MEDA WATER PROGRAMME

Euro-Mediterranean Regional Programme for Local Water Management
IRWA
Improvement of Irrigation Water Management
in Lebanon and Jordan

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Irrigation Practices Evaluation in Jordan Valley

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Partners:
1. Associazione Volontari per il Servizio Internazionale – AVSI – Milan (Italy)
2. Centro de Estudios y Solidaridad con America Latina – CESAL – Madrid (Spain)
3. Litani River Authority – LRA (Lebanon)
4. National Center for Agricultural Research and Extension – NCARE (Jordan)

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1. Introduction

IRWA - Improvement of Irrigation Water Management in Lebanon and Jordan is a regional project co-financed by the European Commission, designed to address the problems related to the irrigation water management in agriculture in the two countries.

In reference to IRWA project guidelines; *"to tackle water quality, inappropriate filtering and irrigation systems"* and *"to increase of crop production and of farmers' income"*, it was decided to undertake irrigation assessments in Jordan to:

- Understand farmers' technical problems related to irrigation,
- Training needs on irrigation issues,
- Generate references in integrate irrigation practices to allow starting a first step in the extension services program that will be launched later on.

The aim of this paper is to present the result of the irrigation and uniformity surveys conducted by NCARE extension agents in the framework of IrWa project in 30 farmers along the Jordan Valley. These farms were selected by the extension agents from three different regions in Jordan Valley; northern part (Al Kraemeh), middle (Ghor Kabed) and southern part (Al Karamah).

2. Brief presentation of the area and problem statement

Endowed with fertile, flat-laying soils, the Jordan Valley is Jordan's premier agricultural production area. Agriculture in the valley includes a wide variety of crops from the high-value horticulture crops to field crops, citrus trees and banana. The Jordan valley can be divided in 3 main agro-ecological regions[1]:

- The north where open field of citrus is the major cropping pattern (57%),
- The middle where vegetable under plastic green house is more widespread (56%),
- And the south where banana and field vegetable represent 33.5 and 37% of the cropping area.

[1] Mauro Van Aken and Al. – 2007 – *Historical trajectory of river basin in the Middle East: the lower Jordan River basin (in Jordan)*. Comprehensive assessment of water management in Agriculture. International Water Management Institute, Mission Régionale Eau Agriculture.

The north of the Jordan Valley is irrigated by fresh water from the Yarmouk River and other side wadis conveyed by the King Abdullah Canal (KAC). In the south, most of the water distributed to the farms is blended water from King Talal Reservoir (treated waste water conveyed by Zarka River) and residual water from the Yarmouk River. As a consequence, salt accumulation is a residual problem, moreover where treated waste water is used.

If the proportion of drip versus surface irrigation is increasing yearly, Shatanawi and All[2] concluded that inadequate management of drip-irrigation has made them less effective than conventional surface irrigation, implying great scope for improvement. In addition, the proper use of modern water distribution systems imply the need of adapted operation and maintenance practices and operational filtration technology lacking in most farm of the Jordan Valley (Mauro and Al., 2007).

3. <u>Methodology</u>

Open/close questionnaire sheet, was used to describe the following irrigation system components (See Annex 1):

- Water sources used
- Filtration system specification
- Irrigation scheduling (monthly basis days intervals and hours duration)
- Leaching requirement
- Irrigation material used
- Land size and slopes if any
- Farmers know –how level
- Farmers' assessment of existing problem if any.

[2] Shatanawi and Al. – 1994 – *Irrigation Management and water quality in the central Jordan Valley*. Baseline report prepared for USAID. Irrigation Support Project for Asia and the Near East, Water and Environment Research and Study Center, University of Jordan.

The above descriptive part was completed by field measurement to determine the coefficient of Uniformity using the low quarter method (Annex 2). Based on the overall management a classification was done based on the following points (Annex 3):

- Filtration System
- Irrigation Practices
- Leaching Requirements.
- Operation and Maintenance

4. Summary of main hints relevant to IRWA PROJECT ACTIVITIES

4.1 On-Farm water management:

- All the farms are using drip irrigation system, assembled yearly and disassembled at the end of crop season.
- The assembling of the lines, both primary and secondary ones, and of the pumping unit is approximate, without any calculation of head and flow, so that nobody knows the volume of water provided to the crop or to each definite farm plot.
- None of the farmers were sure about the amount of water that they receive per season. This is a common situation in the valley where none of the farmers use water meter because they are illegally destroyed.
- Most farmers think that their water attribution is not enough
- Around two thirds of the farmers use electric pumps while the rest still have diesel pumps although they are much more expensive due to the fuel cost and higher maintenance needs. Unfortunately, the un-availability of electricity distribution in the farms forces farmers to use other alternatives.
- The water quantity provided to the crops is scheduled according to farmers' experiences and depending on visual assessment. Tools intended to measure the quantity of irrigation water supply are lacking (tensiometers and class A pan),

- The water is supplied only two to three times weekly by the Jordan Valley Authority (JVA)[3], for roughly 5 hours; obliging farmers to store the water in reservoirs before re-pressurizing it in the irrigation network. Pools are usually made of concrete basement or plastic sheets and are never protected for sun radiation. As a result, accumulation of organic matter, fish farming and algae development imply serious decrease of water physical quality during the water storage.

Figure 1: Upper view of a traditional farm in the Jordan Valley

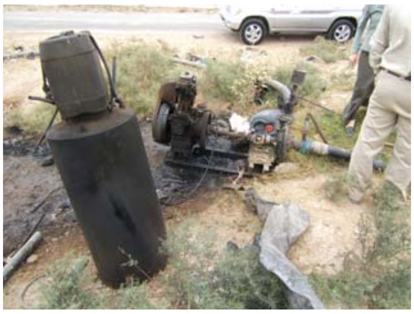

Figure 2: Diesel powered centrifugal pump – no filter

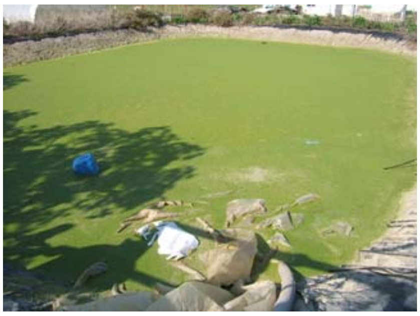

Figure 3: Important algae development in storage reservoir

4.2 Filtration System

Twenty seven farms from thirty were equipped with filters (table 1). Out of them, twenty one are equipped by, traditional sand or screen filters or a combination of both of them, and the rest six are using disc filter, or disc filter with combination with at least one other filtration system (sand or screen filters).

Type of Filtration	No Filtration	Only Sand	Only Screen	Only Disc	Combination of at least two types of filtration
No. of Farmers	3	0	11	2	14

Table 1: Different Types of Filtration

[3] In some areas JVA provides the farmers with flow of 6L/s and in other areas in 9L/s; the areas with the lower discharge get more total hours and frequent supply.

4.3 Filtration Management Classification:

As general comment, the effectiveness of on-farm filtration is **medium to poor**. The maintenance of the filtration was in all cases not done properly (table 2). All the farmers back flush their filters but none is using the proper indicator: the pressure difference between the in-let and out-let of the filter. Back flush done on a scheduled bases is not accurate enough (no control of pressure losses) while back flushing after every irrigation is labor consuming and may result in early material depreciation. Farmers training on operation and maintenance of filtration system should be foreseen.

Filtration System Maintenance	No scheduled back wash	Scheduled back wash	Every irrigation	Using the pressure gage
No. of Farmers	4	14	12	0

Table 2: Filtration System Maintenance Scenes in the Valley

Filtration management	Very Low	Low	Intermediate	Advanced
No. of Farmers	3	21	6	0
Total	30			

Table 3: Filtration Management Classification

In addition several factors affecting filtration system are presented bellow:

- The design of the traditional filters (horizontal) is inappropriate. Indeed, the bottom diffuser isn't the suitable to uniformly back-flush the sand bed (figure 4). The back-flushing water will clean vertically the central layer of sand only and not the layers closer to the container curved walls involving bad back flushing (media is stuck on the side of the filter).

Figure 4: Diffusers in the Bottom of the Traditional Sand Filter

Figure 5: Oversized media used in the Traditional Sand Filter

- ➢ The media used is always oversized (figure 5) which reduces the filtration capacity.
- ➢ The low profile of the maintenance (no pressure gage, no calibration of the filters…) may also increase the clogging problem.

4.4 Irrigation Practices and Irrigation Network Design

Most of the irrigation systems and networks are setup roughly, without any proper design or technical advice. The pipes, in poly ethylene, are never indelibly labeled with technical specifications that are needed to design proper irrigation network (density, pressure supported, manufacturer…). More material specifications are given bellow:

- Dripping lines: mainly GR type with 16 mm∅ or sometimes 20 mm∅, built-in dripper 40 cm apart, declared 8L/h or 4L/h at 1 bar. Usually line are short 35-40m to counteract the rough shaping of the irrigation system but does not solve the uneven irrigation distribution (lack of proper calculation of head, flow and related diesel/each time of operation).
- Secondary lines (Manifold and submains): ∅ 50-75 mm.
- Main line: usually ∅ ND > 75 mm doesn't matter the length.

Figure 6: Drip lines layout, settled before planting

4.5 Irrigation Scheduling

Commonly farmer schedule their irrigation depending on their own experience and taking into account water availabilities climate condition, plant behavior and plant broth stage Six farmers only considered plant behavior and climate condition while one farmer was always applying the same amount of water along the season.. It is very unusual to find a farmer who use tools like tensiometers or water marks to determine when and how much to irrigate.

Irrigation Scheduling Management	Very Low	Low	Intermediate	Advanced
No. of Farmers	1	6	23	0
Total	30			

Table 4: Irrigation Scheduling Management Classification

4.6 Leaching Requirements

Most of the farmers interviewed do not use soil analysis nor soil texture to determine leaching requirement. Despite the problem of high soil salinity, leaching between two crops is not a common practice as most of the farmers think that their water application during summer solarization[4] is sufficient to eliminate the effects of salt accumulation. 8 farmers were not leaching their fields underlying an important lack of technical awareness.

Leaching Management	Very Low	Low	Intermediate	Advanced
No. of Farmers	8	21	1	0
Total	30			

Table 5: Leaching Requirement Management Classification

[4] Soil solarisation is done by covering the field with a plastic shit that rise the temperature and kill most of soil born pathogens.

4.7 Operation and Maintenance

A virtue of a pressurized irrigation system is its ability to deliver a uniform amount of water to each location it serves, so that, water is applied evenly over the field, but only if it is operated and maintained properly. While a well-designed system can deliver water with a high degree of uniformity, the system must be properly maintained to keep the application uniform. The principal cause of non-uniformity in such irrigation systems is emitter clogging by particulate or organic matter, lime precipitates, or iron precipitates.

Due to the improper operation and maintenance practices, GR clogging was identified as a major problem encountered by the farmers. No farmer were back flushing their manifold or GR. Many chemicals are used before and during the season to reduce clogging effect (oxygen, nitric, phosphoric and humic acid). The use of such chemical has both inconvenient; increase the cost of production and be dangerous for the crop when applied during the cropping season (can burn the roots). In addition farmers have developed improper practices that should be rapidly abandoned (knocking on the dripping lines to remove the pracipitation, perforation of nozzles with needle).

The low irrigation network management imply uneven plant growth within the same plot and increase of production cost as farmers are obliged to changed their irrigation network every one or two years.

Figure 7: Uneven water distribution, due to unbalanced distribution pipe system

Operation & Management	Very Low	Low	Intermediate	Advanced
No. of Farmers	5	10	12	3
Total	30			

Table 6: Operation and Maintenance Management Classification

4.8 Irrigation System Uniformity

To evaluate irrigation system uniformity, eight farmers have been surveyed and visited to measure the uniformity coefficient of their irrigation system using Low-Quarter Method. The results, as shown in table 6, confirmed the previous observation as the uniformity coefficient varied between 20.9% and 75%, which is considered very low according as most of the references considered 80% to be the minimum acceptable.

Farm No.	Average Q l/hr	EU%	Notes
1	3.8	55.3	Q_{em} 8 l/hr, screen filter 10 years old,
2	4.8	68.7	Q_{em} 8 l/hr, Age 1 year, electric pump 2 years old 3.5 hp
3	2.6	64.7	Q_{em} 4 l/hr, 1 year old irrigation network
4	3.2	75.0	Q_{em} 4 l/hr, irrigation network 2 years old, Fair pressure 0.6-0.9 bar
5	0.86	20.9	Q_{em} 4 l/hr,
6	4.7	70.2	Q_{em} 8 l/hr, irrigation network 2 years old,
7	2.1	71.4	Q_{em} 4 l/hr, irrigation network 3 years old,
8	5.3	73.6	Q_{em} 8 l/hr, irrigation network 3 years old, good pressure 1.4-1.2 bar

Table 7: Uniformity Coefficient Results

5. Conclusions and recommendations

Improper filtration system, operation and maintenance practices and irrigation design induced critical financial losses for Jordanian farmers as yield is decrease due to the uneven water distribution and production cost is increased to tackle residual clogging problems (labor cost and material renewal).

Cheap screen filter is the most common filtration system encountered but has two disadvantages; too large meshes and easily damaged during manipulation. On the contrary, disc filters are well adapted to the field rustic conditions, easy to clean, cheap and functional with precise meshes. Also, disc filter could be proposed as substitute of screen filter but cannot be the only on farm filtration system used due the poor physical quality of water stored in the farm reservoir. As matter of facts, the traditional horizontal sand filter, with its current coarse media and improper design, is not preventing dripper clogging. To counterbalance this problem the MREA, has developed in collaboration with ACP, a vertical sand filter which fits the filtration requirement of pressurized system in the Jordan Valley (Luc Armand, 2005[5]). This filter locally manufactured has already been tested combined with disc filter by MREA and should be promoted in the Jordan Valley to encourage farmer to switch from their traditional system.

In addition to optimization of filtration, greater concern for the irrigation network design should be taken to eliminate all the associated problems. EPANET software could be helpful to optimize irrigation network design and management but requires the training of local engineers and extension agents. In addition, PROSONIC tool, could allow calculating the pump curve when old material without any reference is used.

Finally, farmer operation and maintenance practices should be enhanced through training and field visit. Particular attention should be paid on fertilization injection that induces pipe clogging with improper filtration system.

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[5] Luc Armand – 2005 – *Mission Report: Optimization of Sand Filters Used in the Jordan Valley*. Mission Régionale Eau Agriculture, Societe du Canal de Provence.

IRWA PROJECT

IRRIGATION PRACTICES

Date: ____

Survey agent: ____

IDENTIFICATION

Name: ____

Phone: ____

Age: ☐ 20-30 ☐ 31-40 ☐ 41-50 ☐ 51 and above

Farm Unit: ______________ DA _____________ Area ________Du

Number of Years working in farming in general:

☐ 1-5 years ☐ 6-10 ☐ 11-15 ☐ More

A. WATER RESOURCES AND IRRIGATION DESIGN

1) What is the irrigated area of your farm? _________________________

2) How often you are entitled to irrigation water per week?

☐ Once ☐ Twice ☐ Three ☐ Four ☐ Five and more

3) Do you know how much water do you receive per season: YES NO

If yes how much ________________________m3

- **WATER Supply (seasonal from network -** m^3/year **):**
  - Length of run (hours)………..h
  - Irrigation interval (ex. every 3 days)………..d
  - Flow rate…………. m^3/s

4) Is the amount you receive:

☐ Enough ☐ Not enough

5) Have you got a flow meter along the network?

☐ Yes……Where they are located ?

☐ after the filter station

☐ at inlet to of each subunit

☐ Other:…….

☐ No

B. IRRIGATION MATERIAL AND O & M PRACTICES

a. Pump characteristics

1) What kind of pump do you have? ☐ Electric ☐ Diesel

2) When and where did you buy it?

---

3) Do you know the hydraulic characteristics of your pump? ☐ Yes ☐ No

Flow rate (m^3/hr)**:**____________,**P_{max}** (Bar)**:** ____________,**$P_{operational}$**(Bar): ____________

4) How often is the maintenance of the pump ? ☐ Regular ☐ Irregular

☐On a weekly basis ☐ Every month ☐Every 3 months ☐ Every 6 months ☐ Every year

☐ more ☐ never

5) Explain how you check your pump:

____

____

____

☐ Good ☐ Bad

- Power (Kw)……..
- Average seasonal consumption of gasoline (liters/year)…….
- Hours of annual operating (h/year)……..
- RPM……….

b. Filtration Characteristics

1) What kind of filtration you have in the farm?

☐Sand ☐ Screen ☐ Disc

2) What type of sand filters do you have? ☐Vertical ☐Horizontal

3) Where, when did you buy it?

4) If you don't have Sand filters explain why?

☐Clean Water ☐Other filters enough ☐ Too expensive ☐ Other

5) What kind of media you use in the sand filters?

☐Gravels ☐Silica

6) How regular do you clean the sand filter?

☐ Regular ☐ Irregular ☐ depending on pressure variation

Where do you measure these pressures?

☐ inlet of filter statio ☐ outlet of filter station ☐ both

8) How often?

☐Every week ☐ Every 2 weeks **(Maybe too low)** ☐ Every month

☐Every 3 month ☐ Every 6 month ☐ Every year ☐ more

Could you elaborate on how do you proceed?

____

____

____

____

☐ Good ☐ Bad

<u>c. Lateral and Drippers</u>

1) What kind of drippers do you have in the farm?

☐GR ☐T Tape ☐Other

☐1l/hr ☐2l/hr ☐4l/hr ☐8l/hr ☐ don't know!

☐20 cm ☐40cm ☐ 60 cm

Flow for meter of lateral …………..l/m

Classification of Lateral:

☐Light ☐Middle ☐Heavy

- Common classification of drip line depending on the lines thickness (more thickness more cost *more* "*length of life*")

You can compare the "length of utilization declared ***(Ask3)"*** *with "dripper length of life"*

2) Do you know the operational pressure that should be delivered at the Dripper?

☐ Yes ☐ No

If yes, what is it? ___________ (Bar)

3) How many years do you keep your lines of drippers? ___________ (year)

4) Do you face any problems of clogging?

5) How do you solve this issue?

☐ C**hange the dripper lines** ☐ **Uses of acid, how often which concentration**

C. IRRIGATION UNIFORMITY ASSESSMENT

1) How did you plan your irrigation design?

☐ **Personal experience Describe _______________________________**

☐ **Technical advice: From whom? _______________________________**

☐ **Others ____**

2) How did you make the selection of pipes diameters? Choose of the followings:

☐**Pump Capacity** ☐**Pipe Lengths** ☐**Block Sizes**

☐**Type of Drippers** ☐**All** ☐ **Not of all**

3) Do you think the head losses will be increased if you use pipes with?

☐ **Large Diameter** ☐**Small Diameter**

4) Are your fields homogeneous? ☐ Yes ☐ No

5) Where do you find irrigation problems?

____

____

____

____

6) In your opinion, what are the reasons of this problem?

☐ Type of drippers (4l/hr, 8l/hr) ☐ Length of dripper lines.

☐ Pipes diameter (Laterals, manifold or mainlines)

☐ Low pressure ☐ Old equipment ☐ All ☐Others

7) Do you know what a collecting pipe is? ☐ Yes☐ No

8) Do you have pressure gauges in the farm? ☐ Yes☐ No

9) IF yes, do you use them? ☐ Yes ☐ No

10) Where are they situated?

☐ **Before and or After Filters** ☐ **On manifold** ☐ **On the dripper lines**

11) Do you know the pressure at the end of the dripper lines? If yes, could you give us estimation?

____

D. TIMING

1) How frequent do you irrigate?

☐ Daily ☐ Once a week ☐ Twice a week ☐ Other

2) How do you decide when to irrigate

☐ Fixed interval ____________________________________

☐ Field observation ___________________________________

☐ Soil dryness _______________________________________

☐ Plants status ______________________________________

☐ Technical advice: from whom? _______________________

☐ Water availability __________________________________

☐ Specific tools _________ Specify: ____________________

☐According to the climate ________________________________

☐ Others ____

3) Do you change the quantity per each irrigation?☐ Yes☐ No

According to the stage growth ___________________________

According to the climate ________________________________

Other ____

4) How do you decide the quantity to be delivered in each irrigation?

☐ Personal experience Describe _________________________________

☐ Technical advice: From whom? ________________________________

☐ Others ____

E. LEACHING PRACTICES

1) Do you use water for leaching? ☐ Yes ☐ No

2) When do you apply it?

Describe:____

3) How do you decide that leaching is needed?

☐ Personal experience _______________________________________

☐ Technical advice: From whom? ________________________________

☐ Others ____

4) On what basis do you decide the time and quantity of water for the leaching?

☐ Personal experience ____

☐ Technical advice: From whom? _________________________________

☐ Others ____

F. WATER QUALITY MONITORING

1) Did you ever analyze the irrigation water? ☐ Yes ☐ No

2) Do you analyze water on regular basis? ☐ Yes ☐ No

If yes, please specify kind of analysis ________________________________

3) Who provides you with water analysis?

Where do you take the sample of water?

When do you take the sample of water (which season)?

4) Do you think that water analysis would be useful?

☐ Yes ☐ No

5) What for?

____

____

G- Irrigation Scheduling

Crop

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec												
Cultivation time: start/end																								
Irrigation interval (days)																								
Irrigation duration (hours)																								
Number of irrigation/half month																								
M3/ha/half month																								

The final water consumption will be calculated depending on irrigation uniformity % and irrigation Scheduling

Coefficient of Uniformity Measurement

Introduction

A virtue of a pressurized irrigation system is its ability to deliver a uniform amount of water to each location it serves, so that, water is applied evenly over the field, but only if it is operated and maintained properly. Because of pressure differences throughout the system and variability in emitter manufacture, even new systems may not apply water completely evenly. While a well-designed system can deliver water with a high degree of uniformity, the system must be properly maintained to keep the application uniform. The principal cause of non-uniformity in such irrigation systems is emitter clogging by particulate or organic matter, lime precipitates, or iron precipitates.

Irrigation Emission Uniformity (EU) is a measure of the evenness of the water application for good irrigation water management. An irrigation system with uniform water application means each plant will receives nearly the same amount of water during the irrigation process. As higher uniformity of application is achieved, variation in the depths applied at different points in the field differ less from the average depth. This can be an important factor, particularly for high value crops, where small variations in irrigation uniformity can cause declines in crop quality. An irrigation system with good uniformity of application saves water, because it allows you to avoid over-irrigating parts of the field while concentrating on putting adequate water on dry or other problem areas.

Procedure

The EU can be easily determined in the field by the following procedure:

1. Select a submain the represent the average operating conditions in all submains.
2. Locate 3 laterals along an operating submain; one lateral near the inlet, one lateral near the middle, and one lateral at the far end.
3. Measure, under normal operating conditions, the pressures at the inlet, near the middle and at the far end of each lateral. This will produce 9 pressure readings.
4. On each lateral, select 2 adjacent emitters at 3 different locations, at the inlet, in the middle and at the end point.
5. Measure the discharge from the selected emitters. Collect the volume for a certain time (10 min) this will produce 18 discharge readings.
6. Enter the information collected in the data sheet
7. Use the average of the lowest 4 discharge rates of all readings as the minimum rate $\mathbf{q}_{4}$
8. The average of all the readings is the average rate of discharge per emitter $\mathbf{q}_{av}$.
9. Calculate the EU use the following equation

$$\mathbf{EU\ \% = (q_4 / q_{av}) * 100}$$

High EU is achieved by maintaining a limited variation in discharge rate among system emitters. Proper maintenance of filters is vital for preserving system EU, because emitter clogging and uneven pressure distribution are the major factors contributing to disparity in discharge rate and poor uniformity. Upgrading EU could save water, power and fertilizer bills, improve irrigation efficiency and crop yield, preserve the environment, and enhance grower's net profit. Periodic evaluation of EU is recommended for monitoring system performance and pinpointing problems. It is also advisable to evaluate newly installed systems to establish a baseline for future evaluations. A simple method for the evaluation of emission uniformity is described below. The equipments needed are readily available on most farms.

Drip or trickle irrigation systems can be evaluated by using a graduated cylinder or measuring cup and measure the time it takes to catch a certain volume of water from each of several emitters throughout a system.

An evaluation of irrigation system will provide the necessary information for scientific irrigation scheduling. It will also tell if you are experiencing excessive application losses (that is, runoff, deep percolation, wind drift) or if the irrigation system needs service or improvement to increase application uniformity. The end result is water savings. Stated in a slightly different context, evaluating and improving your system will help to stretch available water further. Operate irrigation systems near their design limits to achieve peak efficiencies and uniformities.

EQUIPMENT NEEDED

1. Pressure gauge.
2. Stop watch or a watch with a second hand.
3. Plastic cup about 250 ml.
4. Plastic graduate cylinder, 100-500 ml capacity.
5. Measuring tape 100 feet long.

Uniformity Testing Data Collection Form

Part I: Personal Information

Date: ……………………….

Farmer Name: ………………………………………… **FU/DA**: ……………..

Name of Evaluator: ………………

Part II: Irrigation System Information

- **Age:………**
- **Emitters: Type………… Discharge:………….. Spacing:………**
- **Laterals: Type…………. Diameter:…………… Spacing:………**
- **Filter: Type……………. Capacity:…………… Age:………**
  Type…….........…. Capacity:…………… Age:………
  Type……………. Capacity:…………… Age:………
- **Pump: Type……………. Capacity:…………… Age:………**

- **Tentative System Layout and Measurement Locations**:

Part III: Results:

Location of Emitters on the Lateral		**Inlet**		**Middle**		**Far End**	
		Volume Collected ml	**Discharge l/h**	**Volume Collected ml**	**Discharge l/h**	**Volume Collected ml**	**Discharge l/h**
Inlet	**A**						
	B						
	Pressure						
	Time (min)						
Middle	**A**						
	B						
	Pressure						
	Time (min)						
Far End	**A**						
	B						
	Pressure						
	Time (min)						

Calculations:	
q_4	
q_{av}	
EU %	

Result interpretation for the irrigation group:

Part One: Filtration System

Part Two: Irrigation Practices

Part Two/1: Irrigation Scheduling

Part Two/2: Leaching Requirements.

Part Three: Operation and Maintenance.

Part Three/1: Filtration System Maintenance.

Part Three/2: irrigation Network Maintenance.

Classification of irrigation management

Management Level	
Very low	- No filtration or using only traditional sand filer or screen filter - No scheduled back wash - Always apply the same amount of water - No leaching is done - Changing the irrigation network every year
Low	- Traditional Sand Filter - Scheduled back wash - The amount is depending on plant behavior and climatic conditions - Leaching during the solarization process - Changing the irrigation network every 2 years
Intermediate	- Using Combination of the three types of filters - Every irrigation - The amount is depending on plant behavior, climatic conditions, and growth stage - Leaching during the solarization process and between cropping season - Changing the irrigation network every 3 years
Advanced	- Sand filter with adapted media with disc filter - Using the pressure gage reading as indicator - Using soil moisture measurements - Leaching depending on EC analysis - Changing the irrigation network over 3 years or more