



*Improvement of Irrigation Water Management
in Lebanon and Jordan
ME8/AIDCO/2001/0515/59776-P 007*



Construction and Equipment of Litani River Authority Extension and Service Center Khirbet Kanafar- West Bekaa

Introduction

Bekaa valley is the main agricultural region in Lebanon.

Unfortunately, the farmers of this region were suffering from the lack of support, in addition to the annual flooding of Litani River. As nobody since the 1950's made any maintenance or rehabilitation works of the river bed or banks.

The local water authority (LRA) did not have adequate means to support the farmers. Its rural development and extension department did not have any office in the region and its engineers and staffs were far from farmer's reach.

IrWa project intends to orient the local authorities to a more rational use of water.

Its activities, besides providing the solution of some existing problems, aim at transferring to the local water authority a problem solving mentality acting as an example that may be followed in other areas and situations.

Training, creation of the service center and availability of equipment were functional not only for the achievement of the project results, but also for giving the local partner (LRA) all the means required to continue the project activities such as farmers' support, maintenance of the Litani River etc.

The main objective of the project is the reduction of irrigation water losses leading to an improved socio-economic situation in the areas of intervention. The establishment of an Extension and Service Center in the Bekaa Valley contributed strongly in providing services to the local farmers (Extension and training activities, demonstration plots, maintenance of the riverbed, etc.).

Beneficiaries of the Extension and Service Center

The beneficiaries of the Extension Service Center are:

- **The LRA institution** benefited from the construction of the Service Center in the Bekaa Valley and from its equipment with a complete chemical laboratory for water and soil analyses. Moreover, the personnel of the Research and Rural Development Department of LRA were implicated in the project through training sessions on modern technologies in terms of administration, communication, awareness and river rehabilitation, water management, etc, and throughout participation to the ongoing activities of IrWa project.
- **Farmers:** In the last three years, the extension and service center became a focal point for the farmers in the region. Where more than 580 farmers got technical trainings on subjects of their interests, 78 farmers visited and benefited from the demo plots carried out by IrWa. This center made the Local water authority's rural development and extension service (LRA) closer to the farmers who expressed the ease of presenting claims and requests having a reference in their own region. So they could easily contact LRA engineers for claims regarding the performance of LRA distribution network, etc.
Furthermore, as equipped, the farmers of the region will soon be able to get reliable soil and water analysis carried out by a well trained staff using high quality equipment. Added to this, the help they can get from the LRA extension agents in matters related to irrigation scheduling, using the data collected from the weather station.

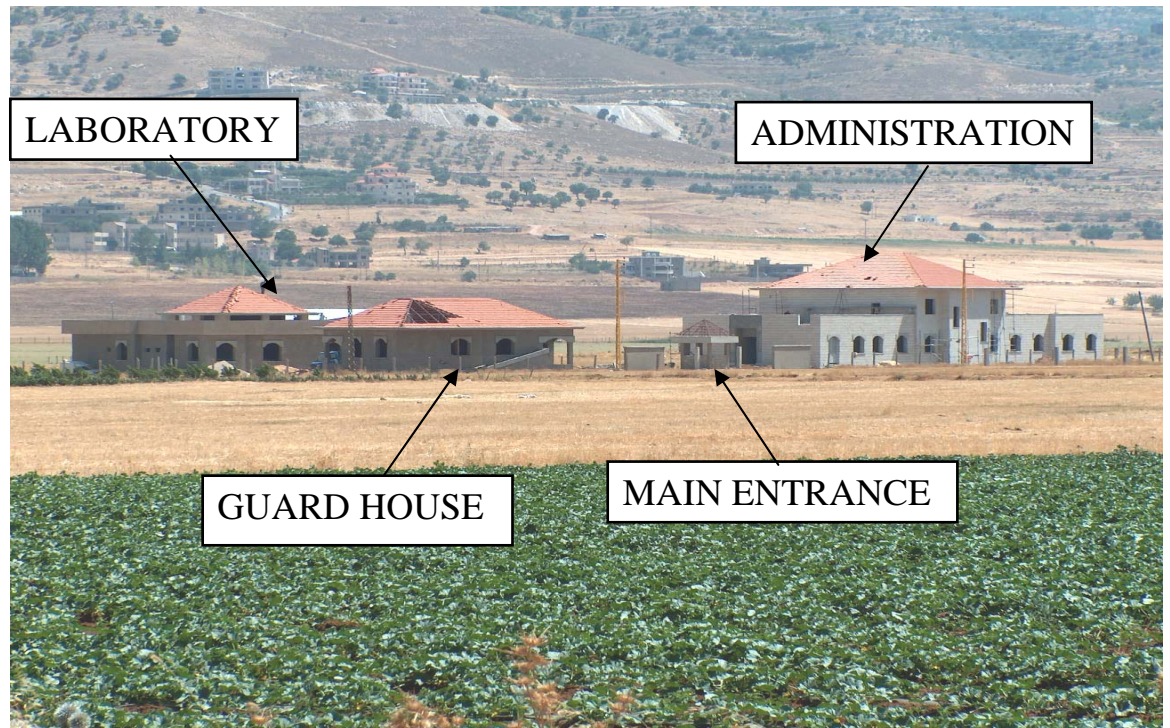
Construction of the Extension and Service Center

For the construction works, a common study between AVSI and LRA was carried out. After a value engineering study carried out by PAG engineering, a local open tender procedure was launched. Following it, the firm ABOU DIB CONSTRUCTION undertook the execution of the construction including civil, electrical and mechanical works.

Construction works have started in May 2004 and have been completed in February 2006 with a total cost of **610.393 Euros**

LRA contributed by asphaltting and paving the road and the parking and the construction inside the Extension Service center's area, in addition to enclosing the Center by an adequate fence. The value of this contribution was: **282 248 000 LL**

LRA Extension and Service center's components



The Extension and Service Center is composed of the followings:

- Administration's building
- Soil, water and phytopathology laboratories
- Demo plot
- Weather station
- Warehouse
- Guard's house
- Parking
- Water reservoir
- Electrical room

Following open tender procedures, the offices equipments, the agricultural machinery, the river cleaning and maintenance machinery, the cars, and the labs furniture, materials and equipments: tender procedures were launched respectively by IrWa staff in collaboration with LRA responsible.

Administration's building



This two floors building is meant to be used by LRA extension agents who will work in close contact with the farmers of West Bekaa. The service will start by covering an area of 200ha, then expanding their activities to the whole region. In this building's first floor, are localized the reception, the offices and the meeting room, while the second floor is mainly occupied by the conference room, which is well equipped for the implementation of trainings, workshops, etc. The logistic equipment was supplied by SOLADO S.R.L after an international open tender procedure with a total amount of The supply of offices furniture and training room was carried out by: Office Design & Supplies

Soil and water laboratories

(See the lab's maps and the attached file relative to the Lab drawings)



The laboratories occupy a separate building of the service center. These laboratories (soil, water and phytopathology labs) are fully equipped with high range equipments and materials in order to provide reliable analysis to farmers.



As furnished, these labs can provide accurate and complete soil and water analysis that might be requested for agricultural purposes in addition to some of the main farmers' requests related to phyto-pathology.

The materials and equipments furnished were purchased throughout an open tender procedure won by Labotech.

The supply of the main part was completed in 2006 with an amount of:

139 253 EURO (including the weather station).

LRA contributed in buying lab chemicals from Numelab, with a total amount of:

21 802 000 LL.

An additional list of lab requirements was set in 2007 and a purchase negotiated procedure was launched in order to buy the specified materials that seemed important after starting the work in the lab on October 8, 2007. These materials with a total value of **12,624.65 Euros** were divided into 8 lots.

Three companies: Labotech, multilab and Numelab were in charge of this supply. Supply contracts were elaborated with them. Labotech supplied 5 lots out of 8 with an amount of 10, 839, 65 Euros; Multilab supplied 2 lots with an amount of 1017 Euros, while Numelab supplied 1 lot only with an amount of: 384 Euros.

LRA took in charge providing additional consumables with an amount of: **1900 USD**



The laboratories are linked to the meteorological station established in the demo plot of the center.

Weather Station

The installation of a fully automated and expandable meteorological station was successfully done in June 2006 in the demonstration area of the LRA Extension and Service Center.

This weather station provides the following parameters on hourly basis: Air temperature, relative humidity, rainfall, wind speed, wind direction, solar radiation, barometric pressure and soil temperature.

It measures, stores and communicates the meteorological data in general to be used for agricultural applications: to make



irrigation management decisions such as irrigation scheduling, frost protection and evapotranspiration calculations. Moreover, tests the evaporation universal formulas under local weather condition and calculates the total chilling hours.

Actually, these data correlated to those obtained from the demo plot could give an accurate figure on potato and corn water

requirements throughout their cultivation period in the service center's demo plot.

The main aims of installing the weather station are to:

- Collect climatic data in order to help the farmer knowing the irrigation calendar and the use of a preventive frost control system;
- Execute studies to calculate crop water use;

Demo plot

An agricultural land of about 20 ha is available for conducting experimentations, demo plots and research activities.

Even though an area of 60 dunums was prepared in the spring 2006 in order to implement a demo plot, the war of July 2006 stopped all the project's activities. In 2007, with the limited remaining budget and time, IrWa staff was constricted to reduce the area of the project's demo plot to 30 dunums.

On this basis, a demo plot on potato and corn production was implemented. Using drip, sprinkler and traveler gun for irrigation; drawing water from LRA hydrant, adopting sand media filter and disc filter (for drip irrigation systems only)

Cultivated area per crop and irrigation system was as follows:

- 6 dunums of potato irrigated with sprinklers (18 x 18 m spacing).
- 6 dunums of potato irrigated with sprinklers (18 x 12 m spacing).
- 6 dunums of potato irrigated with T-Tape.
- 6 dunums of corn irrigated with GR.
- 6 dunums of corn irrigated with a traveler gun.

The established demo plot aimed at:

- Comparison of two different irrigation methods (Sprinklers and Drippers) on the same crop.
- Optimize the use of water irrigation through adequate irrigation practices and scheduling.

- Reduce water losses and increase the efficiency of the irrigation network.
- Monitor the nitrate concentration in soil and plants using the Pilazo technique.



The demo plot was installed in June 2007. Field monitoring lasted till November 2007

In addition to LRA extension agents, Farmers benefited from extension visits to this demo plot on

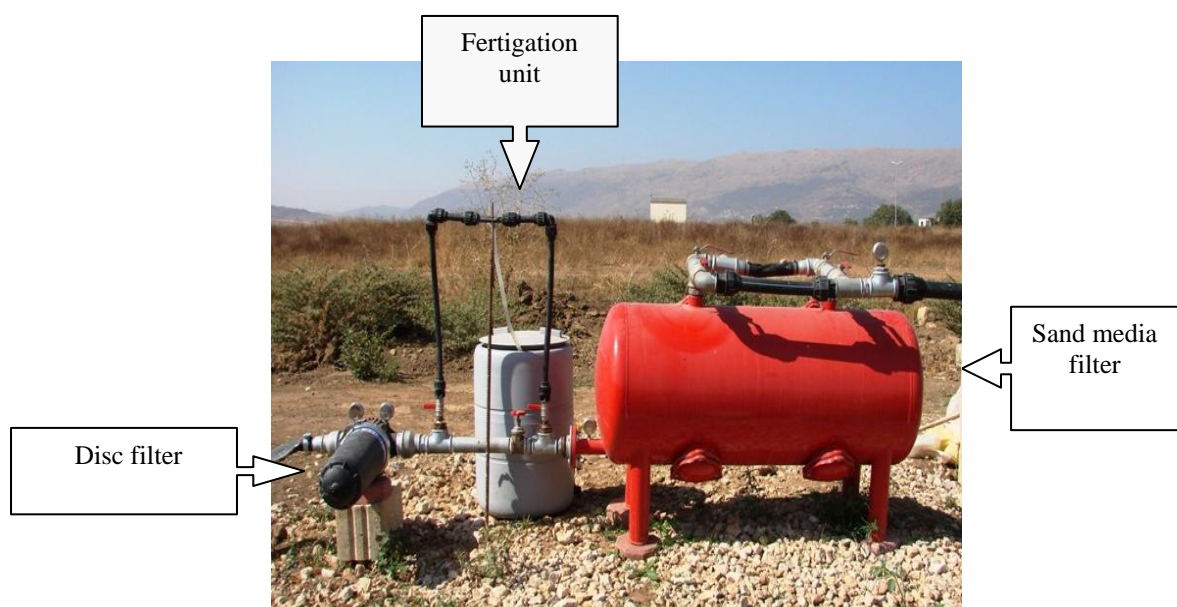
October 2007.

LRA staff was also involved in all activities related to the demo plot (Irrigation scheduling, cultivation practices, fertilization, design and installation of the irrigation systems, etc.).

The total cost of this activity was **38,638.84 EURO** including the irrigation systems, the fertigation tank, the filtration unit etc.

Irrigation and filtration systems were mainly supplied by Debbane Company.

The high cost of the demo plot is due to the fact that all the land preparations (plowing, etc.) were done twice as those done in 2006 were to be redone in 2007 (activity stopped in July 2006 because of the war of July).



LRA contributed by furnishing adequate agricultural machineries such as:

- ❖ 4x4 double cabin field pick-up;
- ❖ Backhoe;
- ❖ Tractor and attachments (container, water tank and pump);

Warehouse



Moreover, IrWa project has foreseen and executed the construction of a warehouse where agricultural equipments and river maintenance machineries furnished by IrWa are preserved.



Vehicules

IrWa project furnished the Extension and Service Center with vehicles allowing IrWa and LRA staff working on the project to achieve their missions within the project's activities.

The vehicles (4*4 cars and Pick up) were provided by Solado SRL who won the international open tender procedure launched in this respect.

The total cost of these vehicles was: 88000 **Euro**

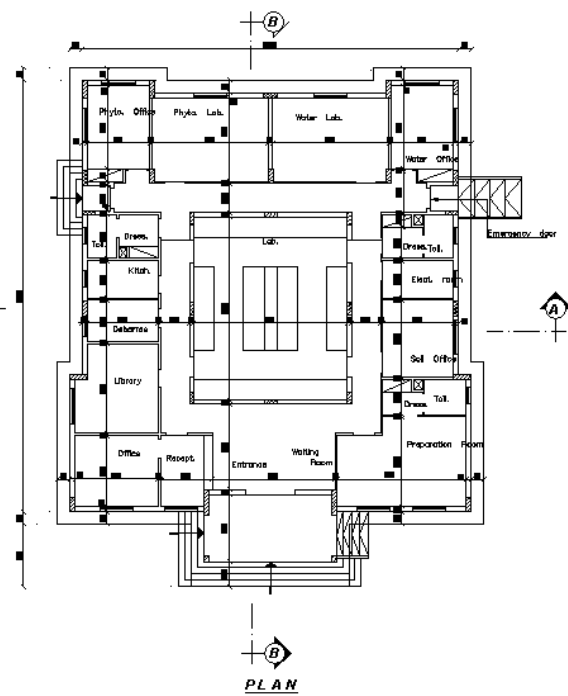
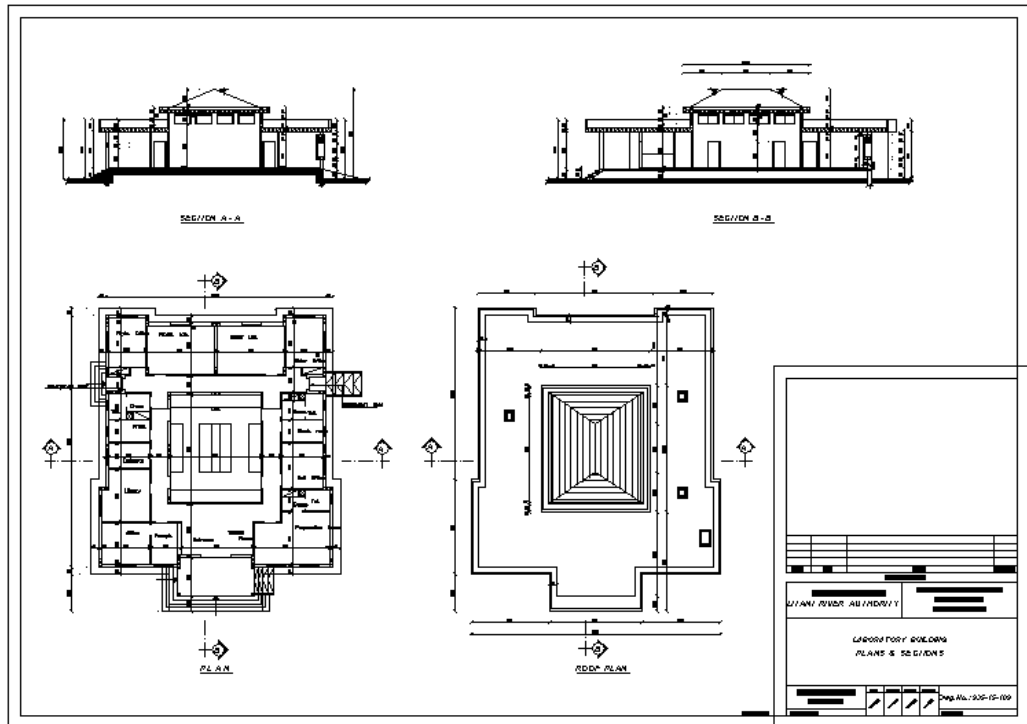
Table 1 - Work contract relative to the construction of the LRA Extension and Service Center Khirbet Kanafar- Lebanon

Date of contract	Description	Contractor	Recipients
03/05/04	Construction works for the Extension & Service Center	Abou Dib Construction Company	Service Center in Bekaa Valley,

Table 2 - Supply contracts relative to the supplies undertaken by IrWa to LRA Extension and Service Center Khirbet Kanafar- Lebanon

Date of contract	Description	Contractor	Recipients
24-Apr-04	Vehicles	SOLADO SRL	IrWa Offices in Beirut and Bekaa, Lebanon
24-Apr-04	Truck, Excavator and Chain Tractor	Baladi Frees	LRA, Lebanon
1-Jul-04	IT equiproject management, photocopy machines and projectors for Jordan and Lebanon	SOLADO Srl	IrWa Offices in Beirut & Bekaa, LB
9-Jul-04	Furniture for Jordan and Lebanon	Office Design and Supplies	IrWa Offices in Beirut & Bekaa, LB
27-Jan-06	Laboratory equipment for water and soil analysis	Labotech	Khirbet Kanafar Service Center Bekaa Valley, Lebanon
10-Feb-06	Spare parts for machines for river rehabilitation	SOLADO Srl	Khirbet Kanafar Service Center Bekaa Valley, Lebanon
7-Jun-06	Irrigation Equipments for demo-plot	DEBBANE FRERES SAL	Khirbet Kanafar Service Center Bekaa Valley, Lebanon
1/14/2008	Lab equipments and consumables	Labotech	LRA Service Center labs in Bekaa Valley, Lebanon
1/15/2008	Lab equipments and consumables	Multilab	LRA Service Center labs in Bekaa Valley, Lebanon
1/14/2008	Lab equipments and consumables	Numelab	LRA Service Center labs in Bekaa Valley, Lebanon

Lab maps



INSTALLATION OF A LABORATORY FOR WATER AND SOIL ANALYSES

The following rooms are necessary for the establishment of a laboratory for soil and water analyses:

- ***AN OFFICE FOR THE RECEPTION OF THE SOIL AND WATER SAMPLES AND THE ISSUING OF THE ANALYSES CERTIFICATES***
- ***REAGENTS ROOM***
- ***ROOM FOR THE PREPARATION OF THE SOIL SAMPLES***
- ***ROOM FOR THE PREPARATION OF VEGETABLE SAMPLES***
- ***ANALYSES LABORATORY***
- ***ROOM OF LABORATORY INSTRUMENTS***
- ***ROOM FOR THE BACTERIOLOGICAL ANALYSES OF WATER****

1- OFFICE

The OFFICE, where there should also be a small library with the analyses handbooks, must be equipped with a Desktop PC for the transcription of the analyses certificates and with a refrigerator and freezer where the perishable samples should be stocked.

2- ROOM FOR THE PREPARATION OF THE SOIL SAMPLES and FERTILIZERS

In this room the following equipment should be installed:

- ***A technical scale (0,1 maximum loading capacity 2 kg);***
- ***Mortars for the preparation of fine soil – diameter 30 cm (n. 2);***
- ***A set of sieves for the mechanical separation of the soil particles (10 sieves with 2 mm mesh and one complete set);***
- ***Plastic basins (trays) where to dry the soil (n. 10);***
- ***One oven for the determination of the soil humidity;***
- ***Jars (500 ml vol.) for the conservation of the fine soil and other samples (n. 50).***

3- ROOM FOR THE PREPARATION OF THE VEGETABLE SAMPLES

In this room the following equipment should be installed:

- ***A mill for the grinding of the samples (250 ml vol. 20000 rpm);***
- ***A mini bench drying unit for the wilting of leaves;***

- A water distiller for the washing of leaves (5 lt./h capacity).

4- SCALES ROOM

The following equipment will be installed in this room on special anti-vibration shelves:

- Analytic digital scale (0,1 mg, maximum bearing weight 500 gr.)
- Technical digital scale (0,01 mg, maximum bearing weight 1000 gr.)
- Hydrostatic scale (scale 1, 00001)
- Thermostatic bath for the hydrostatic scale (range -5 to 110°C)

5- ANALYSES LABORATORY

The room must have enough room to accept the presence of at least two or three people at the same time with comfortable working areas.

Taking into consideration that, once prepared the solutions to be analyzed, the instruments for the soil and water analyses are common, it will be necessary to equip the room as follows:

- a central bench with face-to-face working places equipped with:
 - o a suction plant
 - o a reagent rack
 - o at least two gas points, two water points with related sink and 4 electricity sockets with switches on each side
- a titration counter (240 x 60 x 80 cm with front lighting and on the plane)
- a closeable fume hood (200 x 80 x 90 + 160 cm) complete with a window fan (800 m³/h) and:
 - o 2 gas points
 - o 2 water points with related sinks
 - o 2 electricity sockets with switches
- A bench water distiller and deionizer (production: 2 lt./h distilled water, conductivity: 2,3 microS/cm)
- A horizontal rotating stirrer (complete with clamps for 100 ml, 200 ml, and 300 ml flasks)
- A Dubnoff bath* (temp. from 5 to 100°C; speed: from 30 to 150 rpm) (for the fractionation of the organic matter – a heated stirrer)
- Thermo stated magnetic stirrers (n. 2) (dimensions of the plate: 155 x 155 mm, max t° 350° C)
- A mineralizer for Kjeldhal complete with scrubber to drive away the acid fumes (scrubber: a vacuum pump that sucks and neutralizes the fumes)
- Kjeldhall distiller
- A Richard** plate and membrane (used to determine the capacity soil has to hold water – PAOLA FIORAVANTI SAW IT IN DEIR ALLA)

- **A constant flow permeameter** (tube with 8 taps and cylinders)
- **Automatic burettes with related containers*** (*n.* 8) (*burettes: 50 ml capacity of which 3 with dark glass – containers: 1 lt. capacity*)
- **Rotavapor*** (rotating evaporator to separate the solvent from the solution: vacuum rotating evaporator)
- **Smoothing machines for the determination of the soil texture** (*n.* 10) (*volume of cylinders: 500 ml*)
- **Bouyoucos densitometer to determine the soil texture**
- **Membrane suction pump** (*output: 15 lt./min., vacuum: max 100 mBar ass, pressure: 4 rel. bar*)
- **Cabinets for the glasswork**
- **Glasswork**
- **Refrigerator**
- **Muffle** (*23 x 23 x 18 cm, temperature from 100 to 1000 °C*)

6- INSTRUMENTS ROOM

The instruments listed bellow, being very delicate and sensitive, must be placed in a separate room, far from areas that can produce dust and strong vibrations, in a controlled environment (temperature and humidity). Moreover, to avoid mishandling, only the analysts and clerks should be admitted in this room.

On special counters the following instruments will be installed:

- **Bench pH-meter** (*pH 0,00 – 14,00*) with the possibility to use selective electrodes
- **Bench conducto-meter** (*from 0,01 micrS/cm to 2000 mS/cm*) with:
 - o Platinum and glass cell for general use
 - o Platinum and glass cell to measure low conductivity rates
 - o Automatic temperature compensator
- **dissolved oxygen gauge** (*mg/O₂ range: 0,00 – 19,99, saturation 0,0 – 199,9*) with automatic temperature compensator
- **AA spectrophotometer for the determination of heavy metals** (with air/acetylene oven)
 - *In alternative heavy metal potentiometric analyzer*
- **Visible and UV absorption spectrophotometer**
- **Flame photometer for alkaline metals**
- **IR spectrophotometer for the determination of anions***
- **Gas chromatographer with EC detector fro the analyses of pesticides***
- **A PC to control and manage the instruments.**

7- REAGENTS ROOM

Different reagents are found in this room. Therefore, the cabinets and the shelves must take into account such differences. In any case the room must be well-aired and have easy escape ways with suction and firefighting plants.

More in detail, this room will contain:

- 2 security lockers for the acid and alkaline substances with related suction plant
- 1 anti-deflagrating locker for the inflammable substances
- closed lockers for inert substances
- different shelves for the glasswork and the laboratory materials
- refrigerator for the reagents to be stocked at low temperature

8- LABORATORY FOR THE BACTERIOLOGICAL ANALYSES OF WATER*

This room will be equipped with:

- Refrigerator with freezer
- Suction pump (*15 lt./min, vacuum: 100 absolute mBar maximum*)
- Filtering membranes for bacteriological analyses
- Autoclave for sterilization (*2 cycles at 121 and 134 °C, 18 lt. volume*)
- Mini incubator for the multiplication of microorganisms (*t° from +8 to +60 °C, 12 lt. volume, filter for particles > 0,3 micron*)
- Laminar flux sterile hood (*useful dimensions: 737 x 428 x 510 mm*) with metal closing and UV kit)
- Locker for microbiology material
- **Refrigerating thermostat 20°C for BOD** (*Volume 40 lt., internal temperature range at least +10-+40°C set at 0,2°C*)

In the above description the instruments with * are necessary for an advanced laboratory.

From the visit I noticed that many instruments are already available in the lab and can be used if a more organized and attentive procedure is followed.

The new disposition of the rooms has the purpose of rationalizing the distribution of the equipment avoiding repetitions that are anti-economic and room consuming.

Moreover, the feeling of disorganization and untidiness doesn't help in obtaining secure results. Therefore, if possible, specific tasks should be assigned to the personnel for the daily maintenance of the instruments and counters.

Soil Samples and Fertilizers

- 1) Sieves: 10 sieves (dimensions 20 – 25 cm diameter) with 2mm mesh
- 2) One complete outfit: a complete set of sieves with the following mesh: 5mm, 2mm, 1mm, 0,5mm, 0,25mm, 0,1mm, 0,05mm, 0,025mm.
- 3) OVEN: capacity 80 liters. Temperature from 5 to 250 °C ventilated.

Vegetable Samples:

- 1) Mill: capacity 500 ml. With grinding head for fibrous material and the possibility to insert 0,25 mm sieves.

Scales Room:

- 1) Analytic scale: it is possible to use the analytic scale – 300 g / 0,1 mg
- 2) Technical scale: 0,01 mg is a mistake. Please read 0,01g

Analyses Laboratory:

- 1) Graduated Titration Counter Burette with 50 ml Pellet – with Teflon valve (tap) in dark and transparent glass – 1 liter bottles (5 transparent glass bottles and 3 dark glass bottles)
- 2) Rotavapor: with manual elevation and digital vacuum control, with thermo regulated bath and complete with suction flasks.
- 3) Smoothing machines: these are cylinders for the determination of the texture of soil. More specifically: cylinders calibrated for soil Bouyoucos (10) and soil Hydrometer Bouyoucos.
- 4) Filtration kits: paper Watman filters
- 5) Glasswork:

Beaker V/Duran with beak:

n.10 - 25ml, n.10 - 50ml, n.10 - 100ml, n.10 - 250ml, n. 5 - 400ml, n. 5 - 800ml, n.2 - 1000 ml and n. 2 - 2000 ml

Flask V/Duran narrow mouth:

n. 8 - 25ml, n.10 - 50ml, n. 20 - 100ml, n.10 - 100ml with emery tap, n. 10 - 250ml, n.20 - 300ml, n. 8 - 500ml, n. 3 - 1000ml and n. 2 - 2000ml.

Class A calibrated matrass with tap:

n. 8 - 10ml, n.10 - 25ml, n.10 - 50ml, n.20 - 100ml, n.5 - 200ml, n.5 - 250ml, n.5 - 500ml, n.5 - 1000ml and n.2 - 2000ml.

Class A graduated cylinders:

n.5 - 10ml, n.10 - 25ml, n.10 - 50ml, n.10 - 100ml, n. 5 - 250ml, n. 4 - 500ml and n.2 - 1000ml.

Class A calibrated Pipettes:

n. 2 - 100ml, n.4 - 50ml, n. 4 - 25ml, n.4 - 20ml, n.4 - 25ml, n. 20 - 10ml, n.10 - 5ml, n. 10 - 2ml, n.5 - 1ml.

Class A graduated pipettes:

n. 20 - 10ml div 1/10, n.20 - 5ml div 1/10, n.8 - 2ml div 1/100, n.5 - 1ml div 1/100 and n. 3 - 0,5ml div 1/100.

Pasteur Pipettes: n. 1000

Nipples for Pasteur: n. 100

Class A Burettes, with stands:

n.10 - 50ml transparent, n.5 - 25ml transparent, n.2 - 10ml transparent, n. 5 - 50ml dark,
n.5 - 25ml dark.

Glass thimbles (small funnels):

n. 10 - 55mm diameter, n. 4 - 12mm diameter.

- 6) Refrigerator: volume should be 120 liters approx. with freezer

Instruments Room

- 1) Heavy Metal potentiometric analyzer: reference electrode Ag/AgCl, control electrode in platinum wire, measuring electrode: carbon graphite septum. Analyzable metals: As, Sb, Bi, Cd, Co, Fe, Ga, In, Mn, Hg, Ni, Pb, Cu, Se, Sn, Ta e Zn.
- 2) Ion Chromatograph: what was intended is an infrared (IR) spectrophotometer that can explore the double ray IR radiation fields.
- 3) The Gas Chromatographer to analyze possible pesticide residues on which it should be possible to install capillary columns and have an ECC detector (electron capture) to determine polyhalogen substances such as Dieldrin, DDT, Lindano, Aldrin, nitro compounds, carbonylic compounds and aromatic polycyclic hydrocarbons.

Reagents Room

- 1) The refrigerator must have a capacity of at least 120 liters with freezer (-24 °C)

Analyses of water

- 1) The filtering membranes is an apparatus made of a steel filter that can be sterilized obtainable with the kit for the water polluting bacteria analyses (analysis of the total bacteria count, of the total and fecal coliforms, fecal streptococci, enterococci and sulphur reducers) comprehensive of nutrient soils, sterile filters with different porosity depending on the analysis and analysis handbook (incubation time and temperature ranges).
- 2) The refrigerator , with a capacity of 120 liters will have to be equipped with a freezer.