MOROCCO ECONOMIC COMPETITIVENESS

OPTIMIZING WATER CONSUMPTION IN THE DAIRY INDUSTRY: THE CASES OF COLAIMO OF OUJDA, MONLAIT OF BERKANE, AND HALIB OUED ZA OF TAOURIRT

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MOROCCO ECONOMIC COMPETITIVENESS PROGRAM

OPTIMIZING WATER CONSUMPTION IN THE DAIRY INDUSTRY: THE CASES OF COLAIMO OF OUJDA, MONLAIT OF BERKANE, AND HALIB OUED ZA OF TAOURIRT

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TABLE OF CONTENTS

EXECUTIVE SUMMARY **3**

INTRODUCTION AND CONTEXT **5**

CHOICE OF PILOT PLANTS AND THE CREATION OF A COORDINATION COMMITTEE **9**
CHOICE OF PILOT PLANTS 9
CREATION OF THE COORDINATION COMMITTEE 9
SCOPE OF THIS MISSION 10
1. Industry targeted as part of this mission *10*
2. Tasks to undertake *10*

THE CASE OF COLAIMO **11**
PRESENTATION OF THE COOPERATIVE 11
1. Overview of the cooperative *11*
2. Location *12*
3. Description of industrial and commercial activities *12*
RESULT OF THE AUDIT 15
1. Audit activities *15*
2. Quantification of inputs other than water *15*
3. Water consumption *15*
4. Quantification of discharges *17*
ANAYLSIS OF RESULTS FROM THE AUDIT AND IDENTIFICATION OF WATER CONSERVATION AND POLLUTION PROJECTS 20
1. Actions already taken by COLAIMO *20*
2. Identified Projects *21*
3. Project summary sheets *21*
ACTION PLAN 23
1. Actions to undertake *23*
2. Schedule *24*

THE CASE OF MONLAIT **25**
PRESENTATION OF THE DAIRY 25
1. Overview *25*
2. Location *25*
3. Description of industrial and commercial activities *26*
AUDIT RESULTS 26
1. Conduct of the audit *26*
2. Observed failures *26*
1. LLLLL *26*
ACTION PLANS 27
1. Actions to undertake *27*
2. Schedule *27*

THE CASE OF HALIB OUED ZA **29**
PRESENTATION OF THE DAIRY 29
1. Overview *29*
2. Location *29*
DESCRIPTION OF INDUSTRIAL AND COMMERCIAL ACTIVITIES 30
1. Industrial production *30*
2. Marketing *30*

RESULTS OF THE AUDIT 30
1. Conduct of the audit *30*
LLLLL *30*
2. Observed failures *31*
RECOMMENDATIONS AND ACTION PLAN 31

FIGURES AND TABLES

TABLE 1. PRESENTATION OF COLAIMO 11
TABLE 2. CLEANING TWO PASTEURIZERS 18
TABLE 3. AVERAGE DAILY DISCHARGES FROM THE DAIRY 19
TABLE 4. MINIMUM POLLUTION LOADS 19
TABLE 5. PROVISIONAL TIMETABLE OF ACHIEVEMENTS 24
TABLE 6. PRESENTATION OF MONLAIT 25
TABLE 7. PROVISIONAL TIMETABLE OF ACHIEVEMENTS 27
TABLE 8. PRESENTATION OF THE OUED ZA DAIRY 29

FIGURE 1. AERIAL VIEW OF COLAIMO ..... 12~~14~~
FIGURE 2. DIAGRAM OF YOGURT PRODUCTION: ..... 14~~16~~
FIGURE 3. WATER DISTRIBUTION PATTERN ..... 16~~18~~
FIGURE 4. AERIAL VIEW OF THE DAIRY ..... 26~~28~~
FIGURE 5. AERIAL VIEW OF THE DAIRY ..... 30~~32~~

EXECUTIVE SUMMARY

The proposed action plan is structured around the broad objectives of reducing water consumption, protecting the environment, and promoting the emergence of competitive corporate citizens. This plan seeks to develop the capabilities of dairy facilities to meet the challenges that come with playing an aggregator role and upgrading the dairy industry.

The three audited dairy facilities have different goals and orientations that have led to the tailored proposed actions and recommendations.

The proposed actions are summarized in:

i. Establishing an environmental management program

ii. Supporting the implementation of the ISO 14000 certification

iii. Supporting the introduction of more efficient water treatment techniques

iv. Helping with the reduction of CO2 emissions

INTRODUCTION AND CONTEXT

Faced with a continuously growing demand for water in the Oriental, a region known for its semi-arid climate, the supply is limited. This is due in part to the reduction of mobilized volumes by various hydraulic structures, groundwater depletion by poorly controlled pumping, as well as the quality degradation of these resources.

Water needs will further increase in the future through agriculture intensification, urban development due to a growing population, the creation of new water-based tourism projects such as the Saïdia spa resort, and the planned industrial development project which includes a Technopôle in Oujda, an Agropôle in Berkane, and new industrial zones in the region.

All short-term projections show that future developments will have two major consequences that will inevitably impact the region's development. These could prove fatal and should be taken into consideration during planning. Excessive operation of the resource would quantitatively lead to an imbalance between supply and demand while creating a structural water deficit that would be difficult to restore. Additionally, the activities coming from future developments would detrimentally effect resource quality. The living proof of this is already underway in Taourirt. Olive growing activity development in the region results in the production of margins that are difficult to control, thereby undermining Oued Za.

Water will be a major challenge for years to come. While waiting for the decrees implementing the water act, manufacturers must incorporate the concept of clean technology into their overall management. Pollution must be addressed not only downstream from production facilities (at the end of pipes), but also at this pollution's origin point. Recycling and re-using wastewater is fundamentally important, as demonstrated by a European dairy example. S.L.V.O. rejects 500 CU. meters daily of liquid waste carrying 1.5 tons of DBO5. After introducing clean technologies, more than 350 m3 of water are recycled, representing 70% of total consumption. Compared to the initial state, the dairy reduced 70% of its discharges and consequently reduced its withdrawals from the natural environment by the same percentage. In terms of pollution, flows of suspended solids were reduced by 100% and those of DBO5 and DCO were reduced by 90%.

The MEC project, operating in the two regions of the Oriental and Doukkala, set about the task of introducing into water management both an industry approach and the concept of water valuation. Though this holistic approach is very simple in appearance, it requires the implementation of production programs to maximize value for each cubic meter of water consumed. The analysis is further complicated in terms of working on heterogeneous and non-integrated channels, as they are marked by discontinuities and characterized by sub-sectors. This is the case in the dairy industry, whose upstream consists of forage plant production, the bulk of the industry in milk production, and the downstream in milk processing and meat production.

As in any industry, water consumption in supply chain links is not subject to the summation of any legislation. It is the industrial liquid wastes that are subject to the Water Act 10-95. This law strengthens the "polluter pays" principle, and defines the limits of water pollution by industrial sector. Currently, there is a "Norms and Standards" committee that brings together all concerned bodies. This committee capitalizes the gains in the field of standardization and is active in the process of developing national standards.

Companies say citizens are not waiting to be told by a regulation to act. They follow an environmental policy founded on responsibility for contributing to sustainable development. They are endeavoring to reduce water and energy consumption, focus on clean energy, limit wastewater discharges, and reduce the weight of solid waste. The ISO 14000 provisions are applied these efforts.

Elsewhere in the world, some companies have even engaged in a "total" development approach with significant results on all fronts, thus achieving a significant improvement of the "Water Footprint" with a substantial decrease in water consumption (up to 70%) and a sharp reduction in CO_2 emissions through lower energy consumption (over 50%).

The spread of good environmental practices in the commercial sector must be preceded by preliminary work in the field. Such field work would include assessing major manufacturers' water management experiences, desires, and fears, identifying opportunities for saving water and reducing pollution loads, and identifying the technical and financial mechanisms to transform these opportunities into feasible projects. The present work consists of implementing clean technology water saving techniques and wastewater treatment processes, as part of good practices in the Oriental's industrial units. It is important to choose facilities that will serve as models for the spread of good practices, to carry out early audits, and develop feasibility studies for selected projects.

The objectives of this work are the following:

- Raising industrial units' awareness on optimal water use and environmental protection, focusing on developing understanding of the green label and a certification strategy for ISO 14000;
- Strengthening facilities' technical capabilities to make water and environmental management an overall management component;
- Creating successful models for other industries in the region;
- Contributing to the development of integrated water resource management and the control of industrial pollution; and
- Preparing industrial units to comply with the requirements of the Hydraulic Basin Agency of Moulouya, the agency responsible for the integrated management of water resources.

At first, the MEC project identified facilities that would be interested in pursuing these goals. These facilities would benefit from the following services:

- Conducting a study on optimizing the participating facility's water consumption. The comprehensive water consumption of the facility would be assessed in terms of how rationally it is used, balanced with the constraints imposed by the manufacturing process. The study would provide recommendations based on a clear analysis of performances and operating constraints. By working closely with facility officials, these recommendations would be built into projects and presented as fact sheets. The prioritization of these projects will be made on the basis of the investment cost of each project.
- Determining where sewage treatment of wastewater is necessary. To assess the pollution load of discharges and identify the appropriate treatment, discharges will be analyzed for all pollution indicators.
- Conducting a feasibility study and engineering study of selected water-saving projects. The study will address both technical and financial aspects of projects. The financial organization will match the proposed project.

CHOICE OF PILOT PLANTS AND THE CREATION OF A COORDINATION COMMITTEE

CHOICE OF PILOT PLANTS

This mission, which has a goal of optimizing water consumption in the Orientals' industrial units took place in three phases. In the first phase, an exploratory visit was undertaken in the region. The selection of plants that will serve as pilot projects was made on the basis of a series of previously identified criteria. Candidate industries must:

- Belong to a highly developed sector in the region;
- Have the potential to provide an aggregation role in their industry;
- Be part of water-consuming industries;
- Harm the environment through liquid waste;
- Be led by a management that will adhere to the principle of water savings and environmental management.

After this phase, three types of industrial activities have been identified. They are milk processing, sugar production in Zaio, and olive pressing in Taourirt. The region currently has three dairies, one sugar refinery, and more than a half dozen olive crushing mills. The identified processing industries, which are situated downstream of three potential industries in the region, were discussed with MEC and USAID project officials in a meeting scheduled for this purpose.

CREATION OF THE COORDINATION COMMITTEE

The project's main objective is to spread past projects' good practices and experience. MEC aims to educate all organizations interested in water management and involve them in all stages of this project. To strengthen this participatory-based approach, MEC wanted to make this project a core catalyst in the fight against pollution and the preservation of water resources in the Oriental region. The first move towards this objective will be the creation of a coordination committee.

After information meetings held separately with various agencies, we intend to organize a meeting announcing the start of the project after the preparation of the action plan. This meeting will simultaneously validate the action plan and be a space for formalizing a roadmap of participants' roles and responsibilities. Bodies that may serve in this committee are:

- Candidate industries, and this specific COLAIMO case;
- Hydraulic Basin Agency of Moulouya;
- Regional Directorate of ONEP;
- Regional Delegation of Trade and Industry;
- Regional Inspectorate of the Environment.

This list is not exhaustive and any other organization working in the field of water could join this Committee. All committee members will be signatories to an agreement. Each partner will commit to contributing to the effort of optimizing water consumption in the agro-processing sector. The Hydraulic Basin Agency is cited as an example of a member that is willing to participate financially.

SCOPE OF THIS MISSION

Industry targeted as part of this mission

Per MEC directives, the dairy industry is the focus of this first mission. The three dairies in the region have been audited via a data collection campaign. This was organized on site and included analysis of the data obtained. The report presents the results of the analysis.

Tasks to undertake

The tasks included in the framework of this mission are as follows:

- Promote the industrial unit's adherence to the principles of integrated water resource management;
- Conduct an environmental audit within the plant. This audit will:
  - Quantify the flow at each unitary operation,
  - Establish water balance sheets and identify water-saving projects;
- Develop an action plan presenting all recommendations to optimize water consumption and reduce environmental impact.

THE CASE OF COLAIMO

PRESENTATION OF THE COOPERATIVE

Overview of the cooperative

The main information concerning the cooperative is summarized in the table below:

Table 1. Presentation of COLAIMO

Information	Dairy
Date of Creation	1956
Investment	MAD 242,000,000
Capacity:	150 000 liters/day
Range of manufactured products	Pasteurized milk, fermented milk, yogurt, butter, and lben
Collection areas	Oujda, Berkane, Nador, Taourirt, Guercif and Jerada.
Number of Employees	300 people
Market	Market mainly covering the region

Based in Oujda, COLAIMO meets all of the criteria and was chosen to receive technical assistance from the MEC Project. An agreement subsequently developed by the project will make this a reality with the signature of COLAIMO's commitment to adhere to the concept of integrated water resource management.

COLAIMO was erected in the regional Green Morocco Program as the main dairy industry aggregator in the Oriental. Playing a driving role for the industry's development requires the cooperative to acquire efficient equipment and modern technical and commercial management tools. The challenge is to find a solution for milk production in the region. It must therefore ensure better market penetration in the region and extend its marketing to other neighboring regions. The only way to achieve these goals is to be competitive.

As COLAIMO benefits from the presence of an urban sewage network, it will face the polluter pays principle once the Water Act decrees relating to industrial discharges are implemented. As the main dairy industry aggregator and a cooperative that serves as an engine of development in the region, COLAIMO demonstrates the sustainable development of its strategy and its corporate citizenship model.

To help COLAIMO progress in this role, in its first phase the MEC project proposes providing technical assistance to ensure good environmental management of its production workshops. Note that quality management is already supported by the cooperative itself, and it is indeed HACCP certified. With quality assurance and environmental management, COLAIMO's competitiveness can only be strengthened.

Location

The plant is located in the industrial zone bordering the town of Oujda. The area housing the dairy was previously rural. Currently, it is home to intense urban activity, and a large urban project is in progress. The satellite image shown below gives an idea of COLAIMO's location.

Figure 1. Aerial view of COLAIMO

Description of industrial and commercial activities

Recently rehabilitated, the dairy is equipped with modern machinery and equipment. It is supplied by eight tankers owned by the cooperative itself.

a. Industrial production

COLAIMO consists of four units: pasteurized milk, lben, cream butter, and desserts. On average, the dairy receives 120 tons of milk per day and produces about 80 tons of pasteurized milk. The rest is divided among the other products.

Technology overview of pasteurized milk

After being normalized at the rate of required fat content, the milk passes through heat exchangers to be pasteurized. COLAIMO has two pasteurization lines and treats an average of 80,000 l/day of milk. The packaging machines ascetically pasteurize milk in flexible half-liter plastic bags.

These are other various operations undergone by pasteurized milk:

Cooling: The temperature of milk is reduced to a tolerable level. The temperature of milk must be less than or equal to 6°C. The milk must be maintained at the same temperature during storage.

Mechanical purification: Before processing, the milk must be mechanically clarified. This step is performed at reception. A centrifugal separator is used to perform this operation.

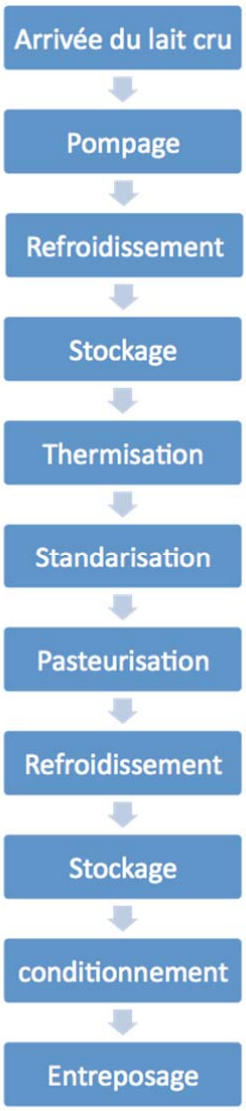
Thermisation: Thermisation is conducted in a plate heat exchanger. The milk is heated to a temperature between 57 and 68 degrees with a maximum holding time of 30 seconds. Thermisation is often used to improve milk's ability to be stored before processing.

Standardization of fat: The fat content of milk is subject to significant fluctuations. Skimming is a mechanical separation of cream that reduces the amount of fat to the regulatory level of 3%. The operation is performed in a separator. The optimum skimming temperature is between 50 and 60°C.

Homogenization: Homogenization is used primarily in the dairy industry to prevent the separation of fat globules by reducing their diameter up to 0.5-1 μm, increasing their number and surfaces a thousand times. The optimal operating conditions are between 60 and 70 °C for temperature and 130 and 140 bars for pressure.

Heat treatment: The main goal of heat treatment is to kill pathologic microorganisms in milk. This can be done with a pasteurization temperature of at least 72 °C during 15 seconds or another combination of temperature and duration of treatment, resulting in efficient pasteurization (negative phosphatase test and a positive peroxidase test).

Below, we present the process of pasteurized milk production process as used by COLAIMO:



Technology overview of yogurts and desserts

The preparation of these products uses milk, powdered milk, water, sugar, and flavorings. The resulting mixture is pasteurized before being inoculated. The fermented product may undergo further treatment before being packaged in plastic pots. The standard process flow diagram is presented below:

Figure 2. Diagram of yogurt production:

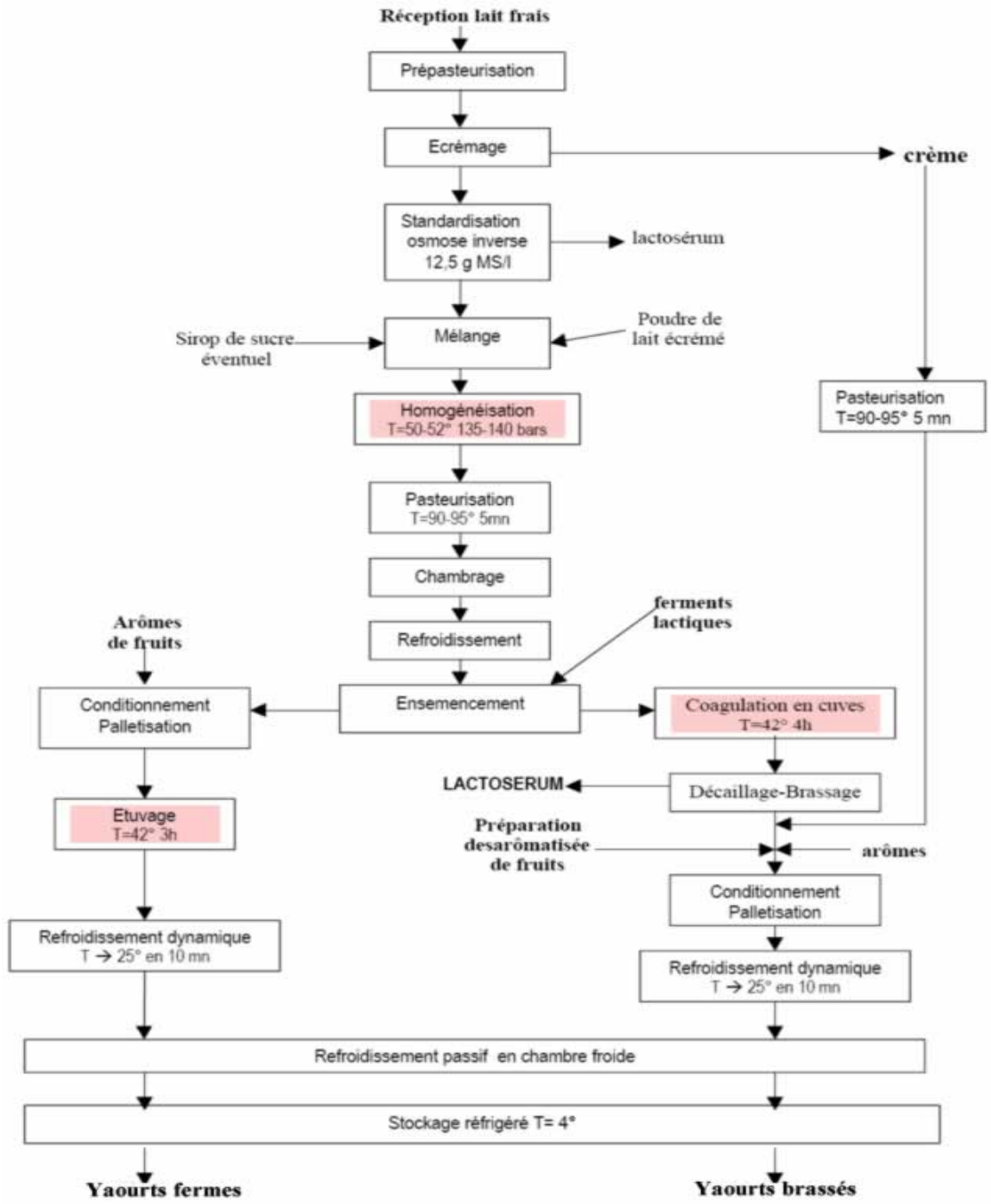


Figure 11 : diagramme de fabrication des yaourts

Powdered milk

Overproduction of milk collected during the high lactation period is sent to Kenitra to be processed into milk powder.

b. Marketing

The delivery area has recently undergone a major expansion that has enabled the cooperative to expand its domestic market share. In addition to the market for the Oriental region, the distribution network extends to regions of Taza Al-Hoceima, Fes, Meknes, Errachidia, and Rabat.

RESULT OF THE AUDIT

Audit activities

Several actions were undertaken during the audit. These are mainly:

- Identifying and quantifying the consumption and discharges;
- Preparing balance sheets;
- Identifying and analyzing water savings projects.

Quantification of inputs other than water

a. Consumption of chemical products

The average specific consumptions are respectively about 1 kg of sodium carbonate, 1 kg of nitric acid, and 0.5 kg of disinfectant per ton of treated milk.

b. Energy consumption: Oil and Electricity

COLAIMO has two boilers with a total capacity of 4.4 tons/h. If operating at full capacity, the annual N°2 oil consumption would be 90 tons/year.

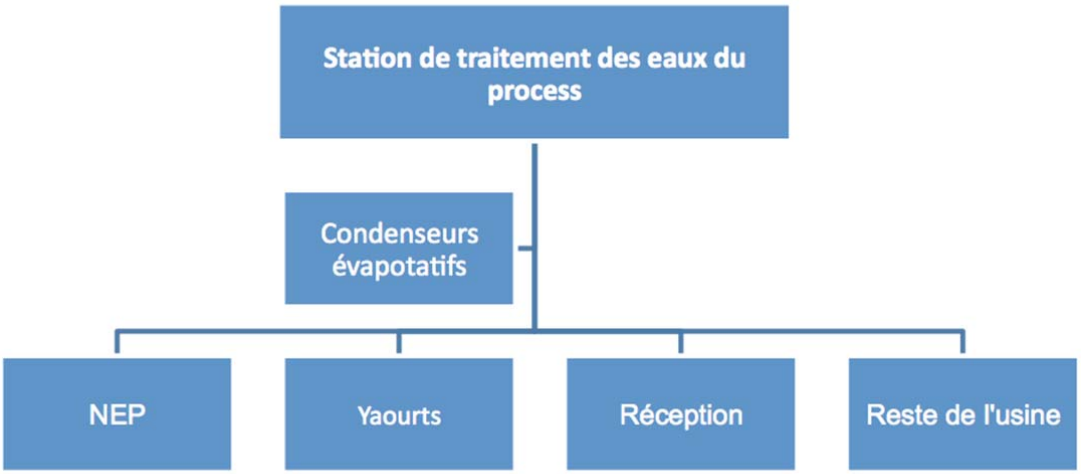
COLAIMO's annual consumption appears normal. Analysis of the power factor and the power demand were not made. COLAIMO could not give us the invoices issued for 2009-2010 in time.

Water consumption

a. Network description

The water consumed by COLAIMO comes from the RADEEO network and drilling. All process water is softened and treated. The water distribution pattern is presented below:

Figure 3. Water distribution pattern



The treated water is sent to a large 500-ton capacity tank for storage. The various workshops are offered water from this tank by a mainline meter equipped with a general meter. The daily readings on this meter are recorded in a register. There are also two other meters installed in the network supplying the cold production workshop and that of the second NEP used in cleaning the downstream portion of the production line. Note that the plant uses a second NEP in the cleaning of the downstream portion of the line.

b. General consumption of the plant

The analysis of meter readings during 2009 and 2010 show that COLAIMO's daily water consumption is around 310 m3/day. In relating this use to the average daily treated volumes over the same period, COLAIMO's specific consumption is around 4 liters of water/liter of treated milk.

The water consumption workshops are:

- Equipment and premise cleaning
- Steam, hot and cold water production
- Yogurt and mix development
- Machine cooling
- Refrigeration condensation
- Watering green spaces
- Other

We chose an indirect method of analysis in the absence of meters upstream of each workshop, which would have allowed us to divide the total consumption. The chosen method consists of evaluating each workshop's discharges.

Quantification of discharges

a. Product losses (milk)

About 2% of approved milk is lost in various operations incurred within the plant at around 2.4 tons/day. Two kinds of losses are recorded: (1) losses due to the material that remains adhered to the walls of equipment after each operation and are flushed down the sewer during cleaning operations, and (2) losses due to operations conducted in the tanks and cisterns at the end of each drain. Annually, COLAIMO loses just under 900 tons of milk, which is an annual shortfall of less than 5 million Dirhams.

b. Liquid waste from the dairy

The quantification and characterization of discharge is critical to evaluating water economics and informs the design of the resulting projects.

The identified discharges are:

- Equipment cleaning water;
- Floor and tanker cleaning water;
- Machine cooling water;
- Water vapor heating water;
- Cooling water used in cooling circuits;
- Push water or white water;

It should be noted that cleaning equipment is a major source of liquid waste. After each treatment, the facilities are cleaned as follows:

- Washing with water to eliminate traces of milk remaining inside the equipment;
- Washing with a diluted sodium hydroxide solution;
- Rinsing with water
- Washing with nitric acid; and
- Rinsing with water

Drainage from NEP

NEP units, used to clean a large share of dairy workshops, consist of four tanks connected to equipment in closed circuit which is cleaned after each operation. Solutions of soda and acid are prepared and stocked in the two different NEP unit tanks, and are used in multiple cleanings before being sent down the drain when they are exhausted. It should be noted that final rinse waters are only partially recovered and used in the first wash during subsequent cleaning.

Some equipment is cleaned again in open circuit. If the cleaning operations are the same as those of NEP, there is no recycling of acid solutions, sodium carbonate, or rinsing water.

The NEP is in charge of cleaning the 35 circuits that make up the dairy. Based on the flow of the pump supplying the NEP with water (20 m3/h) and the duration of the pre-washing and rinsing phases, more than 140 m3/day of water is discharged through the sewer. More than half of this volume is clean because it is rinsing water.

Cleaning pasteurizers operating once daily results in discharges that were evaluated based, as before, on the pump flow rate and the duration of each phase. The result of this assessment is included in the table below:

Table 2. Cleaning two pasteurizers

Pasteurizer	Pumped flow	Phase	Discharges per phase m3 /J	Total discharges m3 /J
Pasto milk		Prewashing Rinsing 1 Rinsing 2	1.5 1.5 1.5	4.5
Pasto of derivative products		Prewashing Rinsing 1 Rinsing 2 Sanitation	1 1 1 1.5	4.5

Cleaning pasteurizers generates water discharges of 9 m3/day.

Cooling

Only the cream separator and conditioners are continuously cooled. It was found on site that the separator is cooled in a closed circuit and therefore generates no appreciable loss of water. As for conditioners operating 12 hours/day that are cooled through a water flow of about 1.5 liters/mn on average, their water consumption is then estimated at 1 m3/day.

Evaporative condensers

Oujda is located in a semi-arid zone where the water problem is acute. From the start, the choice of this type of condenser is subject to discussion. The lack of meters on this circuit prevents us from evaluating the losses in this operation. That said, we believe that for the climatic conditions prevailing in the region and the operating conditions of condensers, the losses may not be negligible.

White water

This is also known as push water because after emptying tanks or cisterns, water is used to push the milk into the circuits. Some of the milk mixed with water is sent directly to the sewer. It is also one of the main sources of milk loss during the manufacturing process. These waters are rich in biodegradable material and it makes sense to us them as low-level reusable products in other sectors, such as the production of animal feed.

Floor cleaning

Cleaning is conducted after each operation. We note that the use of the automatic washer-disinfector minimizes water consumption during cleaning.

Crate washing

Crate washing consists of three tubs. The first two tubs are heated with steam. The prevailing temperatures are 40°C and 70°C, respectively. Although consumption is not significant in this machine, operation and design improvements can greatly reduce them. Repairing leaks and water recycling in the last tub can help save ten cubic meters daily.

Summary of discharges

The amounts of various discharged waste were assessed over a period of 24 hours during the audit and are recorded in the table below.

Table 3. Average daily discharges from the dairy

Types of discharges	Source	Quantity (m3/day)
Clean discharges	Cooling water of conditioners and other equipment	5
	Make-up water of condensers and cooling tower draining	20
	Condensates	10
Polluted discharges	NEP circuit cleaning water	140
	NEP Pasteurizers cleaning water	9
	Tank cleaning water	12
	Push water	20
	Low-level creamery product	5
	Floor washing	2
	Crate washing	5
	Others	10
Total Clean Discharges		35
Total Polluted or Suspected Contaminated Discharges		202
Total Estimated Discharges		237
Total average consumption based on the discharges increased by 30%...		310

Pollutant load of discharges

The pollutant load of discharges from the dairy is a crucial parameter in choosing the option of reusing waste. Waste from a dairy generally contains sugars, proteins, fat, and residual additives (colorings, other). Environmental guidelines for liquid waste from the dairy come from goods reported in the Handbook of Pollution Prevention and Reduction (World Bank):

Table 4. Minimum pollution loads

Parameters	**Minimum values**
DBO5	50 mg/l
DCO	250 mg/l
MES	50 mg/l
P_{total}	2 mg/l
NTK	10 mg/l
Oils and Fats	10 mg/l

These values are closely related to the quantities of milk in the network. Knowing that a liter of milk lost could generate waste of 110 kg of DBO, a theoretical calculation can show that in the COLAIMO waste, one can find at least 500 mg/l of DBO, or approximately ten times its recommended value.

Gaseous emissions from the dairy

Gaseous COLAIMO discharges come from the burning of 90 tons of N°2 fuel. According to our calculations, annual gaseous emissions are around 260 tons of CO2 and five tons of SO2.

Solid waste from the dairy

The main sources of solid waste are:

- Loss during packaging;
- Packaging of consumed chemical products;
- Supply chain returns.

Solid waste discarded annually by COLAIMO is around 200 tons.

Summary of dairy discharges

- Daily consumption of water in the dairy: 310 m3/day
- Specific consumption: nearly four liters of water/liter of treated water
- Daily volume of liquid discharges from the dairy: around 240 m3/day

ANAYLSIS OF RESULTS FROM THE AUDIT AND IDENTIFICATION OF WATER CONSERVATION AND POLLUTION PROJECTS

Actions already taken by COLAIMO

COLAIMO is unquestionably committed to this project. The Cooperative has already initiated water saving actions. While waiting to assess their impact, we consider it useful to include a list of these actions in this report:

- **Floor cleaning:** The system of pressurized water jets used to clean the floor was replaced by cleaning trolleys using little or no water.
- **Cooling water from the separator:** These waters are collected and recycled in a closed loop.
- **Condensate recovery:** COLAIMO recycles nearly all of its condensates.
- **Leakage monitoring:** COLAIMO officials are vigilant about water and steam leaks inside the plant.
- **Raw water treatment plant:** COLAIMO is identifying a new raw water treatment technique based on reverse osmosis.
- **Monitoring water consumption:** COLAIMO has installed meters on certain circuits. The register of monitoring consumption exists but is difficult to use.
- **HACCP Certification:** The cooperative is already HACCP certified and is seeking ISO 22000 certification.

Identified Projects

The results of the audit revealed that there are some currently-unused opportunities for water recycling. This includes cooling water used in the cooling tower machines. Similarly both the cleaning operations delivered through NEPs and those conducted manually, are not optimized. All actions to recycle cooling water and to minimize the consumption of washing water are identified and presented as projects.

In the absence of any cheese-making activity, the DCO/DBO ratio is expected to be around 1.5. In this situation, the biodegradability of waste is therefore assured.

The water conservation and environmental management projects identified during the audit are:

Water conservation projects

1. Recycling equipment cooling water
2. Reducing make-up water of condensers and cooling towers
3. Optimizing NEP functioning
4. Recycling NEP final rinsing water
5. Reducing make-up water in crate washing

Environmental management projects

1. Installing water meters in each workshop
2. Introducing a water management program—in particular and an environmental management program
3. Supporting COLAIMO to become ISO 14000 certified

Project summary sheets

Project N°1: Recycling cooling water

Summary:

Water savings: 600 m3/year

Total earnings: MAD 4,800

The approximate cost of implementation and the time of return on investment will be developed later in a feasibility study.

Recommendations:

Currently, cooling waters are discharged directly onto the floor. For water savings and hygiene reasons, it is recommended that this project is given priority in the implementation timeline.

Project description:

The generalization of collecting, cooling, and recycling equipment cooling water will require the installation of a small tank, a small heat exchanger, and a small pump. All equipment to be cooled will be connected by a reduced diameter pipe. The installation could be done by COLAIMO technical services.

Project N°2 : Reducing make-up water of condensers and cooling towers

Summary:

Water savings: 3650 cu. m/year

Total earnings: MAD 29,200

The approximate cost of the implementation and the time of return on investment will be developed later in a feasibility study.

Recommendations:

Project to be implemented immediately.

Project description:

By optimizing the functioning of condensers and adjoints, the make-up water sent to the system can be reduced. This project aims to reduce this contribution and place draining regulatory sensors on the condenser circuits.

Project N°3: Recycling NEP final rinsing water

Summary:

Water savings: 15,000 cu. m/year

Total earnings: MAD 120,000

The approximate cost of the implementation and the time of return on investment will be developed later in a feasibility study.

Recommendations:

For reasons of water conservation and environmental management, it is recommended that this project is given priority in the implementation timeline.

Project description:

To recover the final rinsing water, there must be sufficient storage capacity. This project will install either a large tank or two average tanks, based on availability of space in the plant's interior. The scheme already used for recycling cleaning solutions must be enforced.

Given the complexity of the NEP system, it is advisable to entrust the implementation of this project to a specialized company.

Project N°4: Recycling NEP final rinsing water

Summary:

Water savings:1000 cu. m/year

Total earnings: MAD 8,000

The approximate cost of the implementation and the time of return on investment will be developed later in a feasibility study.

Recommendations:

For reasons of water conservation and environmental management, it is recommended that this project is given priority in the implementation timeline.

Project description:

Currently, NEP final rinsing water is not recovered. Depending on the availability of space around the cleaned equipment (butter-making), a tank with a 300-liter capacity (or more) will be installed and connected to a pump. This system will send the last rinsing waters into the tank and will reuse them in a subsequent cleaning operation. The implementation plan will be developed for the option preferred by COLAIMO.

ACTION PLAN

Actions to undertake

A program structured around two general objectives is recommended—the reduction of water consumption in particular and the preservation of the environment in general—by promoting the emergence of COLAIMO as a competitive corporate citizen. We seek to develop the cooperative's ability to meet the challenges posed by the Green Morocco Plan in playing an aggregator role and upgrading the dairy industry.

The five main actions enabling these objectives are:

a. Developing an environmental management program

Like the quality management program, we recommend that COLAIMO develops an environmental management program aimed at reducing water consumption and CO_2 emissions by optimizing the consumption of electricity and oil. Among other things, this program will include the description of the current situation, the identified objectives, and the implementation approach.

The actions to undertake will be of two types. The first type is managerial, as COLAIMO will be equipped with a series of management tools to ensure better management. The second action will include the implementation of the projects identified above. Each project will be preceded by a feasibility study demonstrating its relevance and environmental profitability.

c. Supporting the cooperative to implement the ISO 14000 certification

This task should be the culmination of the previous efforts. The pre-requisites for this certification that will not be supported by the PGE will be studied and implemented. The cooperative will be supported throughout the entire certification process. Familiarity gained in quality certification and the existence of established structures linked to this certification will make this task easier.

Aiming for ISO 14000 certification is an approach that has the advantage of providing a concrete goal that is part of the company's greater strategy, under which the various water use management activities fall.

d. Helping COLAIMO introduce more efficient water treatment techniques

Currently, the cooperative is looking for an appropriate technology that will allow it to have water quality consistent with industry standards. The prospecting process allowed it to settle on a technology based on reverse osmosis. We recommend assisting them in identifying the appropriate technology.

e. Helping the cooperative reduce CO_2 emissions

Obtaining the certification will not be an end in itself but the beginning of a new era for the cooperative. It must use its assets as a marketing force to position itself in the market in other regions. The cooperative must strengthen its competitiveness by reducing operating costs through optimal energy consumption. We propose conducting an energy audit within COLAIMO to help first identify problems related to current power consumption and to integrate energy management into

the environmental management program. In doing so, the MEC project will integrate its entire environmental objectives into the dairy industry in the Oriental.

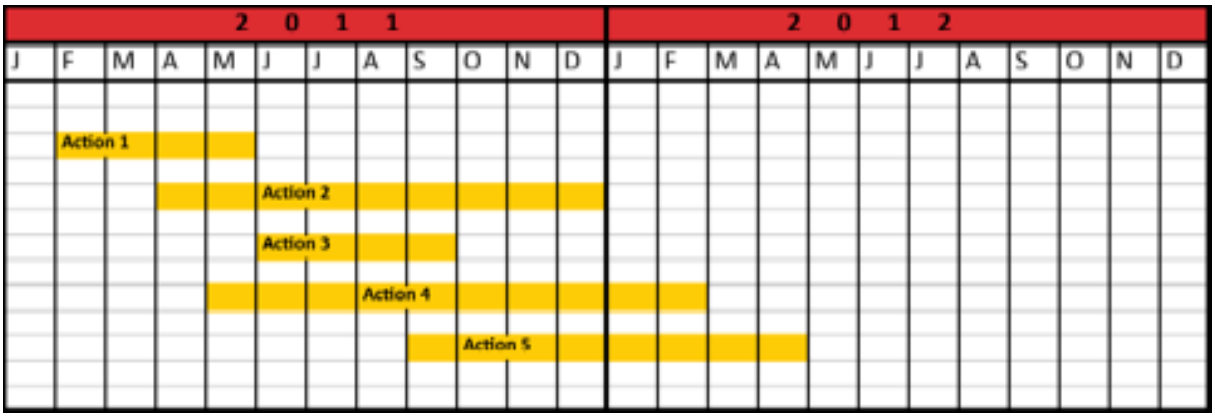
f. Establishing COLAIMO as a competitive aggregator

To support its sales force in the field, the cooperative must strengthen its link with other producers to integrate upstream of the industry and processing plants as well as secure supplies, and also to diversify its products to reach all market segments. For this task, we propose providing COLAIMO with technical assistance to carry out feasibility studies for:

- Creating an animal feed unit. We believe that such production will tighten the link with producers through a supply scheme where a win-win relationship prevails.
- Introducing production training. COLAIMO can exploit this niche in response to intense competition.

Schedule

Table 5. Provisional timetable of achievements



Action 1: Developing an environmental management program

Action 2: Supporting the cooperative to implement the ISO 14000 certification

Action 3: Helping COLAIMO introduce more efficient water treatment techniques

Action 4: Helping the cooperative reduce its CO_2 emissions

Action 5: Establishing COLAIMO as a competitive aggregator

THE CASE OF MONLAIT

PRESENTATION OF THE DAIRY

Overview

The available information concerning this dairy is summarized in the table below:

Table 6. Presentation of Monlait

Information	Dairy
Capacity:	5 000 liters/day
Date of creation	2003
Range of manufactured products	Pasteurized milk, flavored milk, Iben, and butter
Capital	Investment Fund for the Oriental Region with 30%
Collection zones	Madagh, Régada and Ahfir, over a range of 30 km
Number of employees	Less than a dozen
Market	Market of the region

The dairy's move into a 2 ha lot in the Berkane Agropôle was imminent at the time of the study. The dairy also plans to expand its facilities to reach a capacity of 40,000 l/day.

To ensure the milk supply, the company is in the process of creating a livestock farm that will specialize in the production of cow milk. Called LACTIC, this subsidiary will enable MONLAIT to ensure integration upstream and downstream of the Berkane dairy industry.

Location

The dairy is located on the western outskirts of Berkane. The room housing the plant is inside a block of houses, and the space is far from adequate for the activity. The site location is shown in the picture below:

Figure 4. Aerial view of the dairy

Description of industrial and commercial activities

a. Industrial production

Despite its recent creation, the plant does not have the technology to ensure consistency in product quality and production diversity. The dairy is presented as a milk production workshop rather than a factory. It is marked by great production irregularity.

b. Marketing

The dairy suffers from market instability mainly due to an irregularity in product quality and a lack of a marketing strategy.

AUDIT RESULTS

Conduct of the audit

Given the small size of the dairy, its place in the industry, and the technological and commercial problems it faces, an audit relating to water consumption would be inappropriate. The audit is oriented much more towards identifying improvements to MONLAIT in order to prepare it as it plans to scale up in the near future.

Observed failures

The MONLAIT dairy is far from being a business model in the field of milk processing. In part because of its size, which is below the critical level ensuring its sustainability, it suffers from the following shortcomings:

- Quality management should be its main concern. The return of poor quality lots is frequently recorded.
- Technical support was lacking until recently remedied by hiring a technician.
- The equipment used in milk technology is rudimentary. They are not at the forefront of technology and their capacity is very limited.
- Logistics are limited. The number of vehicles used to transport milk upstream and downstream is not enough, and the type is sometimes inappropriate.
- Lack of a business strategy. The dairy sometimes has difficulties selling the processed volumes. It does not retain the Berkane market, though it is its home market. On average, it

sells a little more than 4,500 l/day spread out over the cities of Berkane, Oujda, Taourirt, and Saidia.

- Lack of technical and commercial management.

ACTION PLANS

Actions to undertake

The development of the dairy industry will require upgrading this dairy. As evidenced by the plan to move into the agropole, the officials' goal is clearly demonstrated and they intend to pursue this project. As for the MEC project proposing to provide technical assistance in order to scale-up this unit, we recommend the following actions:

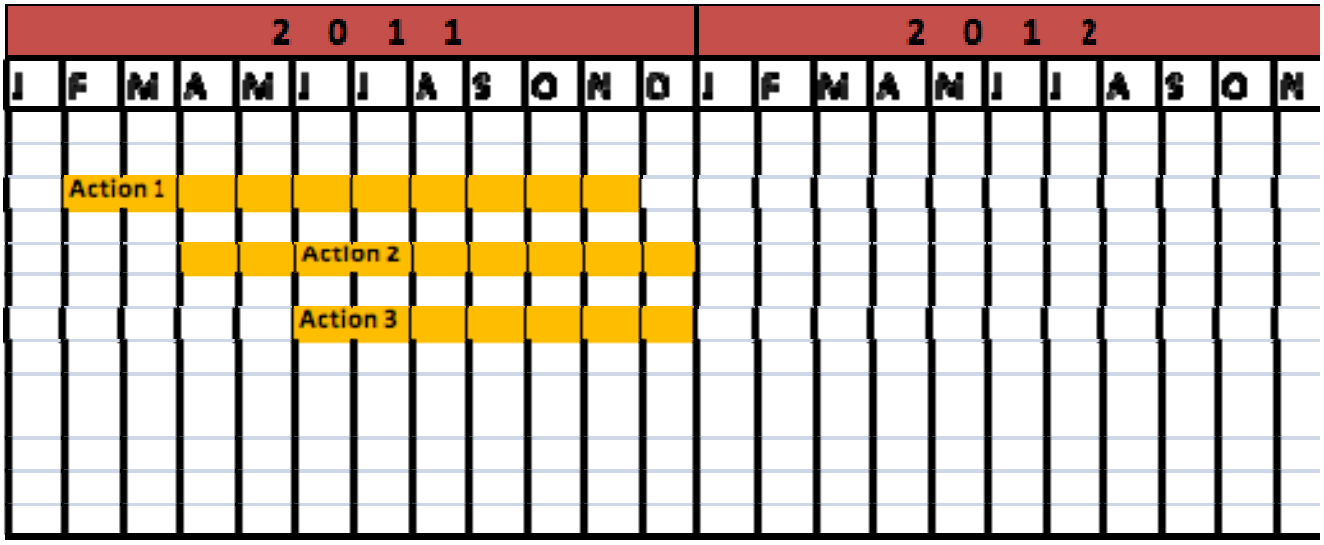
Action i: Implement best management practices and environmental technologies and conduct a training session for the dairy's technical staff;

Action ii: Develop and implement a business strategy supported by an information tool showing the dairy's real-time performance as well as faulty links. Conduct a training session for appropriate staff;

Action iii: Set pre-requisite milestones for water and quality management that will act as a guide in both the current dairy and the new one in the agropole.

Schedule

Table 7. Provisional timetable of achievements



Action 1: Developing an environmental management program

Action 2: Supporting the cooperative to implement ISO 14000 certification

Action 3: Helping Monlait introduce more efficient water treatment techniques.

THE CASE OF HALIB OUED ZA

PRESENTATION OF THE DAIRY

Overview

The information available on this dairy is summarized in the table below:

Table 8. Presentation of the Oued Za Dairy

Information	Dairy
Capacity:	4 000 liters/day
Range of manufactured products	Pasteurized milk, fermented milk, Iben, and butter
Area	500 m², 200 m² of which are covered
Collection zones	Zone of Taourirt, over a 20 km radius
Number of employees	Less than a dozen
Markey	Market of the region and Taza

Location

The plant is located in the industrial zone of Taourirt. It is difficult to access and is not part of the urban sanitation system. The satellite image shown below gives an idea about the location of the dairy.

Figure 5. Aerial view of the dairy

DESCRIPTION OF INDUSTRIAL AND COMMERCIAL ACTIVITIES

Recently rehabilitated, the dairy is outfitted with older equipment. It is supplied by cooperatives in the area of Taourirt with non-performing means of transportation that impact the quality of milk at their arrival to the dairy unit.

Industrial production

The OUED ZA dairy is presented as a milk production workshop rather than a plant. It is marked by great irregularity in production and by technological levels and technical support below the required recommendations.

Marketing

The dairy suffers from market instability mainly due to a defect in the product quality and a lack of marketing strategy.

RESULTS OF THE AUDIT

Conduct of the audit

Given the small size of the dairy, the place that it occupies in the industry, and the technological and commercial problems that it suffers, an audit relating to water consumption would be a luxury. The audit is oriented towards investigating ways to upgrade the dairy so it can play an aggregation role.

Observed failures

As a family business, the Oued Za dairy is far from being a business model in the milk processing field. It suffers from a range of shortcomings, in part because its size is below the critical level ensuring its sustainability due to its insufficient investments. These shortcomings include:

- Quality management is not a major concern. Raw milk can reach temperatures greater than 10 °C and pasteurized milk is often distributed in uninsulated vans.
- Technical support is lacking. The dairy doesn't employee any milk technology technicians.
- The equipment used in milk technology is little more than rudimentary. They are not at the forefront of technology and their capacity is very limited.
- The supply is limited. The number of vehicles used to transport milk upstream and downstream is insufficient and sometimes of inappropriate quality.
- Lack of a procurement strategy. To ensure the two supply sources of the Nasr and Assala cooperatives, the dairy must pay MAD 4/dairy, which is a price higher than that prevailing nationally.
- Lack of a marketing strategy. The dairy sometimes has difficulties selling the processed volumes. It cannot retain the Taourirt market, which is its stronghold. It sells an average of just over 2,000 l/day divided equally among the towns of Oujda, Taourirt, and Taza;
- It is difficult to access this dairy, which makes activity development difficult to envision.

RECOMMENDATIONS AND ACTION PLAN

The development of the dairy industry will require an upgrade of this dairy that will require a significant investment. The project's contribution would be limited to a technical and economic study that the dairy could enforce with banks for the granting of necessary loans.