairy cattle breeding under such conditions is obviously unthinkable.

In order to remedy such a situation, the project will have to provide for the multiplication and the strengthening of valley dams to complement the natural sources for livestock drinking points already existing in these zones. The creation of these water points will enable to minimize the movement of livestock, will encourage the livestock breeders to become sedentary and will limit the damage caused by excessive stamping on the ground in these areas. The receiving reservoir will be equiped with troughs supplied by gravity so that livestock doesn't contaminate water and that the quality of the environment is not affected. Besides, maintenance work will be minimized by the simplicity of the conception of the structures.

It will equally be necessary to teach livestock breeders new rain water pondage techniques. This source of water must be exploited even in humid areas. It has to be recognized that water collected can not only be used to feed livestock, but can also be used to keep clean both the environment and the tools used in livestock keeping.

To enhance promotion of farmers' organizations

The weak level of organization of the farmers is one of the most serious constraints to the development of livestock breeding. Without organziational relay, the capacity to reach the breeders is strongly compromised by the atomization of production. Without functional farmers' associations, extension services, inputs suppliers and the various service providers must join a multitude of small farmers directly rather than go to a number limited of representatives. The effect of such a situation is to limit the services offered and to increase their costs. It also hampers the development of lasting relations between private suppliers and farmers because of the weak profitability of the operations.

The project will also focus on reinforcing the various up-coming cooperatives as well as the existing professional organizations so that they are effective both on the organizational and on the institutional levels. Because these are the organizations that are going to take part in the setting up of all services destined to the farmers, to ensure the management and the follow-up of the necessary interventions for the development of the milk chain. Thus, the setting up of the livestock watering points, of the spray races, the veterinary pharmacies and the milk collection and cooling centres will be conditional to the existence of a functional and representative grouping of the farmers who use them.

Except for the sensitization activities designed to make the interventions known, the project won't intervene directly in the formation of the groupings, leaving the local dynamics to express themselves. Given the high illiteracy rate in the rural areas, it will thereafter be necessary to encourage the existing structures to regroup and to professionalize themselves by hiring a competent staff capable of ensuring a healthy management of the services offered to the members and of increasing their capacity of representation within the sector. After some time, these cooperatives will be given support to constitute larger networks.

To enhance production of high quality milk

The absence of a well structured network of milk collection among the producers constitutes the main bottleneck to the development of the dairy cattle breeding in Rwanda. It is indeed, difficult to convince the breeder to invest in the intensification of dairy production if there are no outlets for his/her production. But this aspect has too often been ignored in the past; the services of the state have been essentially concentrated on the technical aspects of production. Although the local production can satisfy the domestic market, much of the milk produced doesn't reach the market, due to lack of an organized collection network with enough capacity to collect the supply.

To correct this situation, the state will finance or will encourage the financing of the setting up of a sufficient number of small collection and cooling centres spread across the livestock concentrations zones in the country and located in places that are easily accessible to traders. The criteria for the location of every centre will include the capacity to allow the producers to deliver their production within acceptable time limits so that the conditions of the quality of the milk may be maintained. It is agreed that milk should be cooled within two hours after milking. Although dearer, the choice of small cooling centres rather than large ones as a solution to the problems of milk collection is justified by several considerations: the need to minimize the distances to be covered by the producers so that they may themselves assume the responsibility of delivering their milk, the need to store milk in a rural environment while awaiting its evacuation to the markets , the will to rely on private circuits to ensure transportation to the consumption centres, and the improvement of quality and health norms. In fact, the recommended strategy banks on two elements. On the one hand, on the milieu's capacity to organize the milk collection: indeed, the previous experience demonstrated that the setting up of a collection structure requires a logistical organization that is hard to manage and therefore expensive, due to the small quantities marketed by the producers and their being relatively far apart. On the other hand, on the existence of private operators eager to collect cooled milk at the collection centres and carry it consumer markets, as is done with the collection of imported milk.

Setting up milk collection centres will not suffice. There will be need, in addition, of organization in their management so as to ensure that the use of the infrastructure may be efficient and to avoid usable units such as we have today. Indeed one can see that among the existing collection centres, there are some which do not receive sufficient milk, as the following table shows.

Table 62: Existing Milk Collection Centers in 2008 and their capacity

SN	Center	District	Date	Financing	Capacity [L]	Milk/ day [L]	% of used Capacity
1.	Matimba	Nyagatare	2005	PADEBL	2 000	2 000	100
2.	Kirehe	Nyagatare	2006	PADEBL	4 300	3 100	72
3.	Mbare	Nyagatare	2004	PADEBL	5 200	4 200	81
4.	Ndama	Nyagatare	2005	PADEBL	3 289	2 140	65
5.	Ruhuha	Nyagatare	2005	PADEBL	2 150	1 300	60
6.	Nyagatare	Nyagatare	-	District of Nyagatare	3 200	3 200	100
7.	Gacundezi	Nyagatare	1997	PNUD	3 200	2 700	84
8.	Ryabega	Nyagatare	2006	Cooperative of Producers	3 200	1 700	53
9.	Buhabwa	Kayonza	2003	PADEBL	2 000	1 700	85
10.	Rwisirabo	Kayonza	2005	PADBEL	2 150	1 700	79
11.	Kayonza	Kayonza	2006	Gakuba Damascene	2 300	1 030	45
12.	Nyarubuye	Kirehe	2005	PADEBL	2 500	100	4

SN	Center	District	Date	Financing	Capacity [L]	Milk/ day [L]	% of used Capacity
13.	Mbyo	Bugesera	*2001*	Handicap International	1 500	300	20
14.	Rugobagoba	Kamonyi	2005	PADEBL	2 000	3 200	160
15.	Kinazi	Ruhango	2005	PADEBL	2 000	800	40
16.	Buhanda	Ruhango	2005	PADEBL	2 000	0	0
17.	Rurangazi	Nyanza	2005	PADEBL	2 250	800	36
18.	Kageyo	Gicumbi	2004	PADEBL	2 000	5 000	250
19.	Byumba	Gicumbi	-	-	-	-	
20.	Musanze	Musanze	2002	PADEBL	2 015	2 015	100
21.	Kajevuba	Rulindo	2001	Handicap International	1 500	0	0
22.	Mizingo	Rubavu	2004	PADEBL	2 000	3 000	150
23.	Rugende	Gasabo	2002	Handicap International	1 500	200	13

Collection centres proposed by the mission survey

The identification of locations for setting up milk collection centres [MCC] is based on the fact that after milking, the milk must reach the collection centre within two (2) hours if it has to maintain its whole quality.

Thus, the locations chosen according to provinces for milk pools and sub-pools are recorded in Annex 16.

With the improvement of the market supply in quality local fresh milk, i twill be easier for the private sponsors to contemplate setting up modern dairies that will supply the Rwandese market and even milk products processing markets of all kinds, including UHT milk.

Besides setting up milk collection and cooling centres, a national quality control system must be established in order to enable milk processing units to comply with quality norms of dairy products.

At the same time, information and education activities will be supported to allow various intervening parties in the milk chain to embrace milk hygiene oriented conduct.

Milk Collection Point

To easy milk collection and transportation to MCC, milk points should be established where milk in neighbouring villages will be collected and tested.

From there a representative of the MCC will also test and then transport mmilk to the MCC.

Only milk which passed the test should be accepted by the milk point personnel. This system will encourage production of good quality milk.

To create conducive environment for investors

The establishment of a guarantee fund has facilitated credit to livestock breeding oriented projects. Before the establishment of the guarantee fund, access to credit was a major constraint for a large number of private sponsors whose projects were rejected for lack of sufficient bank guarantee even if when those economically viable projects were likely to have an important impact on the development of the milk chain.

In order to counter this constraint, a guarantee fund was established to support loan applications from local banking institutions. The funds used to cover financial risk up to 50% of the loan

balance, under arrangement with banking institutions such Rwanda Development Bank, the People's Bank of Rwanda.

Investment opportunities are still abundant in the milk chain: buying of inputs, veterinary services, purchase of equipment for handling milk, milk transport, setting up of milk collection and cooling centres.

All these point to the need to maintain and strengthen the guarantee fund in order to facilitate access to credit for investors.

Nevertheless, the system of management of the loan awarding process within the fund sometimes prejudices parties to the loan contract who are the farmers and the bank, at least as far as the People's Bank is concerned. Thus, the breeders complain of the poor quality of cattle distributed to them. Indeed, the project provides for breeders to organize themselves in groups in order to lodge their request for a loan from the People's Bank. Local authorities are supposed to support them in that organization. Equally, the RARDA is supposed to ensure the quality and the health of cattle supplied to the breeders. However, some local authorities undertake to buy cattle without the participation of the breeders and to supply the cattle to the breeders without RARDA's consent. This ends in loss of cattle which die, in the delay in cattle multiplication or even sterility; all to the breeder's, the bank's and the guarantee fund's detriment.

To reinforce the marketing of milk and milk products

Marketing has to include public awareness on the importance of consumption of processed milk and milk products. It has been recommended by WHO that a person needs take two hundred liters of milk per year.

At some points in the milk chain, investors have to come in to increase productivity and hence limit importation of milk and milk products. Excess milk products produced in the country should enter the export market.

Marketing should consider purchasing power of consumers in order to increase consumption. This can be achieved by either reducing VAT on milk processing plants or by subsiding on the animal feeds.

To integrate environmental conservation in the milk chain

As far as environment is concerned, the animals kept per peace of land should be maintained in such a way that does not degrade environment.

All the stakeholders in the milk chain should take into account of the environmental conservation and pollution prevention in their daily activities.

To integrate gender issues in the milk chain

It has been shown that in the milk chain women are involved in many activities such as cleaning up kraals, milking ustensils, feeding calves, availing water to the animals, etc. Therefore, the milk chain activities should take into account of financial empowerment for women.

To enhance capacity in terms of Human resource

It has been shown that there is shortage of skilled people in milk chain.For example majority of the farmers practise mainly the traditional ways ofcattle keeping.It has been observed even at the processing level that there is deficiency of technicians.Therefore more training is highly needed.

From milking to processing, milk passes from the hands of breeders, some of whom have no notion of hygiene, to those of the staff of the plant via those of the transporters. The workers are recruited locally, most of whom with a very low level of education. It is not easy to find dairy technologists as the country has no industrial training tradition, particularly dairy industry.

A demanding selection and an intensive training programme must be put into place to train a sufficiently competent staff.

The mission survey was able to identify the following posts whose terms of reference are in Appendix 18.

Post
Cheese curing officer
Team leader, butter making
Line conductor in milk processing
Machine operator in milk processing
Director, quality control in dairy industry
Engineer, research and development
Productive operator, cheese making
Dairy worker
Coagulator pilot
Pilot, automated plant
Pilot, concentration and drying plant
Supervisor, milk control
Suprvisor, production
Technician, milk analysis laboratory
Technician, bacteriological control
Technician, milk control
Technician, cheese making

3. BUSINESS PLANS

3.1. Traditionals Dairy Pools

This study prepared a business plan in a separate document for each of dairy unit in the four traditional dairy pools [Nyanza, Inyange, Nyagatare and Gishwati].

3.2. Proposal Dairy Pools

The mission study proposes that business plans be prepared for the dairy units of the proposed four dairy pools [Ngoma, Nyirangarama, Rusizi and Karongi].

3.3. Milk Collection Center

Plant intends to critically focus on developing a trust-based network supported by contracts throughout the supply chain and establish this network as one of its core competitive advantages.

Milk Collection Centers

Milk collection centers are not only a critical quality point in the milk supply chain but a potential knowledge base for farmers and logistic hub for the supply side network.

Adequate capacity will be installed at all areas with potential high milk volumes supported by contracts with farmers renewable after a minimum of two business cycles.

Distribution Centers and Retail Outlets

A production mix focused on reducing inventory within the supply chain and with capabilities for demand and supply sensing will be supported by a very capable distribution infrastructure and an ICT for strategic supply chain network optimisation and enterprise resource planning.

This will enhance efforts for the quality chain, link operations to sales and evaluate business processes.

Under the better-run schemes, milk is collected both in the morning and evening and rapidly transported to the cooling and/or processing depot. This prevents the problem of preserving evening milk overnight. The producers carry their milk to the Milk Collection Centre where it is measured and tested for payment. Regular testing of each milk supply is preferred. A combination of simple tests and periodic sampling for laboratory complete testing may alternatively be used. Payment may be made either immediately or periodically.

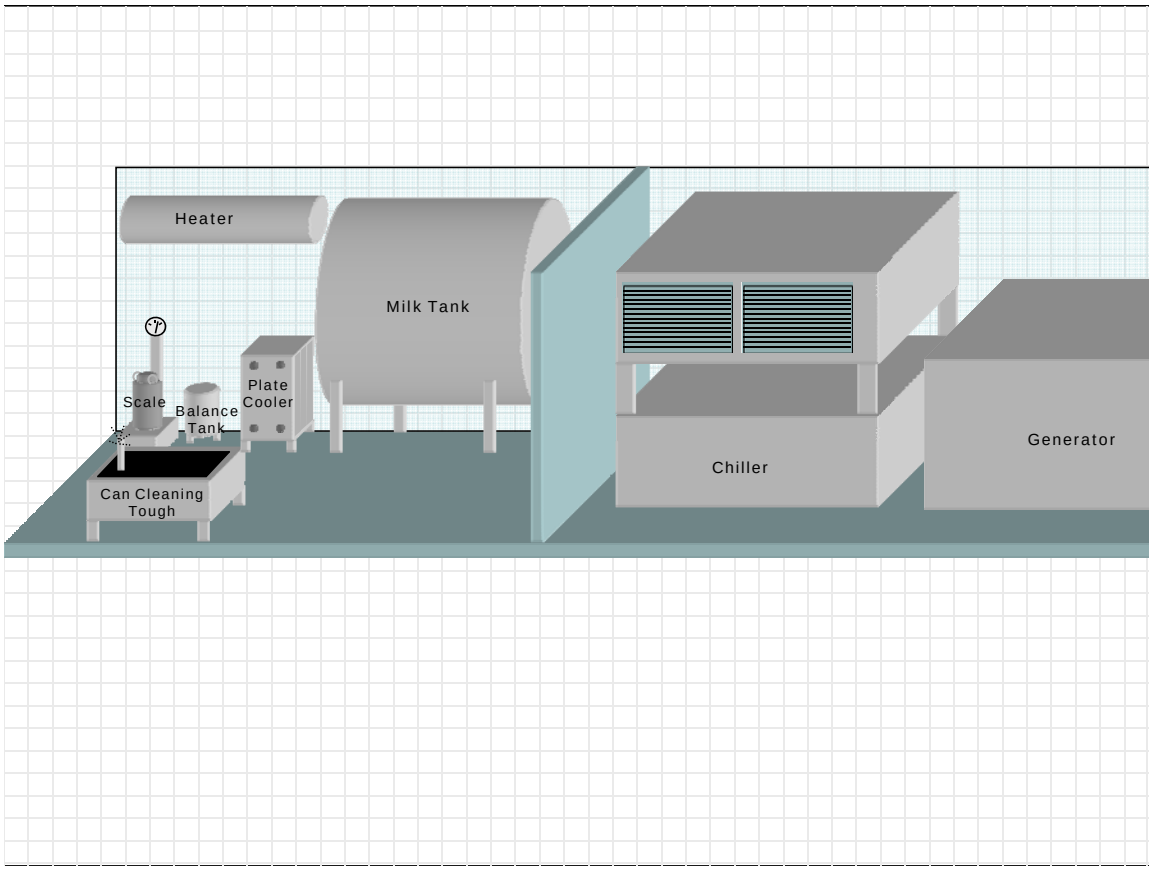
The aim is to collect sufficient milk in several churns to justify the call for a collection vehicle. The milk is then carried immediately to a plant where it is again tested, immediately chilled, pasteurised and either sent on to a further more distant market, packaged for distribution or processed. The system depends upon a rapid movement of only 2 hours between milking and the time of arrival at the plant. Good quality control is essential throughout.

Chilling Unit

The mission proposes the following Chilling unit for all the milk collection centres.

It works on the following principle: Milk is pumped through the cold exchanger and gets chilled instantly; this machine is more efficient because it maintains milk at the same temperature in the cooler as milk is chilled before it enters the tank.

The advantage the Chilling unit has is that it cools the milk to between 3 and 4°C, and the additional milk introduced flows back into the tank under that temperature, and that avoids the temperature changes which can negatively affect the quality of the milk.



Observations

1. The milk is brought to the collection centre in milk cans and other unhygienic plastic jerricans, by the small scale milk producers.
2. The containers are weighed and then stored at ambient temperature awaiting transportation to the dairy. There can be a significant time delay in the milk arriving at the processing plant.
3. The cleaning of some of the jerricans is carried out at the collection centre while the rest are cleaned at the dairy.
4. The milk is not cooled at the collection centre.
5. There is currently no power available at some collection centres; some of them are using generators which is expensive to run.
6. The pasteuriser temperature at the some Dairy indicates that plates may be burnt possibly due to inconsistent quality of the milk received. Therefore the milk might not be processed optimally.

Recommendation

1. The milk should be cooled instantly between 3 and 4 degrees Celsius upon receipt at the Collection centre by using Chilling Unit.

2. The milk should be transported to the Dairy using an insulated tank on the back of a vehicle. This tank should be cleaned at the Dairy. This will ensure that more milk cans are available for the milk producers.
3. These cans should be correctly washed at the collection centre.
4. The milk should be subjected to a quick screening at the collection centre to indicate whether the quality is acceptable or not prior to chilling.
5. The system i.e. pipe work, plate heat exchange and tank must be correctly cleaned daily to eliminate contamination.
6. The power system must automatically switch over from mains to generator and vice versa.
7. The floor must be built in such way that it allows easy drainage.
8. The capacity of the collection centres must be able to accommodate both morning and evening milk.
9. There must be sufficient ventilation provided by means of louvers and extractor fans to ensure a continuous air flow of ambient air through the services section of the building.
10. A constant water pressure pump must be available.

TECHNICAL STUDY

The Milk collection centre building must shelter five different units:

1. Milk cooling hall
2. Laboratory
3. Veterinary pharmacy
4. Conference room
5. Secretariat/Accounts section

The value of such a building is estimated at 32 459 138 RWF.

The material and equipment to be made available for a collection centre and their value are shown in the following table.

Table 63: Material and equipment for a MCC

Material/Equipment	**Quantity**	**Unit Price [RWF]**	**Total Price [RWF]**
Container with generator	1	1 650 000	1 650 000
Milk Vat	1	783 750	783 750
Métalic Table	2	231 250	462 500
Pipe	1	528 063	528 063
Alcohol	2	165 625	331 250
Lactometer	2	32 815	65 630
Thermometer	2	14 063	28 126
Milk cans/20 L	30	75 931	2 277 930
Milk cans/40 L	15	84 463	1 266 945
Generator 15 kVA	1	12 807 063	12 807 063
Total			**20 201 257**

The total amount for a milk collection centre is 52 660 395 RWF.

The following table indicates the sources of financing.

Table 64: Sources of financing for the MCC

Sources of Financing	Investment
District	Plot of 2 ha/site
	Access road
	Water
	Electricity
	Community Based work
	Manual Labour and Material
	Stones
	Cement
	Sand
Cooperatives	20% of the total cost
Government	20% of the total cost
BRD	60% [Loan]

Furniture and office equipment

The milk collection centre will have to acquire office equipment and furniture. If one takes the staff to be hired into consideration, the required office equipment and furniture is given in the following table.

Table 65: Office Material for MCC

	Quantity	Unit Cost [RWF]	Total Cost [RWF]
Office	1	250 000	250 000
Chairs	5	20 000	100 000
Filling Cabinet	1	150 000	150 000
Phone	1	80 000	80 000
Total			**580 000**

ORGANISATIONAL STUDY

Each milk collection centre will need seven staff:

- A Manager;
- A Secretary/Accountant;
- Two persons in charge of receiving milk and control its quality;
- Two persons in charge of hygiene at the centre;
- A security guard.

Table 66: Personnel Emolments for MCC [RWF]

Post	Number	Charges per employee						Grand Total
		Basic salary	CSR 5%	Indemnities			Total	
				Housing	Transport	S/total		
Manager	1	80 000	4 000	13 332	6 668	20 000	104 000	104 000
Secretary/Accountant	1	60 000	3 000	9 999	5 001	15 000	78 000	78 000
Milk Receptionists	2	40 000	2 000	6 666	3 334	10 000	52 000	104 000
Cleaners	2	20 000	1 000	3 333	1 667	5 000	26 000	52 000
Security Guard	1	20 000	1 000	3 333	1 667	5 000	26 000	26 000
Total	**7**							**364 000**

FINANCIAL FEASIBILITY STUDY

Project's Cost.

The investment programme comprises the following main components:
Fixed assets

Land

The milk collection centre will be built on land provided by the District.

Buildings and planning

The building to be put up for the collection centre will have the value of 32 459 138 RWF. The details have been given in the technical part of the study.

Equipment and material for the conservation of milk

The equipment to be acquired will be worth 5 744 187 RWF

Other eqipment and material

Office equipment and furniture to be acquired: Office equipment and furniture has been evaluated at 580 000 RWF.

Intangible assets: This item comprises mainly capital costs made up of costs which will be incurred before the collection centre starts generating revenue.

The following table shows that capital costs amount to 11 508 027 RWF.

Table 67: Estimation of fixed Assets for MCC [RWF]

	Own	Bank	Amount [RWF]
Insurance for loan protection	253 547	0	253 547
Mortgage [Inscription hypothécaire] (2.25% of loan)	1 140 963	0	1 140 963
Borrowing Costs (1% of loan)	507 095	0	507 095
Interim Interests	0	7 606 421	7 606 421
Promotionals	2 000 000		2 000 000
Total	**3 901 605**	**7 606 421**	**11 508 027**

Running capital

This item comprises the necessary running capital to cover one month, one week's supply of milk and one week of upkeep costs.

According to the following table the needs in initial running capital is estimated at 13.37 million Rwanda francs.

Table 68: Working capital requirements for MCC

	Year 1
Stock	
Local raw materials (2 days)	936 833
Imported raw materials (3 months)	0
Packaging materials (3 months)	0
Finished Products (2 days)	1 349 040
1. Total Stock	**2 285 873**
2. Provider Credit (7 days)	3 278 917
3. Client Credit (14 days)	10 869 833
4. Available (1 month)	3 497 521
5. Initial Running Capital [IRC] (1+3+4-2)	**13 374 311**
6. Variation of IRC	**13 374 311**

Miscelaneous costs

For the item « miscellaneous costs », it will be equivalent to 5% of fixed assets to be acquired, or 2.45 million RWF.

Total investment cost

Appendix 1 gives asummary of investments and renewals spread over a period of 10 years. The total amount of initial investments is about 80.42 million RWF.

Financing plan

In addition to the land which will be provided by the district, the contribution of investors will finance 20% of the total investment, the Government will finance also 20% of the total investment or 48.09 million RWF representing 60% of the total investment will be financed by a bank loan.

The detailed financing plan is given in the table below.

Table 69: Detailed Plan of financing for MCC [RWF]

	Total	**To be done by Cooperative**	**BRD Loan**	**Subvention of Government**
Plot	500 000	0	0	500 000
New Constructions	32 459 138	6 816 419	18 177 117	7 465 602
Production Equipements	1 650 000	0	1 650 000	
Small Materials	4 094 187	900 721	2 292 745	900 721
New Production Equipements	12 807 063	2 817 554	7 171 955	2 817 554
New Office Furniture	1 580 000	347 600	884 800	347 600
Capital assets	11 508 027	0	0	
Insurance for loan protection (0.5% of loan)		55 780	141 987	55 780
Mortgage [Inscription hypothécaire] (2.25% of loan)		251 012	638 939	251 012
Borrowing Costs (1% of loan)		111 561	283 973	111 561
Interim Interests		0	7 606 421	0
Promotionals		440 000	1 120 000	440 000
Initial Running Capital	13 374 311	0		
Raw materials (3 months)		206 103	543 363	187 367
Finished Products (7 days)		1 349 040	0	
Clients Credit-Provider Credit		1 670 002	4 175 004	1 745 911
Available (1 month)		769 455	1 958 612	769 455
Miscelaneous and sundry	2 449 810	538 958	1 371 894	538 958
Total	**80 422 536**	**16 274 205**	**48 016 811**	**16 131 520**
In percentage (%)	**100**	**20**	**60**	**20**
		20	**80**	

Operational forecasts

The hypotheses of operational forecasts are based on the evolution of the following main points: the centre will collect and sell the milk; the evolution of operations costs and that of the sales will take the following into account:

- The projections are made over 10 years of running;
- The number of working days per year is fixed at 365;
- Plant maintenance will be carried out outside working hours;
- The working day is 8 hours liable to doubling depending on adopted marketing and Strategies.

Operations costs

Raw materials

The quantity of raw milk to be bought and supplied to dairies by the collection centre and the corresponding cost are indicated in the following table. The total costs for the purchase of raw materials will increase from 1 934.14 million RWF in year 1 to 2 311.47 million RWF in year 10.

Table 70: Raw materials for MCC [RWF]

	Unit	Year 1		Year 2		Year 3		Year 4		Year 5		Year 6	
		Quantity Pcs	Total Price	Quantity Pcs	Total Price	Quantity Pcs	Total Price	Quantity Pcs	Total Price	Quantity Pcs	Total Price	Quantity Pcs	Total Price
Milk	L	1 405 250	1 686 300	2 023 560	2 428 272	2 913 926	3 496 712	4 196 054	5 035 265	6 042 318	7 250 781	1 405 250	1 686 300
Total	**FRW**	**168 630 000**	**202 356 000**	**242 827 200**	**291 392 640**	**349 671 168**	**419 605 402**	**503 526 482**	**604 231 778**	**725 078 134**	**870 093 761**	**168 630 000**	**202 356 000**

Service [maintenance and repair]

The estimate of maintenance and repair costs is presented in the following table. The annual costs under this item amount to 395 208 RWF.

Table 71: Maintenance & Repairs of MCC [RWF]

	Base	Rate [%]	Year 1
New Construction	32 459 138	0.5	162 296
Production Equipements	1 650 000	1	16 500
Small materials	4 094 187	1	40 942
Generator	12 807 063	1	128 071
New Office Furniture	1 580 000	3	47 400
Total			**395 208**

Other services used

These include telephones services, postal mail, transport and travel, banking charges and commission and other various management charges which amount to 100 000 RWF at full operation.

Insurance

The following table shows the estimates of insurance costs for fixed assets, raw materials, finished products and production staff: the total annual insurance premiums amount to about 361 112 RWF.

Table 72: Insurance Cost for MCC [RWF]

	Base	Rate [%]	Year 1
New Construction	32 459 138	0.5	162 296
Production Equipements	1 650 000	0.5	8 250
Small materials	4 094 187	1	40 942
Generator	12 807 063	0.5	64 035
New Office Furniture	1 580 000	1	15 800
Capital assets	3 901 605	0.5	19 508
Interim interests	7 606 421	0.5	38 032
Miscelaneous and sundry	2 449 810	0.5	12 249
Total			**361 112**

Manpower costs

The staff which will be hired will be made up of 7 persons. The calculation of manpower costs is given in the table below. The annual amount of manpower costs will increase from 2.91 million RWF in year 1 to 6.22 million RWF in year 10.

Table 73: Manpower Costs for MCC [RWF]

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Manager	1 248 000	1 297 920	1 349 837	1 403 830	1 459 983	1 518 383	1 579 118	1 642 283	1 707 974	1 776 293
Secretary/Accountant	936 000	973 440	1 012 378	1 052 873	1 094 988	1 138 787	1 184 339	1 231 712	1 280 981	1 332 220
Milk Receptionist	416 000	1 297 920	1 349 837	1 403 830	1 459 983	1 518 383	1 579 118	1 642 283	1 707 974	1 776 293
Cleaner	208 000	648 960	674 918	701 915	729 992	759 191	789 559	821 141	853 987	888 147
Security Guard	104 000	324 480	337 459	350 958	364 996	379 596	394 780	410 571	426 994	444 073
Total	**2 912 000**	**4 542 720**	**4 724 429**	**4 913 406**	**5 109 942**	**5 314 340**	**5 526 913**	**5 747 990**	**5 977 910**	**6 217 026**

Dues and taxes

The collection centre will pay 360 000 RWF in dues and taxes annually.

Depreciation

The following table shows the calculation of depreciation. The annual allotment amounts to 5.74 million RWF.

Table 74: Plan for depreciation of assets for MCC [RWF]

	Base	Rate [%]	Year 1
Plot	500 000	0	0
New Construction	32 459 138	5	1 622 957
Production Equipements	1 650 000	10	165 000
Small materials	4 094 187	33	1 364 729
Generator	12 807 063	10	1 280 706
New Office Furniture	1 580 000	10	158 000
Capital Assets	3 901 605	10	390 161
Interim Interests	7 606 421	10	760 642
Total			**5 742 195**

Forecast trading account

The forecast trading account shown in Appendix 5 shows that the project is financially interesting: it promises an annual net profit of about 141.30 million RWF when fully operational.

Financial posititon

The table showing employment and resources [Appendix 5] shows that the cash flow is generally satisfactory. The good cash flow situation is confirmed by the financial plan set up monthly for the second year of running.

Financial return

Break-even point

The following table gives the distribution of costs between fixed and variable costs for year 5 which is considered as the average/mean year.

Table 75: Distribution of operation cost for MCC in RWF [Year 5]

	Total charges	Fixed Costs	Variable Costs
Raw materials	349 671 168	0	349 671 168
Other furnitures	2 400 000	2 400 000	0
Maintenance and Repairs	395 208	395 208	0
Publicity	1 200 000	1 200 000	0
Other Services	3 600 000	3 600 000	0
Miscelaneous Charges	352 862	352 862	0
Personnel	5 109 942	4 267 644	842 298
Dues et taxes	360 000	360 000	0
Depreciation	5 742 195	5 742 195	0
Total	**368 831 375**	**18 317 910**	**350 513 466**

The break-even point which is determined according to the formula: (FF x CA)/(CA-FV), is equal to 45.97 million RWF and is 8% of the sales of the fifth year. This point will be reached during the first year of running.

Socio-economic aspects

Value-added created and its distribution

The gross value-added earned during the mean year (year 5) amounts to about 141.30 million RWF and represents about 37.36% of the production, which is satisfactory.

The distribution of the value-added in the mean year (year 5) is as follows:

- Salaries (staff) = 5.10 million RWF (2.23%)
- Dues and taxes (State) = 76.45 million RWF (39.29%)
- Miscelaneous costs = 0.35 million RWF (0.15%)
- Self-financing (Enterprise) = 147.05 million RWF (64.22%)

Jobs created

Once completed, the milk collection centre will employ 7 people, which represents an average investment of about 11.49 million RWF for every job created. The wage bill distributed by the project is about 5.11 million RWF when fully operational.

Other benefits brought by the project

The project will bring about the development of production of dairy cattle in the pool where the centre will be set up.

Effects on the environment

The project will not have any harmful effect on the environment. Washing water from tanks and jerrycans used for transportation and conservation of milk will be channeled into a pit where it will be used as compost for neighbouring crops, if the pit is full.

ANNEXES: BASIC DATA FOR FINANCIAL ANALYSIS

Annex 1: Schedule of investment and renewal [RWF]

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Plot	500 000									
New Constructions	32 459 138									
Production Equipements	1 650 000								0	
Small materials	4 094 187		0			0			0	
Generator	12 807 063									
New Office Furniture	1 580 000									
Capital assets	3 901 605									
Interim Interests	7 606 421									
Initial Running Capital	13 382 598									
Miscelaneous and sundry (5%)	2 449 810									
Total	**80 430 823**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Annex 2: Personnel Emolment [RWF]

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Manager	1 248 000	1 297 920	1 349 837	1 403 830	1 459 983	1 518 383	1 579 118	1 642 283	1 707 974	1 776 293
Secretary/Accountant	936 000	973 440	1 012 378	1 052 873	1 094 988	1 138 787	1 184 339	1 231 712	1 280 981	1 332 220
Milk Receptionists	416 000	1 297 920	1 349 837	1 403 830	1 459 983	1 518 383	1 579 118	1 642 283	1 707 974	1 776 293
Cleaners	208 000	648 960	674 918	701 915	729 992	759 191	789 559	821 141	853 987	888 147
Security Guard	104 000	324 480	337 459	350 958	364 996	379 596	394 780	410 571	426 994	444 073
Total Emolment	**2 912 000**	**4 542 720**	**4 724 429**	**4 913 406**	**5 109 942**	**5 314 340**	**5 526 913**	**5 747 990**	**5 977 910**	**6 217 026**

Annex 3: Production and sales Programme [Number per type of package]

Product	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**
Production										
Milk	**1 405 250**	**1 686 300**	**2 023 560**	**2 428 272**	**2 913 926**	**3 496 712**	**4 196 054**	**5 035 265**	**6 042 318**	**7 250 781**
Stock (1 day)										
Milk	**7 700**	**9 240**	**11 088**	**13 306**	**15 967**	**19 160**	**22 992**	**27 590**	**33 109**	**39 730**
Variation of stock										
Milk	**7 700**	**1 540**	**1 848**	**2 218**	**2 661**	**3 193**	**3 832**	**4 598**	**5 518**	**6 622**
Sales										
Milk	**1 397 550**	**1 684 760**	**2 021 712**	**2 426 054**	**2 911 265**	**3 493 518**	**4 192 222**	**5 030 666**	**6 036 800**	**7 244 160**

Annex 4: Operating accounts with funding [RWF]

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Sales	279 510 000	336 952 000	404 342 400	485 210 880	582 253 056	698 703 667	838 444 401	1 006 133 281	1 207 359 937	1 448 831 924
Variation of stock	1 349 040	269 808	323 770	388 524	466 228	559 474	671 369	805 642	966 771	1 160 125
Total production	**280 859 040**	**337 221 808**	**404 666 170**	**485 599 404**	**582 719 284**	**699 263 141**	**839 115 769**	**1 006 938 923**	**1 208 326 708**	**1 449 992 049**
Raw materials	168 630 000	202 356 000	242 827 200	291 392 640	349 671 168	419 605 402	503 526 482	604 231 778	725 078 134	870 093 761
Other furnitures	1 600 000	1 600 000	2 400 000	2 400 000	2 400 000	2 400 000	2 400 000	2 400 000	2 400 000	2 400 000
Maintenance and Repairs	395 208	395 208	395 208	395 208	395 208	395 208	395 208	395 208	395 208	395 208
Publicity	1 200 000	1 200 000	1 200 000	1 200 000	1 200 000	1 200 000	1 200 000	1 200 000	1 200 000	1 200 000
Other services	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000	100 000
Added Value	**108 933 832**	**131 570 600**	**157 743 761**	**190 111 555**	**228 952 908**	**275 562 531**	**331 494 079**	**398 611 937**	**479 153 366**	**575 803 080**
Miscelaneous Charges	361 112	361 112	352 862	352 862	352 862	352 862	352 862	352 862	352 862	352 862
Personnel	2 912 000	4 542 720	4 724 429	4 913 406	5 109 942	5 314 340	5 526 913	5 747 990	5 977 910	6 217 026
Dues and taxes	360 000	360 000	360 000	360 000	360 000	360 000	360 000	360 000	360 000	360 000
Financial expenses	0	7 606 421	5 070 948	2 535 474	0	0	0	0	0	0
Depreciations	5 742 195	5 742 195	5 742 195	5 742 195	5 742 195	5 742 195	5 742 195	5 742 195	5 742 195	5 742 195
Profit before tax	**99 558 525**	**112 958 151**	**141 493 328**	**176 207 619**	**217 387 909**	**263 793 134**	**319 512 109**	**386 408 890**	**466 720 399**	**563 130 997**
Income Taz	34 845 484	39 535 353	49 522 665	61 672 667	76 085 768	92 327 597	111 829 238	135 243 111	163 352 140	197 095 849
NET BENEFIT	**64 713 041**	**73 422 798**	**91 970 663**	**114 534 952**	**141 302 141**	**171 465 537**	**207 682 871**	**251 165 778**	**303 368 259**	**366 035 148**
Capacity of auto-financing	**70 455 236**	**79 164 993**	**97 712 858**	**120 277 147**	**147 044 336**	**177 207 732**	**213 425 066**	**256 907 973**	**309 110 454**	**371 777 343**
Ratio of cover debt service	**0**	**4**	**5**	**6**	**0**	**0**	**0**	**0**	**0**	**0**

Annex 5: Table of Sources and Uses of funds with financing [RWF]

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
SOURCES OF FUNDS										
Invest. et renew.	67 048 225	0	0	0	0	0	0	0	0	0
Variation of IRC	13 382 598	3 854 768	3 419 116	4 066 282	4 878 957	5 854 143	7 024 343	8 428 558	10 113 589	12 135 599
Reimbursment of credit	0	16 903 159	16 903 159	16 903 159	0	0	0	0	0	0
Dividendes	0	6 471 304	36 711 399	45 985 332	57 267 476	70 651 070	85 732 769	103 841 435	125 582 889	151 684 130
Total of Sources of funds	**80 430 823**	**27 229 231**	**57 033 674**	**66 954 772**	**62 146 433**	**76 505 214**	**92 757 112**	**112 269 993**	**135 696 478**	**163 819 729**
USES OF FUNDS										
CAF	70 455 236	79 164 993	97 712 858	120 277 147	147 044 336	177 207 732	213 425 066	256 907 973	309 110 454	371 777 343
Recuperation of IRC										73 157 953
Residual Value										9 626 276
Social Capital	16 276 028									
Loan Local Bank	48 021 451									
Subvention	16 133 343									
Total of uses of funds	**150 886 059**	**79 164 993**	**97 712 858**	**120 277 147**	**147 044 336**	**177 207 732**	**213 425 066**	**256 907 973**	**309 110 454**	**454 561 572**
NET FLOW OF LIQUIDITY										
Annual Flow	**70 455 236**	**51 935 762**	**40 679 184**	**53 322 375**	**84 897 903**	**100 702 519**	**120 667 954**	**144 637 980**	**173 413 976**	**290 741 843**
Cumulative Flow	**70 455 236**	**122 390 998**	**163 070 183**	**216 392 557**	**301 290 460**	**401 992 979**	**522 660 933**	**667 298 913**	**840 712 889**	**1 131 454 733**

Annex 6: Estimated Cash Forecast - Year 2 [RWF]

Periods (months)	January	February	March	April	May	June	July	August	September	October	November	December
Sales (1)	17 517 500	20 495 475	23 979 706	28 056 256	32 825 819	38 406 208	31 511 506	31 511 506	31 511 506	31 511 506	31 511 506	31 511 506
Rwa materials	**11 710 417**	**13 466 979**	**15 487 026**	**17 810 080**	**20 481 592**	**23 553 831**	**29 756 679**	**29 756 679**	**29 756 679**	**29 756 679**	**29 756 679**	**29 756 679**
Electricity and water	**108 577**	**124 864**	**143 593**	**165 132**	**189 902**	**218 387**	**206 455**	**206 455**	**206 455**	**206 455**	**206 455**	**206 455**
Other furnitures	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**
Maintenance abd Repairs	**18 545**	**21 326**	**24 525**	**28 204**	**32 435**	**37 3**	**47 123**	**47 123**	**47 123**	**47 123**	**47 123**	**47 123**
Publicity	**0**	**222 536**	**0**	**0**	**0**	**0**	**222 536**	**0**	**0**	**0**	**0**	**0**
Other services	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**	**8 333**
Miscelaneous Charges	**544 893**		**0**	**0**	**0**	**0**	**544 893**	**0**	**0**	**0**	**0**	**0**
Personnel	**231**	**231**	**231**	**231**	**231**	**231**	**231**	**231**	**231**	**231**	**231**	**231**
Allowance	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**	**41 167**
Dues and taxes	**0**	**0**	**415**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
VAT	**432 098**	**496 913**	**571 45**	**657 168**	**755 743**	**869 104**	**1 097 981**	**1 097 981**	**1 097 981**	**1 097 981**	**1 097 981**	**1 097 981**
Total expenditures (2)	13 100 030	14 618 119	16 927 095	18 946 084	21 745 171	24 964 122	32 161 167	31 393 737	31 393 737	31 393 737	31 393 737	31 393 737
A) Monthly Balance (1-2)	4 417 470	5 877 356	7 052 611	9 110 172	11 080 648	13 442 086	-649 661	117 768	117 768	117 768	117 768	117 768
Other entries et payments												
Own Funds (3)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Emprunt (4)	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
Reimbursments (5)	**0**		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Investments (6)	**814 757**	**814 757**	**0**	**0**	**0**	**0**	**0**	**814 757**	**814 757**	**0**	**0**	**0**
B) Total other entries/payments (3+4-5-6)	-814 757	-814 757	0	0	0	0	0	-814 757	-814 757	0	0	0
Overall Monthly Balance (A+B)	3 602 713	5 062 599	7 052 611	9 110 172	11 080 648	13 442 086	-649 661	-696 988	-696 988	117 768	117 768	117 768
Cumulative Balance	6 861 741	11 924 340	18 976 951	28 087 123	39 167 771	52 609 857	51 960 196	51 263 208	50 566 219	50 683 988	50 801 756	50 919 525

3.4. Sales Center for Milk and Milk Products

DAIRY PRODUCTS

Milk

A natural product, a gift from cows, but especially white gold. Milk is a raw material which offers great opportunities. Butter, cheese, cream, yoghourt or milk desserts, all those dainties come from milk. A source of life, milk is a precious liquid, live and therefore fragile, today, it is a product of high consumption constantly under control. Accomplice at our breakfast, an element that is essential for our feeding and is basic to dairy products. Milk gives the latter both gustatory and nutritional qualities.

Butter

For over 4500 years, butter has conquered most civilizations. White, yellow, soft, unctuous, flavoured, salted…, butter is especially known for its taste enjoyed by connoisseurs.

Vitamin A, found mainly in butter, slows down skin aging and limits the appearance of wrinkles. Zinc, slenium and group B vitamins are equally beneficial to skin, hair and nail tone. Milk is therefore an unsuspeced beauty product!

Cheese

Nature of milk; manufacturing process, variety of terroirs, astonishing diversity; it is even fascinating. Cheese is liked for its taste and its natural origins.

Cream

To skim, to pasteurize, to seed, to mature are terms used for cream: fresh, raw, pasteurized, light, whipped! Cream is the white and satin, fresh and unctuous touch of dishes, sauces or desserts.

Yoghourts

Ribot milk, kefir, kumiss, the very ancient recipe for fermented mil kwas kept secret for a long time. But everything ends by getting known, fortunately. Yoghourt ha dits entry into the dictionary in 1923, and since the 50s it has been getting many varieties.

Milk desserts

Milk-based home made recipes have been ingeniously exploited by processors. Milk desserts appeared on fresh shelves of shops in the 50s. Since then, the line of products has been growing.

NUTRITION AND HEALTH

Consumption of 3 dairy products every day

With a view to improving the health of Rwandans by making recommendations on feeding, dairy products must occupy a place among such recommendations. The focal points will be children, adolescents and people above 55 years of age: it is recommended that they consume 3 to 4 dairy products daily.

Nutritional benefits

Milk and dairy products are well known for their high calcium content. They equally contain high quality proteins, vitamins, mineral salts and trace elements. All those nutrients play important roles in the functioning of the human organism.

Healthy bones

The human skeleton builds and strengthens itself continuously from fœtal stage through childhood and adolescence. It is thereafter important to maintain it during adulthood. A regular and adapted consumption of calcium and proteins [dairy products are a good source of them] together with regular physical activity are useful for maintaining healthy bones.

Health issues

By their nutritional composition, dairy products are beneficial to our health, but there are situations where their consumption must be controlled and adapted (lactose intolerance, weight problems, etc.).

LIVESTOCK BREEDING AND THE MARKET

Dairy livestock breeding

Today, Rwanda has dairy livestock breeders in all its administrative sectors: more than 300 million litres of milk were collected in 2008. But who are those breeders? What are the conditions of production? Sector's panorama.

Food security

Buying milk according to its quality will play a major role in encouraging the production of good milk, with an attractive composition in proteinous fat, and meeting the EAC norms of hygiene. Rwanda's dairy units which transform milk into dairy products will ensure numerous self-inspections; State services will ensure the supervision and general food surveillance.

Market information

Dairy products on the market are as follows:

Table 76: Actual Prices for Milk Products

Product	Price at Milk Plant [RWF]	Retail Price [RWF]
1. Chilled Milk (1 L)	600	700
2. Curd Milk (1 L)	650	800
3. Yoghourt (100 mL)	100	150
4. Cream fresh (1 kg)		2 500
5. Butter (1 kg)		2 500

Viva

Viva milk is sold between 450 and 500 RWF for a pack of 500 mL.

Milk shake

This product is imported from Kenya; it sells for between 350 and 400 RWF for a pack of 250 mL and 1 300 RWF for 1 L.

Skimmed milk

It is imported from Kenya and sells for 1 000 RWF a litre.

Fresh cream

Fresh cream is produced locally. It sells for between 1 400 RWF and 1 500 RWF/500g while the imported one sells for 1 300 RWF/250g

Quark

This cheese is imported. It costs 2 000 RWF for 250 g.

Butter

Local butter costs 2 000 RWF/500g. The one imported from Uganda costs 1 000 RWF/500g.

Present distribution channels

The distribution channels include mainly:

- Major groceries;
- Hotels and restaurants;
- Public and private institutions;
- Hospitals and schools
- Grouped households, etc.

Specific market characteristics

The dairy products market is faced with the following requirements in particular:

- Low purchasing power of the population, which is responsible for their consumption of milk of questionable quality;
- Competition with processed or unprocessed traditional products;
- Hygiene and quality requirements in the agroindustry, particularly dairy products;
- Seasonality of the raw material which is behind price instability. Indeed, milk is abundant during the rainy season and insufficient during dry season;
- Inadequacy of raw milk collection and conservation;
- Non existence of marketing services in the modern milk processing units;
- Irregular power supply and turning to other sources of energy which affects the price of the processed milk.

Information on consumption

Rwandans like milk and milk products but they do not consume them regularly. The consumption varies according to age and environment [rural, urban] and it also changes with the modern consumer habits.

TECHNICAL STUDY

The building of a milk and dairy products sales must shelter two distinct entities:

1. Milk and dairy products sales room;
2. Dining room;
3. Reserves room.

The cost of such a building is estimated at 5 000 000 RWF on a piece of land worth about 500 000 RWF. The same building could be rented for 350 000 RWF per month.

The material and equipment to make available for the sales counter and their value are in the following table.

Table 77: Material and equipment for MVC

Material/Equipment	**Quantity**	**Unit Price [RWF]**	**Total Price [RWF]**
Cooler	1	150 000	150 000
Shelves	5	100 000	500 000
Metallic Table	1	200 000	200 000
Cash Box	1	250 000	250 000
Equipement for dinning room	-	200 000	200 000
Generator	1	150 000	150 000
Total			**1 450 000**

Office furniture and equipment

The milk and dairy products sales counter will have to acquire office equipment and furniture. Taking into account the staff to be hired, the office equipment and furniture required is given in the following table.

Table 78: Office materials for MVC

	Quantity	**Unit Cost [RWF]**	**Total Cost [RWF]**
Office	1	250 000	250 000
Chairs	5	20 000	100 000
Filling Cabinet	1	150 000	150 000
Phone	1	80 000	80 000
Total			**580 000**

ORGANIZATIONAL STUDY

Each milk and dairy products sales counter will need three employees;

- Cashier;
- Care and Customer services;
- Security guard.

Table 79: Personnel Emolment [RWF]

Post	Number	Charges per employee						Total Général
		Basic Salary	CSR 5%	Indemnities			Total	
				Housing	Transport	S/total		
Cashier	1	60 000	3 000	6 857	5 143	12 000	75 000	75 000
Cleaner and in charge of Client service	2	20 000	1 000	3 333	1 667	5 000	26 000	52 000
Security Guard	2	20 000	1 000	3 333	1 667	5 000	26 000	52 000
Total	**5**							**179 000**

FINANCIAL FEASIBILITY STUDY

Project's costs

The investment programme comprises the following main components:
Fixed assets

Land

The milk marketing unit will have to acquire land to the value of about 500 000 RWF

Buildings and planning

The building to be put up for marketing milk and dairy products will have the value of about 5,000,000 RWF.

Required equipment and material

The required equipment for a milk and dairy products sales unit is worth about 1 450 000 RWF.

Other equipment and material

Office equipment and furniture to be acquired: Office equipment and furniture to be acquired has been evaluated at 580 000 RWF.

Intangible assets: This item comprises mainly capital costs made up of costs which will be incurred before the collection centre starts generating revenue and promotion costs.

The following table shows that immobilized costs amount to 2 386 578 RWF.

Table 80: Estimation of fixed assets for MVC [RWF]

	Own	Bank	Total
Insurance for loan protection (0.5% of loan)	51 544	0	51 544
Mortgage [Inscription hypothécaire] (2.25% of loan)	231 947	0	231 947
Borrowing Costs (1% of loan)	103 087	0	103 087
Interim Interests	0	0	0
Other fixed assets	0		0
Promotional Activities	2 000 000		2 000 000
Total	**2 386 578**	**0**	**2 386 578**

Working capital

This item comprises the necessary working capital to cover one week's supply of saleable products and one month of upkeep costs.

According to the following table the needs in initial working capital is estimated at 11.67 million RWF.

Table 81: Working Capital requirements for MVC [RWF]

	Year 1
Stock	
Raw material (2 days)	936 535
Finished Products fins (2 days)	426 845
1. Total Stock	1 363 380
2. Crédit fournisseurs (7 jours)	3 277 873
3. Créances clients (14 jours)	10 120 085
4. Disponible (1 mois)	3 462 304
5. BFR (1+3+4-2)	11 667 897
6. Variation du BFR	11 667 897

Miscelaneous costs

For the item « miscellaneous costs », it will be equivalent to 5% of fixed assets to be acquired, or 376 500 million RWF.

Total investment cost

Appendix 7 gives asummary of investments and renewals spread over a period of 10 years. The total amount of initial investments is about 21.96 million RWF.

Financing plan

In addition to the land which will be provided by the district, the contribution of investors will finance capitalized costs as well as the running costs; the remaining investment amounting to 10.31 million RWF or 47% of the total investment will be financed by a bank loan which the counter will negociate with a local bank.

The detailed financing plan is given in the table below.

Table 82: Detailed Financing Plan for MVC [RWF]

	Total	Apport		Pret Bancaire
		Déjà réalisé	A réaliser	
Plot	500	0	0	500
Constructions	5 000 000	0	0	5 000 000
Equipments	1 450 000	0	0	1 450 000
Movable	580	0	0	580
Capital assets	2 386 578	**0**	**0**	**0**
Insurance loan protection (0,5% of loan)			**51 544**	**0**
Mortgage [Inscription hypothécaire] (2.25% of loan)			**231 947**	**0**
Borrowing Costs (1% of loan)			**103 087**	**0**
Promotional Activities			**2 000 000**	**0**
Initial Running Capital	11 667 897			
Local Raw materials (2 days)		**0**	**0**	**936 535**
Finished Products (5 days)		**0**	**426 845**	**0**
Client Credit- Provider Credit		**0**	**5 000 000**	**1 842 213**
Available (1 month)			**3 462 304**	**0**
Diverse ans Unexpected (%)	376 5	0	376 5	0
Total	21 960 975	0	11 652 228	10 308 748
In percentage (%)	100	0	53	47

Operational forecasts

The hypotheses of operational forecasts are based on the evolution of the following main points: the sales of dairy products; the evolution of operations costs and that of the sales. They will take the following into account:

- The projections are made over 10 years of running;
- The number of working days per year is fixed at 365;
- Plant maintenance will be carried out outside working hours;
- The working day is 8 hours liable to doubling depending on adopted marketing and Strategies.

Operating expenses

Service [maintenance and repair]

The estimate of maintenance and repair costs is presented in the following table. The annual costs under this item amount to 22.760 RWF in year 1 and to 56 900 RWF when fully operational.

Table 83: Maintenance and Repairs [RWF]

	Base	Rate [%]	Year 1	Year 2	Year 3	Year 4
New Constructions	5 000 000	1	10	12 5	15 625	25
Equipments	1 450 000	1	5 8	7 25	9 063	14 5
New Movable	580	3	6 96	8 7	10 875	17 4
Total			**22 76**	**28 45**	**35 563**	**56 9**

Other services used

These include telephones services, postal mail, transport and travel, banking charges and commission and other various management charges which amount to 2 000 000 RWF when fully operational.

Insurance

The table below shows the estimates of insurance costs for fixed assets, raw materials, finished products and production staff: the total annual insurance premiums amount to about 51 865 RWF.

Table 84: Insurance Cost for MVC [RWF]

	Base	Rate [%]	Year 1
New Constructions	5 000 000	1	25
Equipments	1 450 000	1	7 25
New Movable	580	1	5 8
Capital assets	2 386 578	1	11 933
Diverse and Unexpected (5%)	376 5	1	1 883
Total			**51 865**

Manpower costs

The staff which will be hired will be made up of 4 persons. The calculation of manpower costs is given in the table below. The annual amount of manpower costs will increase from 2.42 million RWF in year 1 to 4.03 million RWF in year 10.

Table 85: Personnel Emolment for MVC [RWF]

	Année 1	Année 2	Année 3	Année 4	Année 5	Année 6	Année 7	Année 8	Année 9	Année 10
Manager	1 308 000	1 360 320	1 414 733	1 471 322	1 530 175	1 591 382	1 655 037	1 721 239	1 790 088	1 861 692
Cashier	900	936	973 44	1 012 378	1 052 873	1 094 988	1 138 787	1 184 339	1 231 712	1 280 981
Cleaner and in charge of client service	104	324 48	337 459	350 958	364 996	379 596	394 78	410 571	426 994	444 073
Security Guard	104	324 48	337 459	350 958	364 996	379 596	394 78	410 571	426 994	444 073
Total Emolment	**2 416 000**	**2 945 280**	**3 063 091**	**3 185 615**	**3 313 039**	**3 445 561**	**3 583 383**	**3 726 719**	**3 875 788**	**4 030 819**

Dues and taxes

Concerning dues and taxes, the dairy sales counter will pay 360 000 RWF annually.

Depreciation

The following table shows the calculation of depreciation. The annual allotment amounts to 691,658 RWF annually.

Table 86: Plan for depreciation of assets for MVC [RWF]

	Base	Rate [%]	Year 1
Plot	500	0	0
New Constructions	5 000 000	5	250
Equipments	1 450 000	10	145
New Movable	580	10	58
Capital assets	2 386 578	10	238 658
Total			**691 658**

Production and sales

The sales programme is shown in Appendix 8. The proposed sale prices shall be:

- Pasteurized milk/L: 600 RWF;
- Pasteurized milk ½L: 300 RWF;
- Skimmed milk/L: 600 RWF;
- Skimmed milk ½L: 300 RWF;
- Yoghourt/100 mL: 150 RWF;
- Fresh cream/kg: 1 500 RWF;
- Butter/kg: 1 500 RWF.

The annual sales at the proposed prices amount to 260.23 million RWF in year 1 and to 312.03 million RWF when fully operational [Appendix 8].

Forecast trading account

The forecast trading account shown in Appendix 9 shows that the project is financially interesting: it promises an annual net profit of about 52.91 million RWF when fully operational.

Financial posititon

The table showing employment and resources [Appendix 10] shows that the cash flow is generally satisfactory. The good cash flow situation is confirmed by the financial plan set up monthly for the second year of running [Appendix 11].

Financial return

Break-even point:

The following table gives the distribution of costs between fixed and variable costs for year 5 which is considered as the average/mean year.

Table 87: Distribution of operation costs for MVC in RWF [Year 5]

	Total Charges	**Fixed Costs**	**Variable Costs**
Raw materials	182 472 424	0	182 472 424
Other furnitures	2 400 000	2 400 000	0
Maintenance and Repairs	56 900	56 900	0
Publicity	1 200 000	1 200 000	0
Other services	3 600 000	3 600 000	0
Other Charges	44 615	44 615	0
Personnel	3 313 039	3 313 040	0
Dues and taxes	360 000	360 000	0
Depreciations	691 658	691 658	0
Total	**194 138 637**	**11 666 213**	**182 472 424**

The break-even point which is determined according to the formula: (FF x CA)/(CA-FV), is equal to 32.92 million RWF and is 12% of the sales of the fifth year. This point will be reached during the first year of running.

Socio-economic aspects

Value-added created and its distribution

The gross value-added earned during the mean year (year 5) amounts to about 56.37 million RWF and represents about 37.36% of the production, which is very satisfactory.

The distribution of the value-added in the mean year (year 5) is as follows:

- Salaries (staff) = 2.82 million RWF (3.03%)
- Dues and taxes (State) = 0.04 million RWF (0.05%)
- Miscelaneous costs = 1.01 million RWF (1.06%)
- Self-financing (Enterprise) = 52.50 million RWF (56.52%)

Jobs created

Once completed, the milk collection centre will employ 4 people, which represents an average investment of about 5.49 million RWF for every job created. The wage bill distributed by the project is about 3.31 million RWF when fully operational.

Other benefits brought by the project

The project will bring about the development of production of dairy cattle in the country in general.

Effects on the environment

The project will not have any harmful effect on the environment. Washing water from tanks and jerrycans used for transportation and conservation of milk will be channeled into a pit where it will be used as compost for neighbouring crops, if the pit is full.

ANNEXES: BASIC DATA FOR FINANCIAL ANALYSIS

Annex 7: Schedule of investments and renewals [RWF]

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Plot	500									
New constructions	5 000 000									
Equipments	1 450 000								0	
New Movable	580									
Capital assets	2 386 578									
Initial Running Capital	11 667 897									
Diverse and unexpected (5%)	376 5									
Total	**21 960 975**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Annex 8: Production and Sales Programme [Number per type of package]

Product	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year	Year 8	Year 9	Year 10
Production										
Pasteurised Fresh Milk 1/2 litres (000)	255 5	260 61	265 822	271 139	276 561	282 093	287 734	293 489	299 359	305 346
Pasteurised Fresh Milk 1 L (000)	54 75	55 845	56 962	58 101	59 263	60 448	61 657	62 891	64 148	65 431
Skimmed Milk/ 1/2 L (000)	109 5	111 69	113 924	116 202	118 526	120 897	123 315	125 781	128 297	130 863
Skimmed Milk (1 L)	23 464	23 934	24 412	24 9	25 398	25 906	26 425	26 953	27 492	28 042
Yoghourt 100 mL	5 214	5 319	5 425	5 533	5 644	5 757	5 872	5 99	6 109	6 232
Cream fresh/kg (000)	2 64	2 693	2 747	2 802	2 858	2 915	2 973	3 033	3 093	3 155
Butter/kg (000)	1 056	1 077	1 099	1 121	1 143	1 166	1 189	1 213	1 237	1 262
Stock (2 days)										
Pasteurised Fresh Milk 1/2 litres (000)	1 4	1 428	1 457	1 486	1 515	1 546	1 577	1 608	1 64	1 673
Pasteurised Fresh Milk 1 L (000)	75	77	78	80	81	83	84	86	88	90
Skimmed Milk/ 1/2 L (000)	150	153	156	159	162	166	169	172	176	179
Skimmed Milk (1 L)	32	33	33	34	35	35	36	37	38	38
Yoghourt 100 mL	7	7	7	8	8	8	8	8	8	9
Cream fresh/kg (000)	4	4	4	4	4	4	4	4	4	4
Butter/kg (000)	1	1	2	2	2	2	2	2	2	2
Variation of stock										
Pasteurised Fresh Milk 1/2 litres (000)	1 4	28	29	29	30	30	31	32	32	33
Pasteurised Fresh Milk 1 L (000)	75	2	2	2	2	2	2	2	2	2
Skimmed Milk/ 1/2 L (000)	150	3	3	3	3	3	3	3	3	4
Skimmed Milk (1 L)	32	1	1	1	1	1	1	1	1	1
Yoghourt 100 mL	7	0	0	0	0	0	0	0	0	0
Cream fresh/kg (000)	4	0	0	0	0	0	0	0	0	0
Butter/kg (000)	1	0	0	0	0	0	0	0	0	0
Sales										
Pasteurised Fresh Milk 1/2 litres (000)	254 1	260 582	265 794	271 11	276 532	282 062	287 704	293 458	299 327	305 313
Pasteurised Fresh Milk 1 L (000)	54 675	55 844	56 96	58 1	59 262	60 447	61 656	62 889	64 147	65 43
Skimmed Milk/ 1/2 L (000)	109 35	111 687	113 921	116 199	118 523	120 894	123 311	125 778	128 293	130 859
Skimmed Milk (1 L)	23 432	23 933	24 412	24 9	25 398	25 906	26 424	26 952	27 491	28 041
Yoghourt 100 mL	5 207	5 318	5 425	5 533	5 644	5 757	5 872	5 989	6 109	6 231
Cream fresh/kg (000)	2 636	2 693	2 747	2 802	2 858	2 915	2 973	3 032	3 093	3 155
Butter/kg (000)	1 055	1 077	1 099	1 121	1 143	1 166	1 189	1 213	1 237	1 262

Annex 9: Operating accounts with funding [RWF]

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year	Year 8	Year 9	Year 10
Sales	**260 230 767**	**266 318 072**	**271 644 434**	**277 077 323**	**282 618 869**	**288 271 246**	**294 036 671**	**299 917 405**	**305 915 753**	**312 034 068**
Variation of stock	**426 845**	**8 537**	**8 708**	**8 882**	**9 059**	**9 241**	**9 425**	**9 614**	**9 806**	**10 002**
Total production	260 657 613	266 326 609	271 653 142	277 086 204	282 627 929	288 280 487	294 046 097	299 927 019	305 925 559	312 044 070
Raw materials	**168 576 314**	**171 947 841**	**175 386 797**	**178 894 533**	**182 472 424**	**201 464 300**	**201 464 300**	**201 464 300**	**201 464 300**	**201 464 300**
Other furnitures	**1 600 000**	**1 600 000**	**2 400 000**	**2 400 000**	**2 400 000**	**2 400 000**	**2 400 000**	**2 400 000**	**2 400 000**	**2 400 000**
Maintenance and Repairs	**22 76**	**28 45**	**35 563**	**56 9**	**56 9**	**56 9**	**56 9**	**56 9**	**56 9**	**56 9**
Publicity	**1 200 000**	**1 200 000**	**1 200 000**	**1 200 000**	**1 200 000**	**1 200 000**	**1 200 000**	**1 200 000**	**1 200 000**	**1 200 000**
Other services	**2 000 000**	**2 800 000**	**3 600 000**	**3 600 000**	**3 600 000**	**3 600 000**	**3 600 000**	**3 600 000**	**3 600 000**	**3 600 000**
Added Value	87 258 539	88 750 319	89 030 782	90 934 771	92 898 605	79 559 287	85 324 896	91 205 818	97 204 359	103 322 870
MiscelaneousCharges	**51 865**	**51 865**	**44 615**	**44 615**	**44 615**	**44 615**	**44 615**	**44 615**	**44 615**	**44 615**
Personnel	**2 416 000**	**2 945 280**	**3 063 091**	**3 185 615**	**3 313 039**	**3 445 561**	**3 583 383**	**3 726 719**	**3 875 788**	**4 030 819**
Dues and taxes	**8 447 560**	**8 630 919**	**8 796 338**	**8 965 065**	**9 137 166**	**9 312 709**	**9 491 763**	**9 674 399**	**9 860 687**	**10 050 700**
Financial expenses	**1 443 225**	**962 15**	**481 075**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Depreciations	**691 658**	**691 658**	**691 658**	**691 658**	**691 658**	**691 658**	**691 658**	**691 658**	**691 658**	**691 658**
PROFIT BEFORE TAX	74 208 231	75 468 446	75 954 005	78 047 818	79 712 126	66 064 743	71 513 476	77 068 428	82 731 611	88 505 077
Income Tax	**25 972 881**	**26 413 956**	**26 583 902**	**27 316 736**	**27 899 244**	**23 122 660**	**25 029 717**	**26 973 950**	**28 956 064**	**30 976 777**
NET BENEFIT	48 235 350	49 054 490	49 370 103	50 731 082	51 812 882	42 942 083	46 483 760	50 094 478	53 775 547	57 528 300
Capacity of autofinancing	48 927 008	49 746 148	50 061 761	51 422 740	52 504 540	43 633 741	47 175 417	50 786 136	54 467 205	58 219 958
Ratio of coveer debt service	10	12	13	0	0	0	0	0	0	0

Annex 10: Table of sources and uses of funds [RWF]

	Année 1	Année 2	Année 3	Année 4	Année 5	Année 6	Année 7	Année 8	Année 9	Année 10
SOURCES OF FUNDS										
Invest. et renew.	**10 293 078**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Variation of IRC	**11 667 897**	**-6 893 283**	**123 137**	**95 148**	**96 679**	**98 662**	**100 686**	**102 753**	**104 863**	**107 018**
Reimbursment of credit	**3 436 249**	**3 436 249**	**3 436 249**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Dividendes	**0**	**4 823 535**	**24 527 245**	**24 685 051**	**25 365 541**	**25 906 441**	**21 471 042**	**23 241 880**	**25 047 239**	**26 887 774**
Total of Sources of funds	25 397 225	1 366 502	28 086 632	24 780 199	25 462 220	26 005 103	21 571 728	23 344 633	25 152 102	26 994 791
USES OF FUNDS										
CAF	**48 927 008**	**49 746 148**	**50 061 761**	**51 422 740**	**52 504 540**	**43 633 741**	**47 175 417**	**50 786 136**	**54 467 205**	**58 219 958**
Recuperation of IRC										**5 603 560**
Residual Value										**3 376 500**
Social Capital	**11 652 228**									
Subvention	**10 308 748**									
Total of uses of funds	70 887 983	49 746 148	50 061 761	51 422 740	52 504 540	43 633 741	47 175 417	50 786 136	54 467 205	67 200 018
NET FLOW OF LIQUIDITY										
Annual Flow	45 490 758	48 379 646	21 975 129	26 642 541	27 042 319	17 628 638	25 603 690	27 441 503	29 315 103	40 205 227
Cumulative Flow	45 490 758	93 870 405	115 845 534	142 488 074	169 530 394	187 159 032	212 762 722	240 204 225	269 519 328	309 724 555

Annex 11: Estimated Cash Forecast - Year 2 [RWF]

Periods (Month)	January	February	March	April	May	June	July	August	September	October	November	Décember
Sales (1)	15 535 221	16 311 982	17 127 581	17 983 960	18 883 158	19 827 316	26 774 809	26 774 809	26 774 809	26 774 809	26 774 809	26 774 809
Raw materials	**10 030 291**	**10 531 805**	**11 058 395**	**11 611 315**	**12 191 881**	**12 801 475**	**17 287 113**	**17 287 113**	**17 287 113**	**17 287 113**	**17 287 113**	**17 287 113**
Other furnitures	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**	**133 333**
Maintenance and Repairs	**7 113**	**0**	**0**	**7 113**	**0**	**0**	**7 113**	**0**	**0**	**7 113**	**0**	**0**
Publicity	**0**	**0**	**400**	**0**	**0**	**0**	**400**	**0**	**0**	**0**	**0**	**400**
Other services	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**	**233 333**
Miscelaneous Charges	**25 933**						**25 933**					
Personnel	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**	**245 44**
Dues and taxes	**0**	**0**	**8 630 919**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Financial expenses	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**	**80 179**
VAT	**344 622**	**361 853**	**379 945**	**398 943**	**418 89**	**439 834**	**987 806**	**987 806**	**987 806**	**987 806**	**987 806**	**987 806**
Total expenditure (2)	11 100 243	11 585 944	21 161 546	12 709 656	13 303 057	13 933 595	19 400 249	18 967 204	18 967 204	18 974 317	18 967 204	45 781 161
A) Monthly balance (1-2)	4 434 978	4 726 038	-4 033 965	5 274 304	5 580 101	5 893 721	7 374 560	7 807 605	7 807 605	7 800 492	7 807 605	-19 006 351
Other entries and payments												
Own Funds (3)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Loan (4)	**0**	**0**	**0**	**0**	**0**		**0**	**0**	**0**	**0**	**0**	**0**
Reimboursements (5)	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**	**286 354**
Increasing of IRC (6)	**-1 723 321**	**0**	**0**	**0**	**-1 723 321**	**0**	**0**	**0**	**-1 723 321**	**0**	**0**	**-1 723 321**
B) Total other entries/pay. (3+4-5-6)	1 436 967	-286 354	-286 354	-286 354	1 436 967	-286 354	-286 354	-286 354	1 436 967	-286 354	-286 354	1 436 967
Overall monthly Balance (A+B)	5 871 944	4 439 684	-4 320 319	4 987 950	7 017 068	5 607 367	7 088 205	7 521 251	9 244 571	7 514 138	7 521 251	-17 569 385
Cumulative Balance	51 362 703	55 802 387	51 482 067	56 470 017	63 487 085	69 094 452	76 182 657	83 703 908	92 948 479	100 462 618	107 983 868	90 414 483

4. CONCLUSION AND RECOMMANDATIONS

In order to meet the population's requirements in animal proteins by the year 2020, livestock breeding will have to be able to produce 483,693 tonnes of milk, among other things.

The present trends aim at a genetic improvement of the stock under breeding instead of increasing their numbers, and the recent GIRINKA move « One cow for every poor family » is perfectly in consonnance with that orientation and a lot is expected from that programme.

In order for those programmes to bear fruit, solutions to the problems identified by this survey must be found namely:

- Insufficient food resources;
- Insufficient water resources;
- Lack of total control of animal diseases;
- Weak access to veterinary services;
- Poor performance of the livestock;
- Poor milk quality;
- Weak organizational and institutional capacity of producers' organizations;
- Limited access to financial resources.

Confronted with all these problems, the survey has proposed a number of strategic objecives namely:

- To enhance quality of dairy culture in the country;
- To avail animal feeds in terms of quality and quantity at affordable prices;
- To enhance promotion of farmers' organizations;
- To enhance production of high quality milk;
- To create awareness among the farmers with regard to milk handling;
- To reinforce the marketing of milk and milk products;
- To integrate environmental conservation in the milk chain;
- To create conducive environment for investors;
- To integrate gender issues in the milk chain;
- To enhance capacity in terms of Human resource.

What remains is to formulate in detail the strategic programme proposed by this survey and make it operational.

Besides the proposal of a strategic project for the development of the milk chain, this survey has prepared business plans for the four traditional dairy pools. The survey mission recommends the elaboration of business plans for the four new dairy pools proposed by the survey.

Since the farmer is a principal factor in the milk chain, it necessary that he receives all services requires from his MCC:

- Training and Information
- Animal Feeding
- Veterinary services

Thus, the Milk Collection Center is therefore a critical quality control point in the milk supply chain and also a potential knowledge base for farmers and logistic hub for the supply network.

The study recommends that after the construction of about one milk collection center by administrative sector, the remuneration of veterinaries of cells/villages [utugali/imidugudu] should be ensured by the collection centers themselves.

The study recommands that the sub sector of milk should be legislated.

The study recommends the instutionalization of a National Milk Day to highlight the importance of milk in human life.

The study recommends that in order to facilitate the implementation of all the above, a National Milk Board should be intituted.

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PADEBL	Rapport trimestriel [Janvier – Mars 2007]	Avril 2007	Kigali
PADEBL	Raporo y'igihembwe cya kabiri	Kanama 2007	Kigali
PADEBL	Raporo y'igihembwe cya gatatu	Ukwakira 2007	Kigali
PADEBL	Rapport trimestriel du projet [Octobre – Décembre 2007]	Janvier 2008	Kigali
PADEBL	Rapport 2ème trimestre 2008	Juillet 2008	
Diakite Noumou	Aide-mémoire, Mission du 8 juillet au 6 septembre 2005 + Annexes	Septembre 2005	Kigali
Diakite Noumou	Rapport de mission 1 : Novembre 2004 à Février 2005, Données d'ensemble du sous secteur Elevage : Analyse et Propositions	Février 2005	Kigali
Diakite Noumou	Rapport de mission 2 : 8 juillet au 6 septembre 2005, Elevage bovin laitier et promotion du lait et des produits laitiers	Septembre 2005	Kigali
Diakite Noumou	Rapport de mission 3 : 9 avril au 30 juillet 2006, Note technique et approche pratique de suivi évaluation	Juillet 2006	Kigali
Diakite Noumou	Rapport de mission 3 : 9 avril au 6 septembre 2006, Situation des infrastructures réalisées par PADEBL (Centres de collecte du lait, Marchés à bétail et Valley-dams)	Juillet 2006	Kigali
MINITERE	Amabwiriza ya Komisiyo ku rwego rw'igihugu ishinzwe gukemura ibibazo by'ubutaka arebana n'ibigenderwaho mu gukodesha no gucunga inzuri za Gishwati	Mai 2007	Kigali

6. ANNEXES

Annex 12. Questionnaire for Primary Producer

Turabasaba ko mwadufasha gusubiza ibibazo bikurikira kugirango inzego zifata ibyemezo zizamenye ibibazo muhura nabyo.

1. Izina _____
2. Telephone _____
3. Akarere _____
4. Intara _____
5. Umubare w'inka mutunze _____
   A) Iza kizungu _____
   B) Inyarwanda _____
   C) Ibyimanyi _____
6. Mwumva muteganya kuzongera mu gihe cy'imyaka 2 – 5?
   A) Yego
   B) Oya
7. Urwuri rwawe rungana gute? (Shyira muri [ha] cyangwa m^2)?
8. Hahinze ubwatsi cyangwa ni kimeza
9. Ubwatsi ufite buraguhagije?
10. Inka mutunze zakomotse he? _____
    A) Ku muryango _____
    B) PADEBL _____
    C) Gahunda Gira inka _____
    D) Send a cow Rwanda _____
    E) HEAIFER International _____
    F) Other sources _____
11. Hari impfizi ya kijyambere mugira?
    A) Yego
    B) Oya, nteza intaga
12. Utera intangna aboneka ku gihe iyo akenewe ?
    A) Yego
    B) Oya
13. Uburumbuke bw'inka zawe
    A) Ibyara ubwa mbere ingana ite? _____
    B) Imara igihe ki gukurikiza? _____
    C) Inka zawe zisaza zifite imbyari zingahe? _____
14. Uko worora?
    A) Mu kiraro gusa
    B) Kuragira ukongeraho ubwatsi
    C) Kuragira gusa
15. Mukama amalitiro angahe ku munsi? _____
    A) Amalitiro y'inka za kizungu _____

B) Amaltiro y'inka z'inyarwanda _____

16. Murateganya umukamo ungana gute mu gihe cy'imyaka itanu iri imbere? _____
17. Hari ibindi biryo mugaburira inka usibye ubwatsi?
    A) Yego
    B) Oya
18. Niba ari yego, ese mubona bihenze mukurikije umukamo mubona?
    A) Birahenze cyane
    B) Birahenze buhoro
    C) Ntibihenze
19. Ibyansi byanyu mubyogesha iki?
    A) Amazi atetse n'isabune
    B) Amazi adatetse n'isabune
    C) Amazi adatetse avanze na siro
    D) Amazi gusa
    E) Isuku y'abakamyi [kwoga intoki, kwambara bottes, salopeti cyangwa ikoti]
    F) Isuku ku nka [kwoza amacebe mbere yo gukama]
    G) Isuku y'ikiraro
20. Amazi mukoresha mu bworozi aboneka gute?
    A) Kuvoma
    B) Kuyagira mu rugo
    C) Gushora inka ku mugezi
21. Niba muvoma, muyavana kure ki?
22. Niba muvoma isuku yayo yifashe gute?
23. Ugira umuganga uvura cyangwa usuzuma amatungo yawe?
    A) Yego
    B) Oya ni njye
24. Niba ari yego, aboneka mu buryo bworoshye
25. Iduka muguramo imiti y'amatungo riri hafi yanyu?
    A) Oya
    B) Yego
26. Ese igiciro k'imiti y'amatungo gihagaze gute?
    A) Irahenda cyane
    B) Irahenda buhoro
    C) Ntabwo ihenda
    D) Ese iboneka mu buryo bworoshye?
27. Ni irihe soko ry'umukamo wawe
    A) Uruganda
    B) Abantu basanzwe
    C) Ikigo cy'ishuri
    D) Ikigo cya gisirikare
    E) Cooperative ibanza kuyakonjesha
    G) Hotel na/cyangwa Restaurant

H) Ibitaro

28. Ese igiciro ugurishaho amata kiragushimishije?
    A) Oya
    B) Yego
29. Niba ari oya wifuza amafaranga angahe kuri litiro kugirango ubone inyungu
30. Ni ikihe gikoresho ugemuramo amata kw'isoko?
    A) Igicuba (rutare)
    B) Injerekani ya plastike
31. Bitwara amasaha angahe kugera kw'isoko?
    A) Iminota 30
    B) Isaha imwe
    C) Amasaha abiri
    D) Amasaha atatu
    E) Amasaha ane no kurenga
32. Amata agera gute kw'isoko?
    A) Ku mutwe
    B) N'igare
    C) N'imodoka
    D) Baza kuyitwarira
33. Mukamisha iki?
    A) Imashini
    B) Intoki
34. Hari koperative y'aborozi ubarizwamo
    A) Yego
    B) Oya
35. Any problem [Which?]_____
_____
36. Solutions
_____

Annex 13. Questionnaire for Milk Collection Centers

Turabasaba ko mwadufasha gusubiza ibibazo bikurikira kugirango inzego zifata ibyemezo zibashe kumenya ibibazo muhura nabyo.

1. Izina _____
2. Akarere _____
3. Intara _____
4. Iki cyuma mukusanyirizamo amata ni icyande?

A) Ni icy'umuntu kugiti cye

B) Ni icya koperative

5. Mwakira amalitiro angahe mu gitondo _____
6. Mwumva mu myaka itanu muzaba mushobora kwakira amata yose y'aka gace ?

A) Yego

B) Oya

7. Niba ari oya, urateganya Kwongera ubushobozi bw'icyuma cyawe? _____
8. Mwakira amalitiro angahe nimugoroba _____
9. Ababazanira amata baturuka kure bava ku bilometero bingahe? _____
10. Mufite ubushobozi bwo kwakira amata angina iki ku munsi _____
11. Ni ayahe masaha ntarengwa umworozi agomba kugemura amata?

A) Ni mugoroba

B) Mu gitondo

12. Mufite ubushobozi bwo gupima ubuziranenge bw'amata?

A) Yego

B) Oya

13. Niba ari yego mukoresha iki kuyapima?

_____

14. Icyuma cyanyu kimara igihe kingana gute kugirango gikonjeshe amata nibura kugeza kuli 6°C?

A) Isaha imwe

B) Amasaha abili

C) Amasaha atatu

D) Amasaha ane no kurenga

15. Mukoresha iki gukonjesha amata?

A) Generator

B) Umuriro wa Electrogaz

C) Byombi (Generator na Electrogaz)

16. Ni irihe soko ry'aya mata mukonjesha?

A) Uruganda

B) Abantu basanzwe

C) Ikigo cy'ishuri

D) Ikigo cya gisirikare

E) Hotel na/cyangwa Restaurant

17. Amata mwakira ni ayo?

A) Muteganyiriza uruganda [Yego/Oya]? _____

B) Gucuruza [Yego/Oya]? _____

18. Amata yose mwakira niko mufite aho muyagurisha?

A) Yego

B) Oya

19. Niba ari oya, amata atagurishwa angana ate? _____

20. Niba ari yego, ibiciro

A) Kuyagura _____

B) Kuyagurisha _____

21. Hari ubwo amata ajya yuzura iki cyuma gikonjesha mugasubiza inyuma aborozi?

A) Yego

B) Oya

22. Niba ari yego ni izihe ngamba mufite zo kongera ububiko bwanyu?

_____

23. Ese nimwongera ububiko hari isoko mwizeye?

A) Yego

B) Oya

24. Ni ayahe masaha ntarengwa mugomba kubika amata akonje mbere y'uko muyagemura kw'isoko?

A) Amasaha 10

B) Amasaha 15

C) Amasaha 20

D) Amasaha 48

25. Aya mata mukonjesha muyageza kw'isoko gute?

A) Abaguzi baza kuyatwara

B) Amagare

C) Imodoka

26. Niba mukoresha imodoka irayakonjesha?

A) Yego

B) Oya

27. Iri kusanyirizo ry'amata mubona rikora gute?

A) Neza

B) Neza buhoro

C) Nabi buhoro

D) Nabi

28. Mwaduha ikigereranyo cy'amata muzanirwa buri munsi:

A) N'aborozi ku giti cyabo _____

B) N'amashyirahamwe _____

29. Any problem [Which?]

_____

30. Solutions

_____

Annex 14. Questionnaire for Milk Processors

1. Name of the plant _____
2. Name of the contact person _____
3. What is the capacity of your plant? _____
4. Where do you get milk?
   A) From individual farmers
   B) From cooperative of farmers
   C) From your own farms
5. Are you satisfied with the quality of milk you are getting?
   A) No
   B) Yes
6. If no what are the measures you have taken to improve quality?

_____

7. Are you satisfied with the quantity of milk you are getting?
   A) No
   B) Yes
8. If no what are the steps taken to increase the quantity?

_____

9. At what percentage do you utilize your plant capacity?
   A) 50%
   B) 70%
   C) 80%
   D) 100%
10. What are other milk products do you produce?

_____

11. Do you produce long life milk products?
   A) Yes
   B) No
12. If yes what are those products?

_____

13. If no are you planning to produce long life products in the future?
   A) Yes
   B) No
14. What is your market share?
   A) 50%
   B) 70%
   C) 80%
   D) 90%
15. How do you rate your main competitor?

Local dairy processors ( ), Regional dairy processors ( ), International dairy processors ( ), Hawkers ( )

16. Do you export your products?

A) Yes

B) No

17. If yes in which countries do you sell your products?

_____

18. If no do you plan to export in the future?

A) Yes

B) No

19. How do you rate the price of your products with the same products from your competitors?

A) Same

B) Low

C) High

20. How do you rate the production cost of milk in Rwanda?

A) High

B) Low

21. What are your prices?

A) Buying

B) Selling

22. Profit margins [Milk]? _____

23. Profit margins [Milk products]? _____

24. Current investments for Nyagatare, Nyanza and Inyange [Buildings, Equipment, Maintenance cost]

25. Describe activities, facilities and plant processes on the premises including all materials which are or could be discharged including cleanup

26. Do you use water in milk or milk product processing? _____

27. If yes in which product processing that you use more water and why? _____

28. Do you have a cooling water discharge? _____

29. If yes does the cooling water discharge to storm sewer of reused? _____

30. How do you manage the wastes from the plant?

A) Solid wastes _____

_____

B) Liquid wastes _____

_____

31. Does your facility pre-treat or plan on pre-treating any wastewater prior to discharge to environment? _____

32. Description of the discharge and onsite disposal system _____

_____

33. Contents removed, by who and the ultimate disposal site _____

_____

34. Any problem [Which?]_____

_____

35. Solutions _____

Annex 15. Questionnaire for Beneficiaries and Investors in dairy inputs

Turabasaba ko mwadufasha gusubiza ibibazo bikurikira kugirango inzego zifata ibyemezo zibashe kumenya ibibazo muhura nabyo.

1. Job opportunities [Farmers, Collection Centres, MCC] _____
2. Investors in dairy inputs _____
3. Preferences of Consumers of milk and milk products [Fresh milk, processed milk, milk products]

_____
_____
_____

4. Women and Youth involvement in milk chain _____
5. PADEBL murayizi?

A) Yego
B) Oya

6. Gahunda ya Gira inka murayizi?

A) Yego
B) Oya

5. PADEBL na Gahunda ya Gira inka hari icyo byabagejejeho?

A) Yego
B) Oya

INVESTORS IN DAIRY INPUTS

- Abahugura aborozi
- Abagira inama aborozi
- Abavuzi b'amatungo
- Abacuruza imiti y'amatungo
- Abacuruza ibiryo by'amatungo
- Abacuruza ibikomoka ku mata byo mu gihugu n'ibyo hanze
- N'abandi

Annex 16. Sites proposed for the MCL

Province	District	Site
Ouest	Rubavu	Rugerero, Arusha, Gisenyi, Mahoko, Mudende, Cyanzarwe
	Rutsiro	Gatare, Ngongo, Terimbere, Bitenga, Kinihira, Congo Nil, Manihira, Kabona, Gasasa, Mukura, Rufungo, Nyarubuye, Kayove, Kinunu, Gakeli, Kigeyo, Kivumu, Mubuga
	Karongi	Ngoma, Kirambo, Gakuta, Kiniha, Rugabano, Bisesero, Bihugu, Ryaruhanga, Byogo, Gahunduguru, Rubona,
	Rusizi	Nkanka, Kamembe, Mushaka, Bugarama, Muganza, Giheke, Nyakabuye, Butare, Bweyeye
	Nyamasheke	Shangi, Karengera, Ninzi, Ntendezi
	Ngororero	Nyange, Muhororo, Muhanda, Butimba, Mugano, Gahinda, Rubaya, Muramba
	Nyabihu	Gatindori, Mukamira, Gasiza, Kora
Est	Rwamagana	Nyagasambu, Muhazi, Buhimbe, Gahengeri, Munyiginya
	Bugesera	Ruhuha, Juru, Rweru
	Kayonza	Videwo Centre, Nkamba, Kimodoka, Ndego, Kageyo, Rusera Centre, Kayonza Centre
	Kirehe	Nyagasambu, Mpanga, Mushikiri
	Gatsibo	Kabarore, Kiramuruzi, Gitoki, Ngarama, Muhura, Murambi
	Ngoma	Kibungo ville, Karembo, Sake, Rukira
	Nyagatare	Kabare, Nyamiyonga, Gitarama
Nord	Musanze	Gacaca, Nkotsi, Busogo, Shingiro, Remera
	Gakenke	Mugunga, Gatonde, Gakenke, Rushashi, Cyabingo, Muhondo
	Rulindo	Bunyoga, Tumba, Buyoga, Rukozacyungo, Tumba
	Burera	Nemba, Kirambo, Kivuye, Bungwe, Rugarama
	Gicumbi	Miyove, Rutare, Mumaya, Giti, Gaseke, Bukure, Manyagiro
Sud	Ruhango	Byimana, Gitwe, Mbuye
	Nyanza	Migina, Giramata, Nyanza
	Gisagara	Kibirizi, Ndera, Gikonko, Save
	Nyaruguru	Kibeho, Ruramba, Muganza, Cyahinda, Ngoma, Ruheru, Rusenge
	Huye	Kinazi [Arrêté], Maraba, Sovu, Mukura
	Nyamagabe	Cyanika, Musebeya, Tare, Kaduha, Mushubi, Gasaka
	Muhanga	Mushishiro, Kiyumba, Kibarage
	Kamonyi	Mugina
VK	Kicukiro	Gahanga
	Gasabo	Rugende
	Nyarugenge	-

Annex 17. Lab Results

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INYANGE INDUCTRIES WASTWATER ANALYSIS REPORT

1. Chemical results

Parameters	In let		Out let	
	A	B	A	B
BOD_5 (mg/l O_2)	680	760	252	240
	720		**246**	
Calcium (mg/l Ca^{+2})	46.5	47.2	50.5	52
	46.8		**51.3**	
Ammonia Nitrogen (mg/l N)	29.5	26.5	81	96
	28		**88.5**	
Total Phosphorus (mg/l P)	4.6	4.8	5.5	6.3
	4.7		**5.9**	

BIRORI Mardochée

Head of Laboratory

Annex 18. Terms of reference of positions of the milk chain

Position	Mission	Responsibilities	Tasks
Cheese curing supervisor	Supervises and follows up the last phase of cheese making by ensuring the key stages of maturation He makes the cheese	• When cheese reaches the maturing room after curdling, moulding, drainage, he controls the quality of the paste which must be soft. • All along the maturation phase of cheese, he ensures the evolution according to specifications (different for type of cheese). • He supervises a team of operators distributed along various stages, from the washing of the cheese to screening before packaging through specific operations duch as the « liage des livarots » • In permanent contact with production, he is regularly in consultation with cheesemakers and the technical director. Together they verify the results of samples, visit the maturing rooms and the manufacturing workshop. They record their observations on a traceability notebook.	In charge of the good running of the workshop, he prepares the various posts for his team. He checks the maintenance of temperature in maturing rooms and waters the floor, disinfects the scouring machine, brings cheese for screening. He reviews the day's programme with the technical director. They ensure that the cheeses are ready to undergo the scheduled operations. He spends the rest of the day visiting maturing rooms with the cheesemakers, following up the results of samples and bacteriological analyses entered in the traceability book. But beyond « quality precautions », curing is also a matter of perception. Nothing replaces the weekly tasting to analyse its mellowness, its perfume, and assess the differences in taste in the mouth.
Team leader, butter making	In the butter making workshop, a team leader trains butter churns, and ensures that the production orders are met in the shortest delays and best possible conditions	• Relaying three other team leaders in butter making, he manages machine operators on a daily basis and ensures security rules are observed. • He fulfills administrative duties related to his processing services • He enforces the production programme and follows up the rate of production of the machines. • He follows up the quality of the product made along the production programme.	As team leader, he must motivate his colleagues and dialogue with them in order to continuously improve production conditions. He favours their ability to work on different machines, making their job more interesting, and team management is more flexible. In case of breakdown, he calls for maintenance services, using a complaint book. He is also in permanent contact with the production manager (his immediate superior) and with the sales manager. His supervisory role and the link he maintains with other services of the plant require a high sense of tact and diplomacy.
Milk packaging machine operator	He uses his machine to supervise the packaging of milk into bricks. Responsible for packaging fresh dairy products from the vat to the jar, he supervises the good running of the operations	He ensures the quality of production by maintaining a constant watch on his machine and by making adjustments when necessary. • He feeds his machine with raw materials: rolls of paper, aluminium film, antiseptic.	Rigorous, the operator supervises the good running of the milk packaging process. Not only does he supervise the good running of his machine but also the quality control of the production. The machine is largely

Position	Mission	Responsibilities	Tasks
	to enable a process in the best conditions of hygiene and quality.	• In case of a problem, he assesses the seriousness of the malfunction and intervenes directly or calls for help from the maintenance team • He is flexible and will leave his machine to give a hand to other points of production • Responsible for his packaging line, he supervises the good working of his machine, controls the adjustments, doses the quantities, checks the supplies of packaging material • Once the machine has started, he verifies all the packaging stages: the position of the jar, the filling, the positioning of the foil lid, date stamp… • He acts in case of breakdown or a break, he must be ready to alert the maintenance team • He performs his duties binomially. Each operator positions himself at the end of the line and changes his position with the other every day. • Depending on the size of his factory hem ay be required to change lines and must be capable of adapting himself to the specificities of each one.	automatic. For example, a pack falls into a chute every three minutes. The operator only has to mark the sample to identify it and sen dit to the laboratory for analysis. On the other hand, every day, he adjusts the automaton so that the ODU (Optimal Date for Use) printed on the packs may be always correct. One of the most delicate operations is the changing of the roller. It is an elaborate operation that takes fifteen minutes for an experienced operator. He makes a weld joint between the two rollers and then programmes the machine to eject the first four packs. He is thus sure no pack will bear an unseemly mark of welding which could endanger the quality. Then he removes one pack from the chain to check whether the new pape ris properly shaped. Always alert, he monitors everything all the time. His experience and knowledge of the machine enable him to detect the slightest malfunction: a weak weld joint, poorly adjusted foil seal…He reacts immediately by making the correct adjustments. In case the malfunction is serious, he calls for the maintenace team: production must not stop for too long for all the workshops are interdepenedent. Solidarity is therefore vital and the operator has to leave his machine to give a hand to other posts.
Milk packaging machine operator			Once the machine has started, he has to be vigilant for the incident detectors can break down! He must keep an eye on the filling up, another eye on the fixing of labels; the operator supervises the good running of operations. He ensures that the jars are well positioned, that they are filling up correctly, that the inner seal are correctly placed and that the date stamp readable and well centred. His daily challenge: ensuring the movement of milk products from the vat to the jar in the best

Position	Mission	Responsibilities	Tasks
			hygienic and quality conditions. In case of a break-down or a break, he has to be quick, establish a first diagnosis and according to the case intervene directly or alert the maintenance team. In fact, the machine has its own limits, and it is up to the operator to react correctly in order to avoid an incident.
Director of quality control dairy industries	From the raw material, milk, to the packaged product, the director ensures the follow up and the quality control of at all processing stages	• In agreement with the general management, he defines the quality policy of the enterprise he is in charge of. • He is responsible for: consumer service, customer satisfaction, certification, regulations, comparative tasting tests, animation and quality training of teams and services… • Besides the fabrication process, he involves all the partners of the enterprise (customers, suppliers) into the quality management policy. • He formalzes the procedures for the implementation of quality measures. • Subject to some risks, he plans solutions to handle occasional malfunctions and act in case of crisis.	He is in charge of consumer service, customer satisfaction (wide distribution, secondary industries etc…), certification, regulations, comparative tasting tests, animation and quality training of teams and services… In order to be able to intervene in all these activities, he is surrounded by collaborators, and has set up a solid and dependable organization. He is also supported by procedures that have to be followed: service audit, customer satisfaction measures, records recapitulating constraints met and solutions found. Despite all the precautions taken, the risks still exist. Neither man nor machine are infallible! There are many opportunities to put the procedures to test and follow them up if necessary. Quality management is a progressive approach: it is based on permanent apparaisal. The quality control director's mission is not limited to project specifications and trend charts nor to the four walls of the enterprise. An incident, an occasional malfunction, an audit, a satisfaction survey make him pay regular visits to the supplier or a distributor. Always on stand-by, he is on his way at the slightest alert because he is the one, at the end of the day, who is in charge of crisis management, whatever magnitude the crisis has.
Engineer, Research and Development	In conjunction with the marketing and production teams, he develops new products in the enterprise, in consonance with the consumers' needs and	• He is in charge of research projects on new products or packagings, from the study phase to the elaboration of industrial parameters, in accordance with precise costs and time schedules.	Coordinator on several fronts, he must adapt his research to the consumer's habits and expectations. That is why he ensures technological intelligence, on the look-out for new products, chasing

Position	Mission	Responsibilities	Tasks
	abiding by well defined costs and deadlines.	• After defining the project and technical procedures with marketing and production, he organizes a programme of trials by subjecting the prototypes to a series of tests. • With production supervisors he prepares tools enabling to move from a home made sample to an industrial product. • In constant contact with the operators involved, he coordonates the project's progress and supervises a diversity of know-how. • He ensures technological intelligence in order to be up to date with new innovation opportunities	opportunities. When he proposes a new idea, after testing it, he ensures the protection of the innovation with appropriate patents.
Productive operator in cheese factory	In a medium size cheese factory, the position of operator involves one or more operations which are essential for the transformation of milk into cheese.	• The operator intervenes at one or many stages of cheese making: curdling, moulding, salting, ripening, etc. • These operations can be carried out by hand, but they are becoming more and more automated, and the operator is therefore responsible for a machine. • His duties involve him in a long manufacturing process, and he works in close collaboration with other operators. • In direct contact with the product, he permanently ensures its quality and its conformity with the type of expected cheese	The productive operator in cheese making is therefore involved in a long manufacturing process. His work depends closely on that of the other operators and he must have a strong team spirit. He esnures the quality of his product, from the consistency of the curd to the crust of the ripened cheese. In case of a problem, he intervenes directly or alerts his supervisor. Sometimes specialized in one specific operation, sometimes in many operations, he must be thorough.
Dairy worker	Has different tasks depending on the enterprise where he works. He processes milk to get milk for consumption: pasteurized milk, sterilized milk, concentrated milk, powdered milk. He can also process it to obtain fresh or matured cheese, butter, cream, and yoghourt.	• In order to make cheese, the dairy worker cuts the curd, handles salting, ladle moulding and fills the moulds. For the preparation of milk and butter he uses different machines: cream separators, pasteurizers, sterilizers, churns, etc. He controls the state of the product, the rooms' humidity and temperatures. He weighs and cuts products to be packaged. He cleans manufacturing vats disinfects the facilities, ensures the cleanliness of the premises and of his clothings • He ensures the good running of the machines	The dairy worker works in a workshop. The premises are generally spacious but humid. These are sometimes very cold cellars. He may have to lift very heavy cheese blocks. Most of the work is done in the morning. He may work overtime. Some big enterprises run 24 hours a day in alternate shifts. The dairy worker may work at night and on week-ends.
Coagulating machine operator	Before his machine situated at the heart of the cheese factory, he operates and controls the	• The coagulator looks like a large gutter-shaped carpet: it contains milk and it moves	The coagulator is permanently controlled by several sensors. Its screens signal to the operator

Position	Mission	Responsibilities	Tasks
	transformation of milk into curd.	slowly. At the end of its movement, the milk has become sliced curd. • The operator treats the milk according to a pre-defined recipe and watches its transformation. He carries out temperature, pH and setting time tests and notes the results down. • All along the process, he takes samples and notes each intervention he makes. • The machine is monitored by sensors connected to touch screens. The slightest change or malfunction is immediately signalled to the operator. Depending on the magnitude of the problem, he intervenes or calls maintenance.	the slightest irregularity: a temperature that is too low or too high, an inactive sensor…nothing escapes it. He intervenes directly or calls maintenace. All along the process, the operator takes many measurements and notes them on record cards. He verifies that the transformation of milk is going on smoothly by checking its acidity and the setting time. He also fills sterile tubes for bacteriological analysis. Finally, for the sake of product traceability, he takes a dozen samples for each type of cheese processed. Thanks to touch screens, the operator is immediately informed about the slightest irregularity: a temperature that is too low or too high, an inactive sensor…nothing escapes his watch.
Automated plant operator	At the same time operator and signalman, he controls a series of automated operations: reception of milk at the factory, preparations and then distribution to workshops according to the processing required.	• From his cab that overlooks the vat rooms, pipes and machines, he directs milk according to a well designed path without seeing or touching it. • He controls a series of automated gates which link vats to curing rooms then to workshops • Step by step, he directs the milk where it has to go: pasteurizers, cream separators and eventually to microfiltration units. • Because of stringent hygiene rules, he ensures regular and thorough cleaning of the area under his control. • In a constant flux, he links up with other operators, deals with priorities, readjusts the projections in order to conform better to the processing plans.	Without seeing or touching the milk, the operator directs it through precise circuits: pasteurizers, centrifuges and eventually microfiltration units. The operator controls them all. From his control panel he opens the automated gates placed over channels that link vats to processing rooms and processing rooms to workshops. All the machines are equiped with sensors and the history of the processing is carefully recorded by computer. Working on living matter which requires strict hygienic conditions the operator must also master the cleaning of the circuits. Each storage tanks is emptied then cleaned before being reused. Great attention must be paid to the operation time: never start cleaning the tank before it has been emptied of milk.
Concentration and drying plant operator	From the automated control room, the operator supervises the good running of a series of machines which transform mlk into powder.	The processing of milk powder is a delicate operation, and the operator must always follow many parameters and a thorough production plan. • Milk is first sent into the concentrators where part of its water evaporates, then into	From a glass control room in the centre of the workshop, he follows the control screens, comments made by machine operators, automatons, sensors in concentrators and towers. He makes the necessary adjustments, assisted by the

Position	Mission	Responsibilities	Tasks
		huge drying tunnels where it becomes powder under a current of hot air. • The operator supervises a team of other operators who operate directly each machine. He must be very vigilant and full of initiative in order to solve any problem that could interrupt the good running of the plant.	team of operators. The latter also take samples for analysis and do the cleaning after each production cycle. The operator must be vigilant and must react at the slightest alert. At the rythm of the continuous flow of milk through the gigantic machines, a broken belt or a pump that breaks down can endanger tonnes of finished products.
Milk control supervisor	He coordinates the activities of milk control technicians and gives them a methodological support.	• He supervises the Milk Control Unit staff, trains them and contributes to the advancement of the unit. He does all that in close collaboration with the director (at technical and organizational level), in order to ensure adequate service to members permanently.	He provides leadership to une or more teams. He can serve as a technical expert. He proposes and collaborates in the development of methods and tools for technical support to producers and ensures their evolution He directs and administers the application of Technical Regulations. He is a force for the future of the services.
Production Supervisor	At the factory, the production supervisor spearheads the organization of dairy products processing in a dynamic of continuous improvement: time schedules, profitability, quality and security.	• He organizes the work of several production workshops: identifies the necessary resources, distributes operators to various positions, adapts time schedules and coordinates planning. • Once production has started, he ensures its follow-up: he verifies the programme's progress with reference to the plan, controls compliance to norms and rules of hygiene. • He carries out assessments, studies the feasibility of new products and improvements to be brought in at both technical and human level.	At the heart of the plant's process, he is in regular contact with numerous professionals, at consultation meetings with the planning unit, the scheduling officer just like with the director of quality or the one in charge of Research and Development. He is a Coordinator, a real team coach involved in the field. His charisma and his leadership mobilize team leaders, motivate and empower operators. Eager not to leave anything to chance, he knows how to face the unexpected. Tarting an operational line despite an absence, catch up with the plan after a repair of a machine are some of the chance occurrences to which he has to adapt him and be ready to face any challenge.
Technician, milk laboratory	His tests enable to know the bacteriological quality and the composition of the milk in each farm.	• At the interface between livestock breeding and the dairy industry, the interprofessional laboratory technician analyses the quality of the milk: the results will determine the milk's market value. • From milk samples taken three	Inside a laboratory equiped with modern apparatus, he carries out analyses in series on several hundreds of samples per hour (about 400 per hour), following rigorously established procedures. He first ensures that the analysers are well calibrated, then checks if the samples to be

Position	Mission	Responsibilities	Tasks
		times a month in each farm, he assesses the fat, protein, water contents of the milk, and checks the absence of inhibitors. • Inside interprofessional laboratories spread in milk producing areas, technicians control milk from several thousand producers taking several hundred samples per hour, following rigorously established procedures. • Theys end the results to members within a few hours, anabling them to to react instantly in case of any anomaly.	analysed are intact and well labelled. During the analysis, the machines are controlled to avoid any irregularity. At the end of the day, he thoroughly cleans up the apparatus, and, on a regular basis, he re-calibrates and ensures preventive maintenance to automatons. The analyses are based on the latest technologies: infra-red analysers give the fat and protein contents, the water content of the samples is determined by cryoscopy, cell counts are carried out using the flux cytometry principle. After the incubation of samples, the verification of the absence of inhibitors in the milk can be read on the scanner.
Bacteriological laboratory technician	He carries out analyses at all the stages of the processing, to check the absence of micro-organisms that are harmful or that constitute a health risk.	• From the milk vat to the packaged product, he takes samples at every stage, including from raw materials used or even from the packaging material. • He cultures the samples, incubates them to enhance the multiplication of micro-organisms and dventually detects the presence of undesirable hosts. • He specialises in dairy products' bacteriological specialities, and is capable of distinguishing harmful bacteria from useful ones. • He equally submits finished products to aging tests to find out their behaviour in the process.	He carries out a series of tests to check the absence of micro-organisms that are harmful to the quality of the products or dangerous to health. Dairy products require a particularly thorough analysis because they contain thousands of live micro-organisms. Some are useful, cultured and seeded in the milk to give a flavour or a texture peculiar to yoghourts and cheeses. Others can be dangerous for the taste of the finished product, or even for health. The laboratory technician must therefore know how to detect their presence among useful ones.
Milk recording technician	Responsible to the cattle breeder for measuring the herd's milk profitability, he is also a technical and strategic advisor on all the key points that enable the enterprise to prosper.	• Qualified technician, he is employed by one of the 83 milk recording units which are independent or members of a Chamber of Agriculture. • He is responsible for preparing a milk audit by establishing reliable statistics on the herd's milk production. They have an official reference value for the chain. • He intervenes every month on the farm during night and morning milking. He records the number of litres produced by each cow, and he takes a sample for a composition analysis. • Side by side with the breeder	His services are remunerated by the keeper member, who in return expects a reliable performance assessment of his animals and a long-term technical and economic support. They enable the breeder to check the results of genetic improvement of one generation over another, to select the best cows in the herd…and to sell a heifer or a cow for the best price, according to its performance. The milk recording technician occupies a strategic position within the enterprise: he is at the same time an evaluator and

Position	Mission	Responsibilities	Tasks
		and with the help of his computer in collecting data for each farm, he analyses the control results and their evolution. • He uses the data collected to accompany the member in milk recording and thereby assess the progress made.	a technical advisor. Beyond the analysis of the milk, the milk recording technician gathers a lot of information on the herd: feeding, milking, animals' origin… The information enables him to propose strategic advice, on all the key points, to the breeder: feeding for each cow, choice of fodder crop system, selection of the best dairy cows or even the overall management methods for the herd. With the support of his analyses and his sound knowledge of animals and animal breeding systems, the technician makes an overall assessment and, together with the breeder, they define objectives of progress. As a person in the field and of dialogue, he can listen and observe. Together with the breeder, he builds up a relationship of trust, based on his human qualities, his technical skills and the quality of his advice.
Cheese making technician	He supervises the first phase of transforming milk into cheese, using at the same time on rogorous manufacturing process, a high sense of observation and a perfect knowledge of milk.	• He is responsible for various operations that will transform milk, living and liquid material into a solid and enjoyable product. • He supervises the stages, using fermentation and curding techniques, his knowledge of milk transformation processes and his capacity of analysis and appreciation. • He has to adapt himself permanently to seasonal vagaries and anticipate differences in milk, so as to ensure systematically the same level of quality to the product. • Inside a team, he coordinates the manufacturing with the help of several workers and ensures a continuous follow-up of production.	To obtain young cheese from milk, each stage requires accuracy in both action and timing; no approximation is accepted. Thoroughness alone is not enough. Cheese making is above all know-how. Automation has made milk transfers easier, removed heavy transportation, but has not removed skill, intuition or perfect knowledge of milk acquired by the cheese maker Milk is indeed a living raw material, its curding capacities vary with seasons, and even with the weather…To obtain the best results permanently, we need the experience of a good cheese maker.

Annex 19. Associations/Cooperatives of cattle keepers of West and North Provinces & Kigali City

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
1	T.G.N.S.	Iburengerazuba	Rusizi	Gihundwe	2007
2	COOPANYE	Iburengerazuba	Rusizi	Nzahaha	1989
3	TUZAMURANE	Iburengerazuba	Rusizi	Gihundwe	2008
4	COJETRA	Iburengerazuba	Rusizi	Nkanka	2008
5	GABANUGABE	Iburengerazuba	Rusizi	Kamembe	2008
6	ZIRAKAMWA	Iburengerazuba	Rusizi	Nyakarenzo	2008
7	ORORA	Iburengerazuba	Rusizi	Kamembe	2007
9	IMPETA	Iburengerazuba	Nyabihu	Bigogwe	2007
10	KODUKI-IMBABAZI	Iburengerazuba	Nyabihu	Bigogwe	2007
11	URUHIMBI RW'ABOROZI	Iburengerazuba	Nyabihu	muhe	2008
12	CEMO	Iburengerazuba	Nyabihu	Bigogwe	2008
13	NYIRABIHURURU	Iburengerazuba	Nyabihu	Muringa	2008
14	NKOMANE	Iburengerazuba	Nyabihu	Kanama	2008
15	NYIRAGIKOKORA	Iburengerazuba	Nyabihu	Rambura	2008
16	INKA IRARERA	Iburengerazuba	Karongi	Rubengera	2007
17	COPED	Amajyaruguru	Musanze	Muhoza	2007
18	ZIRAKAMWA TWICUNDIRE	Iburengerazuba	Rubavu	Kanzenze	2008
19	DUKUNDAMATUNGO	Amajyaruguru	Musanze	Nkotsi	2002
20	TWOROREKIJYAMBERE	Amajyaruguru	Musanze	Remera	2000
21	AGIRA GITEREKA	Amajyaruguru	Musanze	Kinigi	2006
22	CEPTEL	Amajyaruguru	Burera	Cyanika	2008
23	TERIMBERE MWOROZI	Amajyaruguru	Burera	Cyeru	2008
24	ZIRAKAMWA	Amajyaruguru	Burera	Butaro	1997
25	I.A.B.O-Remera	Amajyaruguru	Rulindo	Rusagara	2006
26	AVERU	Amajyaruguru	Rulindo	Rusagara	2003
27	TURWANYINZARA	Amajyaruguru	Rulindo	Mbogo	1995
28	NKUNDAMATUNGO	Amajyaruguru	Rulindo	Ruhanya	1986
29	UKWIBYARA	Amajyaruguru	Rulindo	Mbogo	1978
30	TWOROREKIJYAMBERE	Amajyaruguru	Rulindo	Ruhanya	2003
31	TURWANYINZARA	Amajyaruguru	Rulindo	Mbogo	1995
32	DUHARANIRUMUSARURO	Amajyaruguru	Shyorongi	Rutonde	2001
33	HINGA WORORE	Amajyaruguru	Shyorongi	Rwahi	2002
34	TERIMBERE MUH-MWORO	Amajyaruguru	Shyorongi	Rwahi	2001
35	DUTERANE INKUNGA	Amajyaruguru	Shyorongi	Gitanda	2002
36	ABARWANASHYAKA	Amajyaruguru	Shyorongi	Musagara	1987
37	ISARU	Amajyaruguru	Shyorongi	Rubingo	1995

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
38	ZIGAMA	Amajyaruguru	Gicumbi	Coko	2002
39	TWITEKUBWOROZI	Amajyaruguru		Joma	1992
40	ABUNGURANAMA	Amajyaruguru	Gicumbi	Buheta	1992
41	I.A.B	Amajyaruguru	Gicumbi	Gatare	2002
42	ABIHUJE	Amajyaruguru	Gicumbi	Rushashi	2002
43	GERUMU	Amajyaruguru	Gicumbi	Kiriku	1998
44	ISIBO	Amajyaruguru	Gicumbi	Ruli	1992
45	DUKUNDAMATUNGO	Amajyaruguru	Gicumbi	Mbirima	1999
46	DUFATANYE	Amajyaruguru	Gicumbi	Raba+Shyombwe	1992
47	GIRAMATA	Amajyaruguru	Gicumbi	Gatagara	2003
48	ABATICUMUGAMBI	Amajyaruguru	Gicumbi	Minazi	1998
49	ZIRAKAMWA TWICUNDIRE	Iburengerazuba	Rubavu	Kanzenze	200
50	URUMURI RWABOROZI	Iburengerazuba	Rubavu	Kanama	2008
51	KOAMU	Iburengerazuba	Rubavu	Mudende	2008
52	KABU	Iburengerazuba	Rubavu	Busasamana	2008
53	TUGEMURE AMATA	Iburengerazuba	Rubavu	Mudende	2008
54	CODERU	Iburengerazuba	Rubavu	Gisenyi	2007
55	COMUTERU	Iburengerazuba	Rubavu	Rugerero	2007
56	COPTEGI	Iburengerazuba	Rubavu	Gisenyi	2007
57	COOVAPA	Iburengerazuba	Rubavu	kanama	2007
58	COPBT	Iburengerazuba	Rubavu	Mudende	2007
59	COO.ABIYEMEJE	Iburengerazuba	Rubavu	Kanama	2007
60	URUHIMBI RW'ABOROZI	Iburengerazuba	Rubavu	Kanama	2008
61	URUKUNDO	Iburengerazuba	Rutsiro	Mukura	2007
62	TUZAMURANE	Iburengerazuba	Rutsiro	Nyabirasi	2008
63	GIRAMATA	Iburengerazuba	Rutsiro	Musasa	2008
64	GIRA INKA	Iburengerazuba	Rutsiro	Ruhango	2008
65	DUKUNDUMUTUNGO	Iburengerazuba	Rutsiro	Gihango	2007
66	DUFATANYE	Iburengerazuba	Rutsiro	Gihango	2006
67	INTASYHA	Iburengerazuba	Rutsiro	Gihango	1995
68	GIRA INKA	Iburengerazuba	Rutsiro	Kivumu	2008
69	APESEKI GIRIMPUHWE	Iburengerazuba	Rutsiro	Kivumu	2003
70	KORAMUNYARWANDA	Iburengerazuba	Rutsiro	Kivumu	2003
71	SHISHOZA	Iburengerazuba	Rutsiro	Kivumu	2005
72	JYAMBERE GIRINKA	Iburengerazuba	Rutsiro	Kivumu	2008
73	APECM	Iburengerazuba	Rutsiro	Mushubati	2006
74	TWOKIMA	Iburengerazuba	Rutsiro	Mushubati	2006
75	GIRINKA	Iburengerazuba	Rutsiro	Mushubati	2008
76	UBUDEHE	Iburengerazuba	Rutsiro	Mushubati	2008
77	TERIMBERE MUHINZI MWOROZA	Iburengerazuba	Rutsiro	Boneza	2008
78	GIRA AMATA	Iburengerazuba	Rutsiro	Boneza	2008
79	TWITEZIMBERE BOROZI	Iburengerazuba	Rutsiro	Mushonyi	2002
80	GIRA INKA	Iburengerazuba	Rutsiro	Murunda	2008
81	GIRA INKA	Iburengerazuba	Rutsiro	Kigeyo	2008
82	AKAMARO K'UBUMWE	Iburengerazuba	Rutsiro	Kigeyo	2008
83	INGABO IDUKINGIRA UBUDEHE	Iburengerazuba	Rutsiro	Kigeyo	2008

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
84	GIRA INKA	Iburengerazuba	Rutsiro	Rusebeya	2008
85	GIRA INKA	Iburengerazuba	Rutsiro	Manihira	2008
86	URUHIMBI RW'ABOROZI	Iburengerazuba	Rubavu	Kanama	2003
87	TURWUBAKE	MVK	Kicukiro	Gatenga	2007
88	TWITEZIMBERE	MVK	Kicukiro	Gahanga	2007
89	KAMIRABANA	MVK	Kicukiro	Niboye	2007
90	ASSOC.PMFPA (PROFESSIONALS MODERN FARMING PROMOTORS ASSOCIATION)	MVK	Kicukiro	Kicukiro	2007
91	ABAZATSINDA	MVK	Kicukiro	Kigarama	2007
92	PAMASOK-RWANDA	MVK	Kicukiro	Kigarama	2007
93	ASSOC.TERIMBERE MUHINZI-MWOROZI (TMM)	MVK	Kicukiro	Kanombe	2007

Annex 20. Associations/Cooperatives of cattle keepers of the East Province

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
1	GIRAMATA	Iburasirazuba	Nyagatare	Nyagatare	2004
2	TERIMBERE-MWOROZI	Iburasirazuba	Nyagatare	Karangazi	2004
3	KIREBE KAMATE ZIRAKAMWA	Iburasirazuba	Nyagatare	Rwimiyaga	2004
4	MATIMBA TWORORE KIJYAMBERE	Iburasirazuba	Nyagatare	Matimba	2005
5	ABARWANASHYAKA MILK SUPPLYER	Iburasirazuba	Nyagatare	Ruhuha	2004
6	RWABIHARAMBA DAIRY FARM SOCIETY	Iburasirazuba	Nyagatare	Karangazi	2004
7	UBUMWE	Iburasirazuba	Nyagatare	Nyagatare	2004
8	ABASHUMBA BEZA	Iburasirazuba	Nyagatare	Rwimyaga	2005
9	KABARE MIXT FARMERS	Iburasirazuba	Nyagatare	Rwimiyaga	2004
10	INYANGE GIRAMATA	Iburasirazuba	Nyagatare	Nyagatare	2004
11	MUVUMBA ZIRAKAMWA	Iburasirazuba	Nyagatare	Nyagatare	2005
12	TAPROFA	Iburasirazuba	Nyagatare	Tabagwe	1997
13	ABATIGANDA	Iburasirazuba	Nyagatare	"	1995
14	Nyabitekerezi F.A	Iburasirazuba	Nyagatare	"	2000
15	DUKOREREHAMWE	Iburasirazuba	Nyagatare	"	1998
16	ABOKI	Iburasirazuba	Nyagatare	"	1996
17	KOARU	Iburasirazuba	Nyagatare	"	1998
18	URUGWIRO	Iburasirazuba	Nyagatare	"	1995
19	TWIFATANYE	Iburasirazuba	Nyagatare	"	1999
20	ABAHUZAMUGAMBI	Iburasirazuba	Nyagatare	"	2002
21	BENISHYAKA	Iburasirazuba	Nyagatare	"	1994
22	TUVUGURURA Ubworozi	Iburasirazuba	Nyagatare	"	2002
23	UMURAVA	Iburasirazuba	Nyagatare	"	1998
24	DUHOZANYE	Iburasirazuba	Nyagatare	Nyamiyonga	1999
25	ABURUKUNDO	Iburasirazuba	Nyagatare	Rabega	1999
26	Kabare Cooperative	Iburasirazuba	Nyagatare	Hakurya ya muvumba	2004
27	TWORORE	Iburasirazuba	Nyagatare	Musheli	2000
28	KANGUKA	Iburasirazuba	Nyagatare	Lyabega	1997
29	TWIZAMURE	Iburasirazuba	Nyagatare	Nyamiyonga	1998
30	ISANGANO	Iburasirazuba	Nyagatare	Kazaza	1999
31	DUFATANYE	Iburasirazuba	Nyagatare	Kaza	2000
32	INDAHINYUKA	Iburasirazuba	Nyagatare	Cyenjojo	1998
33	TUZAMURANE	Iburasirazuba	Nyagatare	Cyenjojo	1998
34	MASHAKA DEVEL	Iburasirazuba	Nyagatare	Cyenjojo	1998
35	MISHENYI F.A.	Iburasirazuba	Nyagatare	Bweya	1998
36	NYAMIFASO	Iburasirazuba	Nyagatare	Nyamiyonga	1998
37	NIBOMABOKO	Iburasirazuba	Nyagatare	Kazaza	1999
38	UMUWIPRODEFA	Iburasirazuba	Nyagatare	Kabare	1998
39	ABATIGANDA	Iburasirazuba	Nyagatare	Kabare	2001
40	DUTERIMBERE	Iburasirazuba	Nyagatare	Gacundezi	2002
41	Turwanye Uburondwe	Iburasirazuba	Nyagatare	Gacundezi	2002
42	TUZAMURANE	Iburasirazuba	Nyagatare	Matimba	2003
43	ABISHYIZE HAMWE	Iburasirazuba	Nyagatare	Nkerenke (Kamagili)	2002
44	TWITEZIMBERE	Iburasirazuba	Nyagatare	Bwera (Rutungu)	2002
45	INYANGE	Iburasirazuba	Nyagatare	Nyawera	1999

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
46	Gacundezi	Iburasirazuba	Nyagatare	Gacundezi	2005
47	TWORORE KIJYAMBERE	Iburasirazuba	Nyagatare	Musenyi	1999
48	NDAMA Zirakawa.	Iburasirazuba	Nyagatare	Ndama	2004
49	M.B.R.U. Mixte Farmers	Iburasirazuba	Nyagatare	Rwimbo	1999
50	Rwabihara. farmers Ass.	Iburasirazuba	Nyagatare	Ndama	2003
51	AMATUNGO	Iburasirazuba	Bugesera	Kamabuye	2006
52	KOPEMOKA	Iburasirazuba	Bugesera	Kamabuye	2001
53	CODECOL	Iburasirazuba	Bugesera	Mayange	2003
54	COOPEM	Iburasirazuba	Bugesera	Mwogo	2004
55	ABAHUJUMUGAMBI W'ITERAMBERE	Iburasirazuba	Bugesera	Mwogo	2004
56	COEDIBU	Iburasirazuba	Bugesera	Ntarama	2002
57	COPREBU	Iburasirazuba	Bugesera	Nyamata	2003
58	COOPAM-INKURIRARWANDA	Iburasirazuba	Bugesera	Musenyi	2005
59	ABAKUNDAMATUNGO	Iburasirazuba	Bugesera	Nyarugenge	2000
60	GIRAMATUNGO	Iburasirazuba	Bugesera	Ruhuha	2000
61	ABADACOGORA	Iburasirazuba	Bugesera	Karera	1997
62	TWISUNGANE	Iburasirazuba	Bugesera	Karera	2000
63	ABAKANGUKIYAMAJYAMBERE	Iburasirazuba	Bugesera	Rwinume	1996
64	ABAHUZAMUGAMBI	Iburasirazuba	Bugesera	Musovu	1995
65	ABAJYAMUGAMBI	Iburasirazuba	Bugesera	Juru	1997
	UBUMWE	Iburasirazuba	Bugesera	Nkanga	1996
67	ABASHYIZEHAMWE	Iburasirazuba	Bugesera	Karera	2003
68	TWISUNGANEBOROZI	Iburasirazuba	Bugesera	Rwinume	1998
69	TWOROREKIJYAMBERE	Iburasirazuba	Bugesera	Musovu	2000
70	DUFATANYE	Iburasirazuba	Bugesera	Rilima	2002
71	ZIRAKAMWA	Iburasirazuba	Bugesera	Mbyo	2002
72	TWIFATANYE	Iburasirazuba	Bugesera	Mbyo	1998
73	TWITEZIMBERE	Iburasirazuba	Bugesera	Rilima	1997
74	ABATICUMUGAMBI	Iburasirazuba	Bugesera	Mbyo	1997
75	DUHAGURUKIYAMAJYAMBERE	Iburasirazuba	Bugesera	Rweru	1996
76	DUTERANINKUNGA	Iburasirazuba	Bugesera	Mwendo	1998
77	TWISUNGANE	Iburasirazuba	Bugesera	Gashora	1998
78	URUMURIRWUBUMWE	Iburasirazuba	Kayonza	Nyamirama	2004
79	GIRAMATAKAYONZA	Iburasirazuba	Kayonza	Mukara	2007
80	GIRAMATA MURAMA	Iburasirazuba	Kayonza	Murama	2002
81	INYANGE	Iburasirazuba	Kayonza	Nyawera	2001
82	NGWINUREBE	Iburasirazuba	Kayonza	Rukara	2003
83	RUKARA FARMERS'COOPERATIVE	Iburasirazuba	Kayonza	Rukara	2006
84	TURUTEZIMBERE	Iburasirazuba	Kayonza	Rwinkwavu	2008
85	TWORORE DUSAN'IGIHUGU	Iburasirazuba	Kayonza	Nyarugari	2001
86	ABISHYIZEHAMWE	Iburasirazuba	Kayonza	Gati	2001
87	TURWANYUBUKENE	Iburasirazuba	Kayonza	Duha	2001
88	RWISIR.FARMERS ASS	Iburasirazuba	Kayonza	Nyamiyaga	2003
89	MUBARI FARMERS ASS	Iburasirazuba	Kayonza	Buhabwa	2003
90	INTATEZUKA	Iburasirazuba	Kayonza	Mahama	2002
91	INTIGANDA	Iburasirazuba	Kayonza	Mahama	2002
92	INYAMIBWA	Iburasirazuba	Kayonza	Ndengo	2002
93	INDINGANARE	Iburasirazuba	Kayonza	Ndengo	2002
94	ABIYEMEJE	Iburasirazuba	Kayonza	Ndengo	2002
95	INSHONGORE	Iburasirazuba	Kayonza	Ndengo	2002
96	ABADAHIGWA	Iburasirazuba	Kayonza	Ndengo	2002
97	INDAHANGARWA	Iburasirazuba	Kayonza	Ndengo	2002

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
98	KOAKA	Iburasirazuba	Kayonza	Ndengo	2002
99	ABAKERAGUSHOKA	Iburasirazuba	Kayonza	Nyamirama	2002
100	ABISHYIZEHAMWE	Iburasirazuba	Kayonza	Gasozi	2002
101	ABAKERAGUSHOKA	Iburasirazuba	Kayonza	Rutare	2002
102	INTAZI	Iburasirazuba	Kayonza	Nyamirama	2000
103	DUTERANINKUNGA	Iburasirazuba	Kayonza	Remera	2001
104	TWIFATANYE	Iburasirazuba	Kayonza	Remera	2001
105	INYABUTATU	Iburasirazuba	Kayonza	Matongo	2001
106	ABATANGANA	Iburasirazuba	Kayonza	Gashanda	1999
107	ABISHYIZEHAMWE	Iburasirazuba	Kayonza	Matongo	2002
108	DUFATANYE	Iburasirazuba	Kayonza	Fuke	2002
109	DUKUNDUMURIMO	Iburasirazuba	NGOMA	Rugarama	1999
110	TWISUNGANE	Iburasirazuba	NGOMA	Rugarama	1999
111	ISUKIRAKIZA	Iburasirazuba	NGOMA	Rugarama	1998
112	TURWANYINZARA	Iburasirazuba	NGOMA	Rugarama	1996
113	ABAJYAMUGAMBI	Iburasirazuba	NGOMA	Rugarama	1996
114	URUGWIRO	Iburasirazuba	NGOMA	Murama	1998
115	DUTERANINKUNGA	Iburasirazuba	NGOMA	Gituku	2002
116	INYAMAMARE	Iburasirazuba	NGOMA	Mushikiri	2000
117	NKUNDUBWOROZI	Iburasirazuba	NGOMA	Rusera	2002
118	TWITEZIMBERE	Iburasirazuba	NGOMA	Rusera	2002
119	DUTERANINKUNGA	Iburasirazuba	NGOMA	Rutare	2002
120	DUFATANYE	Iburasirazuba	NGOMA	Sakara	2001
121	TWISUNGANE	Iburasirazuba	NGOMA	Kibaya	2002
122	ABURUKUNDO	Iburasirazuba	NGOMA	Gituza	2001
123	ABISUNGANYE	Iburasirazuba	NGOMA	Karembo	2000
124	TWIZERANE	Iburasirazuba	NGOMA	Sangaza	2000
125	ABARIRAHAMWE	Iburasirazuba	NGOMA	Shywa	2001
126	ABAHUZAMUGAMBI	Iburasirazuba	NGOMA	Kagashi	2001
127	TWORORE KIJYAMBERE	Iburasirazuba	Kirehe	Mahama	2002
128	TWIFATANYE	Iburasirazuba	Kirehe	Mahama	2002
129	ABASHIMANKUYO	Iburasirazuba	Kirehe	Ndengo	2002
130	ABISHYIZEHAMWE	Iburasirazuba	Kirehe	Ndengo	2002
131	NGOBOKA	Iburasirazuba	Kirehe	Ndengo	2002
132	F.H.W.F.G.	Iburasirazuba	Kirehe	Ndengo	2002
133	TWORORE KIJYAMBERE	Iburasirazuba	Kirehe	Ndengo	2002
134	JYAMBERE MWOROZI	Iburasirazuba	Kirehe	Ndengo	2002
135	UMURAVA	Iburasirazuba	Gatsibo	Ndatemwa	1996
136	GREEN VALLEY FARM	Iburasirazuba	Gatsibo	Ndatemwa	1996
137	UBUMWE	Iburasirazuba	Gatsibo	Kiramuruzi	1999
138	AVEGA	Iburasirazuba	Gatsibo	Kiramuruzi	1999
139	GIRAMATA	Iburasirazuba	Gatsibo	Ndatemwa	2001
140	KIZIGURO DAIRY COPERATIVE	Iburasirazuba	Gatsibo	Kiziguro	2007
141	RWIMBOGO DAIRY FARMERS'	Iburasirazuba	Gatsibo	Rwimbogo	2004
142	UMURAVA	Iburasirazuba	Gatsibo	Ndatemwa	1996
143	GIRAMATA	Iburasirazuba	Gatsibo	Ndatemwa	2001
144	DUKUNDAMATUNGO	Iburasirazuba	Rwamagana	Kigabiro	2008
145	CECOLA	Iburasirazuba	Rwamagana	Rubona	2008

Annex 21. Associations/Cooperatives of cattle keepers of the South Province

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
1	Giramata	Amajyepfo	Kamonyi	Nyarubaka	2007
2	Mugomero milk Koperative	Amajyepfo	Kamonyi	Runda na Rugalika	2007
3	Giramata –Musambira	Amajyepfo	Kamonyi	Musambira	2007
4	Giramata Munyarwanda	Amajyepfo	Kamonyi	Runda	2007
5	Koperative amizero	Amajyepfo	Kamonyi	Gacurabwenge	2002
6	Kopeka zirakamwa	Amajyepfo	Kamonyi	Kayumbu	2007
7	Koperative umuhuza	Amajyepfo	Kamonyi	Nyamiyaga	2002
8	Tuzamure umworozi Rukoma	Amajyepfo	Kamonyi	Rukoma	2006
9	COPEKA	Amajyepfo	Kamonyi	Kayenzi	2006
10	Giramatamaraba	Amajyepfo	Huye	Maraba	2002
11	Urwuri	Amajyepfo	Huye	Maraba	2001
12	Imanzi	Amajyepfo	Huye	Huye	2002
13	Zirakamwa	Amajyepfo	Huye	Gishamvu	2003
14	KABIKI	Amajyepfo	Huye	Ruhashya	2001
15	Nkundamatungo	Amajyepfo	Huye	Rwaniro	2000
16	Giramata –Rusatira	Amajyepfo	Huye	Rusatira	2002
17	Zirakawa-Kinazi	Amajyepfo	Huye	Kinazi	2001
18	Vumera	Amajyepfo	Huye	Tumba	2003
19	Tugandukireamajyamber	Amajyepfo	Huye	Karama	2003
20	Inyemeramihigo	Amajyepfo	Huye	Mbazi	2003
21	Dufashanyetwitezimbere	Amajyepfo	Huye	Tumba	2000
22	Umushumbamwiza	Amajyepfo	Huye	Kigoma	2000
23	Duhange	Amajyepfo	Huye	Simbi	2001
24	Duhurizehamwe	Amajyepfo	Huye	Simbi	2001
25	Umurava	Amajyepfo	Huye	Simbi	2001
26	Wisungane	Amajyepfo	Huye	Simbi	2001
27	Ingabo	Amajyepfo	Huye	Simbi	2001
28	Orora	Amajyepfo	Huye	Simbi	2001
29	COP GIRINKA	Amajyepfo	Nyaruguru	Kibeho	2000
30	COP GIRINKA	Amajyepfo	Nyaruguru	Ruramba	2000
31	COP GIRAMATA	Amajyepfo	Nyaruguru	Mata	2001
32	COP MUNYURANGABO	Amajyepfo	Nyaruguru	Rusenge	2002
33	COP GIRINKA	Amajyepfo	Nyaruguru	Ruheru	2007
34	COPAPEMU	Amajyepfo	Nyaruguru	Munini	2007
35	COP GIRINKA CYAHINDA	Amajyepfo	Nyaruguru	Cyahinda	2007
36	COP GIRINKA	Amajyepfo	Nyaruguru	Nyabimata	2007
37	COGIKI	Amajyepfo	Nyaruguru	Kivu	2006
38	COP GIRINKA	Amajyepfo	Nyaruguru	Muganza	2007
39	COP GIRINKA	Amajyepfo	Nyaruguru	Busanze	2007
40	COP GIRINKA	Amajyepfo	Nyaruguru	Ngoma	2007
41	Nkundamatungo	Amajyepfo	Gisagara	Gikonko	2006
42	Terimbere	Amajyepfo	Gisagara	Gishubi	2007
43	Girinka	Amajyepfo	Gisagara	Kigembe	2007
44	GFC&GIDECO	Amajyepfo	Gisagara	Ndora	2007
45	Girinka association	Amajyepfo	Gisagara	Nyanza	2007
46	Girinka association	Amajyepfo	Gisagara	Kibilizi	2007
47	Girinka association	Amajyepfo	Gisagara	Kansi	2007
48	Girinka association	Amajyepfo	Gisagara	Mukindo	2007
49	Girinka association	Amajyepfo	Gisagara	Mugombwa	2007
50	Girinka association	Amajyepfo	Gisagara	Muganza	2007

N°	Cooperative/Association	Work Station			
		Province	District	Sector	Year of birth
51	Girinka association	Amajyepfo	Gisagara	Save	2007
52	Girinka association	Amajyepfo	Gisagara	Mamba	2007
53	Girinka association	Amajyepfo	Gisagara	Musha	2007
54	AKOPAMUKI	Amajyepfo	Ruhango	Mwendo	2000
55	Umuhuza	Amajyepfo	Ruhango	Kinazi,Ntangwe	2005
56	Turengeraborozi	Amajyepfo	Ruhango	Bweramana, Kinihira,Kabagali	2004
57	Giramata	Amajyepfo	Nyamagabe	Gasaka	2000
58	COOPEGI-Uwinkingi	Amajyepfo	Nyamagabe	Uwinkingi	2001
59	IAM (Ishyirahamwe ry'aborozi ba Mushubi)	Amajyepfo	Nyamagabe	Mushubi	2000
60	Cooperative y'aborozi ba Kibumbwe	Amajyepfo	Nyamagabe	Kibumbwe	2000
61	Cooperative GIRINKA	Amajyepfo	Nyamagabe	Buruhukiro	2007
62	Cooperative y'aborozi ba Gatare	Amajyepfo	Nyamagabe	Gatare	2007
63	COODAJEM	Amajyepfo	Nyamagabe	Kaduha	2003
64	COPABARU	Amajyepfo	Nyamagabe	Kamegeri	2003
65	Ishyirahamwe ry'aborozi Nkomane	Amajyepfo	Nyamagabe	Nkomane	2000
66	Coperative Kundinka	Amajyepfo	Nyamagabe	Cyanika	2000
67	Coperative Umurimo	Amajyepfo	Nyamagabe	Tare	2000
68	Coop y'aborozi ba Musebeye	Amajyepfo	Nyamagabe	Musebeya	2000
69	COOP Girinka Musange	Amajyepfo	Nyamagabe	Musange	2007
70	Coop Girinka Urugero	Amajyepfo	Nyamagabe	Kitabi	2007
71	Tuzamurane kubuzima	Amajepfo	Muhanga	Shyogwe	2006
72	Twiyegeranye	Amajepfo	Muhanga	Cyeza	2005
73	COEBODAM	Amajepfo	Muhanga	Muhanga	2004
74	Twibature	Amajepfo	Muhanga	Shyogwe	2006
75	KTK	Amajepfo	Muhanga	Nyarusange	2007
76	Coopapiki	Amajepfo	Muhanga	Cyeza	2004
77	Zamuka mworozi	Amajepfo	Muhanga	Cyeza	2005
78	Girumusaruro	Amajepfo	Muhanga	Rugendabali	2007
79	Twisungane	Amajepfo	Muhanga	Kabacuzi	2005
80	COPEDE	Amajepfo	Muhanga	Nyamabuye	2006
81	KOABONYA	Amajepfo	Nyanza	Busasamana	2005
82	Girinka	Amajepfo	Nyanza	Kigoma	2007
83	KOABONYA	Amajepfo	Nyanza	Mukingo	2005
84	Gwizumukamo	Amajepfo	Nyanza	Busoro	2006
85	Twiyororere kijyambere	Amajepfo	Nyanza	Muyira	2008
86	Zirakamwa	Amajepfo	Nyanza	Kibirizi	2007
87	COAKI	Amajepfo	Nyanza	Kibirizi	2007
88	Abishyizehamwe	Amajepfo	Nyanza	Ntyazo	2003
89	90. Duhuzimbaraga	Amajepfo	Nyanza	Ntyazo	2003
90	KOABONYA	Amajepfo	Nyanza	Rwabicuma	2005
91	Giramata mworozi	Amajepfo	Nyanza	Nyagisozi	2006
92	Duteraninkunga	Amajepfo	Nyanza	Cyabakamyi	2007

Annex 22. Persons met

Institution	Names	Post
Province du Nord	1. Boniface Rucagu	Gouverneur
	2. Déogratias Kabagamba	Secrétaire Exécutif
	3. Jean Bosco Sibomana	Chargé des relations publiques et Guichet unique
MINAGRI	4. Ernest Ruzindaza	SG
Province de l'Ouest	5. Nkurayije Edouard	Secrétaire Exécutif
	6. Laurent Nsengiyumva	Secrétaire Permanent du Gouverneur
PADEBL	7. Michel Ngarambe	Coordinateur du Projet
	8. Gilbert Mutoni	Responsable Vulgarisation
	9. Séraphine Umurerwa	Responsable Animation et Crédit
	10. Eliane Kayitesi	Responsable Suivi & Evaluation
	11. Zibie Nyiramajyambere	Assistante Suivi & Evaluation
RARDA	12. Théogène Rutagwenda	DG
	13. Alphonse Nshimiyimana	Head of Genetic Improvement Unit
Laiterie Nyanza	14. Lt Jacques Karekezi	Factory Manager
	15. Joseph Mutagoma	General Manager
	16. Gaëtan	
District Rulindo	17. Déo Nzamwita	Vice Mayor, Economic Affairs
	18. Augustin Dusengimana	Director, Planning
	19. Emmanuel Murara	Director, Infrastructure
District Gakenke	20. Félicien Mporanyimana	Vice Mayor, Economic Affairs
	21. Jean Nshimiyimana	Agronome
Laiteri de Nyirangarama	22. Gérald Sina	DG
District Rubavu	23. Evariste Bizimana	Vice Mayor, Economic Affairs
	24. Marcel Rwabutogo	Secrétaire Exécutif
	25. Bunyoni Jean Paul	Vétérinaire Gishwati
	26. Robert Kalisa	Agronome
District Ngororero	27. Jacques Habimana	Vice Mayor, Economic Affairs
	28. Joseph Hakizimana	Directeur, Planification
District Rutsiro	29. Odette Mukantabana	Vice Mayor, Social Affairs
	30. Patrick Muhizi	Directeur, Agriculture & Elevage
	31. J. M. Lambert Mpimbaza	Chargé Agriculture & Elevage
	32. Willy Mwiza	Vétérinaire de la Province de l'Ouest
	33. Aniceth Nsanzabera	Vétérinaire Mushubati

Institution	Names	Post
	34. Théoneste Munyazogeje	Vétérinaire Mubuga
	35. Jean Paul Sinzabaheza	Vétérinaire Manihira
	36. Félicien Ntahombasanze	Vétérinaire Rusebeya
	37. Claudine Mukamurenzi	Vétérinaire Ruhango
	38. Valens Bizimungu	Vétérinaire Kigeyo
	39. Marcel Simbizi	Vétérinaire Nyabirasi
	40. Emmanuel Barayavuze	Vétérinaire Mushonyi
	41. Frédéric Nzabonimpa	Vétérinaire Boneza
	42. Pascal Niyonsenga	Vétérinaire Kivumu
	43. J. Damascène Nizeyimana	Vétérinaire Gihango
	44. M. Chantal Nyiransabimana	Vétérinaire Murunda
	45. Javan Habimana	Vétérinaire Musasa
District Karongi	46. Alphonsine Mukangwije	Director, Planning
	47. Sylvère Habimana	Agronome
	48. Willy Mwiza	Vétérinaire de la Province de l'Ouest
	49. Fidèle Niyonzima	Vétérinaire Bwishyura
	50. Télésphore Ahigereje	Vétérinaire Murambi
	51. Jeannette Uwingabire	Vétérinaire Twumba
	52. Augustin Bukavu	Vétérinaire Rubengera
	53. J. Damascène Uwiragije	Vétérinaire Murundi
	54. Daniel Kanyamugenga	Vétérinaire Gishyita
	55. Diane Turikumwe	Vétérinaire Gitesi
	56. Solange Nishimwe	Vétérinaire Rugabano
	57. Monique Mukamwiza	Vétérinaire Mubuga
District Nyamasheke	58. Jean Pierre Ndagijimana	Secrétaire Exécutif
	59. Albert Sengambi	Agronome
District Rusizi	60. Théogène Nkuranga	Vice Mayor, Economic Affairs
	61. Espérance Umutoni	Vice Mayor, Social Affairs
	62. Boniface Bajyanama	Secrétaire Exécutif
	63. Faridha Uwamahoro	Vétérinaire
District Ruhango	64. Thacien Uwayisaba	Agronome
	65. Syridion Dusabimana	Vétérinaire de la Province du Sud
	66. Job Kanyarwanda	Vétérinaire Bweramana
	67. Laban Kwizera	Vétérinaire Kinihira
	68. Védaste Nsabimana	Vétérinaire Kabagali
	69. Wellars Kamanzi	Vétérinaire Kinazi
	70. Innocent Bizimana	Vétérinaire Byimana
	71. Léopold Sinamenye	Vétérinaire Ntongwe

Institution	Names	Post
	72. Hormisdas Gakumba	Vétérinaire Ruhango
	73. Martin Ndagijimana	Vétérinaire Mwendo
District Burera	74. Aimé Bosenibamwe	Mayor
	75. Come Habineza	Director, Planning
	76. Jean Marie Vianney Kabirigi	Planificateur
	77. Jean Pierre Barigira	Chargé des statistiques
District Musanze	78. Winifride Mpembyemungu	Vice Mayor, Social Affairs
	79. J. Pierre Ndagijimana	Chargé de l'environnement & ressources naturelles
	80. Dany Twagiramungu	Chairman "Inka zirakamwa"
	81. Charles Ruzindana	Director, Planning
District Nyabihu	82. Athanase Kabera	Chargé des infrastructures
District Gicumbi	83. Bonane Nyangezi	Maire
	84. Ildephonse Butera	Vice Mayor, Economic Affairs
	85. Maximilien Niyonzima	Secrétaire Exécutif
	86. Emmanuel Akimanizanye	Directeur, Planification
	87. Ali Sanane Musangwa	Agronome
	88. Tharcisse Nzayiramya	Chargé de la planification
District Rwamagana	89. J. Baptiste Ndanyuzwe	Vice Mayor, Economic Affairs
	90. Richard Niyomwungeri,	Director, Planning
	91. Léandre Ndahayo	Agronome
District Kayonza	92. Augustin Sibomana	Vice Mayor, Economic Affairs
	93. Jackline Mutesi	Vétérinaire du district
District Gatsibo	94. Hippolyte Ndimanyi	Secrétaire Exécutif
	95. Théoneste Hitimana	Director, HR
	96. Jean Claude Butera	Agronome
	97. Jean Claude	Vétérinaire du district
	98. Dickson Kimenyi	Director, Infrastructure
District Nyagatare	99. Anselme Majoro	Vice Mayor, Economic Affairs
	100. Flick Murenzi	Vétérinaire du district
	101. Jean de Dieu	Vétérinaire UDAMACO
District Kirehe	102. Jean Pierre Rwema	Secrétaire Exécutif
	103. JMV Dusengimana	Director, Planning
	104. Habimana Emmanuel	Agronome
District Ngoma	105. Charles Ntageruka	Director, Planning
	106. Gilbert Rutayisire	Agronome
District Bugesera	107. Jean de Dieu Nkinzingabo	Agronome
District Gisagara	108. Léandre Karekezi	Maire
	109. Eugène Muzuka	Secrétaire Exécutif

Institution	Names	Post
	110. Jules Kazungu	Chargé des statistiques
	111. Eugène Hakizimana	Vétérinaire
	112. Jean Hemerintwali	Agronome
District Nyaruguru	113. Domina Dusabeyezu	Chargée des statistiques
	114. Nelson Muhayimana	Agronome
	115. Martin Uwineza	Vétérinaire
District Huye	116. Frodouald	Planificateur
	117. Ildephose Gatete	Vétérinaire Ngoma
	118. Calliope Kayiranga	Vétérinaire Karama
	119. Béline Kagwesage	Vétérinaire Mukura
	120. Janvier Kayigamba	Vétérinaire Tumba
	121. Jean Pierre Singirankabo	Vétérinaire Huye
	122. Vénant Mukeshimana	Vétérinaire Kinazi
	123. Prosper Ingabire Rukundo	Vétérinaire Simbi
	124. Claudine Nyiramana	Vétérinaire Rusatira
	125. Jean Pierre Ngabo	Vétérinaire Gishamvu
	126. Fiacre Ruzindana	Vétérinaire Maraba
	127. Euphrasie N. bakinamurwango	Vétérinaire Mugano
District Nyamagabe	128. Donath Twagirayezu	Vétérinaire Kitabi
	129. Delphine Ingabire	Vétérinaire Uwinkingi
	130. Jean Claude Uwizeyimana	Vétérinaire Kaduha
	131. Dieudonné Dusabimana	Vétérinaire Kibilizi
	132. François Xavier Zirarushya	Vétérinaire Gatare
	133. Thomas Sibomana	Vétérinaire Tare
	134. Gaspard Bakundakwita	Vétérinaire Buruhukiro
	135. African Mugiraneza	Vétérinaire Mbazi
	136. Vénuste Manzi	Vétérinaire Nkomane
	137. Dieudonné Habimana	Vétérinaire Kamegeli
District Nyanza	138. Joseph Bizimana	Vétérinaire
	139. Janvier Mutesi	Agronome
	140. Angelique Mukamana	Vétérinaire Rwabicuma
	141. Vital Nkurunziza	Vétérinaire Busoro
	142. B. Joseph Bizimana	Vétérinaire Busasamana
	143. Noel Hitimana	Vétérinaire Kibirizi
	144. Egide Nsengimana	Vétérinaire Muyira
	145. Chantal Mukaruganza	Vétérinaire Kigoma
	146. J. Claude Nyabyenda	Vétérinaire Cyabakamyi
	147. Blandine Mukantegeye	Vétérinaire Nyagisozi

Institution	Names	Post
District Kamonyi	148. Justin Mukiza	Agronome
Ruyenzi Dairy [Runda]	149. Paul Uwimbabazi	DG
District de Muhanga	150. Faustin Sunzu	Agronome
	151. Madelène Uwizeyimana	Vétérinaire Shyogwe
	152. Thaddée Habumuremyi	Vétérinaire Rugendabari
	153. Clément Murenzi	Vétérinaire Nyabinoni
	154. Christine Mukeshimana	Vétérinaire Mushishiro
	155. Laetitia Karekezi	Vétérinaire Nyamabuye
	156. Déo Niyonsenga	Vétérinaire Rongi
	157. Lazare Kamarade	Vétérinaire Kabacuzi
	158. Védaste Muramira	Vétérinaire Kiyumba
	159. Elyse Umuhoza	Vétérinaire Nyarusange
District Kicukiro	160. Innocent Uwurukundo	Agronome
District Gasabo	161. Faustin Ntiramira	Agronome
CAPMER	162. John Ndikuwera	Chargé du développement des Affaires [Agri business]
	163. Callixte Kagaba	Chargé du développement des Affaires [Education et Formation Entreprenariales]
FSP	164. John Bosco Kabagambe	Director Enterprise and Business Growth Department
BRD	165. Juvenal Kalema	Manager, Agriculture and Animal Resource Unit
Banque Populaire du Rwanda	166. Vestine Mukanyonga	Commercial Officer
CSS	167. Kalisa	Credit Manager
Land O' Lakes	168. Roger Steinkamp	Country Manager
LWF	169. Sophie Gebreyes	Program Coordinator
Laiterie Inyange	170. Kanimba	Director General
	171. Rucaca Pascasie	Quality Assurance Manager
Send a cow Rwanda	172. Henry Pomeroy	Executive Director
HPI	173. Josephine Umuganwa	Program Secretary
PAPSTA	174. Felly Musoni	Monitoring and Evaluation Officer
Eleveurs	175. Kagofero Rwabuhirambuga	
	176. Rwibasira Patrick	
	177. Gakaramu Buseye	
	178. Gapira Aron	
	179. Kabayiza Sekabanza	
	180. Kanyamagari Donath	

Institution	Names	Post
	181. Kadari Jean Claude	
	182. Masuhuko Ndirikije	
	183. Safari Augustin	
	184. Nubaha Rodrigue	
	185. Turamusabira Eric	
	186. Munyagishari Charles	
	187. Mbangurira Rwarika	
	188. Kabayiza Jonas	
	189. Kankundiye Stéphanie	
	190. Kanyange odette	
	191. Subwanone Appolinaire	
	192. Gasana Aminadam	
	193. Nshimiyimana Elie	
	194. Kayitaba Emanuel.	
	195. Ruhamiliza Evariste.	
	196. Mugwaneza Bosco	
	197. Nsengiyumva Seprian	
	198. Masozera Silas	
	199. Mpayimana Siriake	
	200. Kananga Evariste	
	201. Ntirenganya	
	202. Karera	
	203. Maria	
	204. Ngango Zackaria.	
	205. Migabo Vicent	
	206. Igenaukwayo Japhet	
	207. Ntenda Innocent	
	208. Ngango Jaferi	
	209. Ntihabose Mudesta	
	210. Rurangirwa Jado	
	211. Sengarasi Prudance	
	212. Mucumbitsi	
	213. Gashumba Innocent	
	214. Ndayisaba Philipple	
	215. Gasozi Holding	
	216. Kaributusi	
	217. Uzamukunda	
	218. Munyakazi	

Institution	Names	Post
	219. Ndushabandi	
	220. Murenzi	
	221. Jack	
	222. Munyaneza	
	223. Gasabune	
	224. Karamira	
	225. Karega	