AGRIWATER

Basic calculations of Measures for Water Management

EDUCATIONAL MATERIAL FOR FARMERS

MODULE NO. 3

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IN THIS MODULE YOU WILL LEARN

- Introduction
- Climate change adaptation measures
- Adaptation measures examples
- Basic calculations examples
- AGRIWATER Learning Hub

INTRODUCTION

Water needs for agriculture must be supplied taking into consideration a decreasing availability, due to:

- environmental awareness,
- population growth,
- economic development and
- global change.

Water management for agriculture is then inter-related with:

- traditional water resources management,
- food production,
- rural development and
- natural resources management.

INTRODUCTION

Climate change negative impacts:

- reduce water availability for agriculture environmental awareness,
- extreme whether events

current water management at risk → **Adaptation measures**

INTRODUCTION

An adaptation measure/strategy is an intervention to reduce the vulnerability of the agricultural sector to climate change effects.

Best practices: are a selection of interventions proven to work well and produce good results.

Adaptation Measure Examples

Adaptation Need	Adaptation Measure	Best Practice Type	Best Practice Number
Responding to changes in water availability	Reuse of treated wastewater for irrigation	Technological	BE_05
	Underground irrigation strips with integrated dripper	Technological	ES_01
	Automation of irrigation systems	Technological	ES_02
	Reverse osmosis desalination plant	Technological	ES_08
	Rooftop rainwater harvesting	Technical	IT_05
	Supplemental irrigation ponds	Technical	IT_06
	Drip Irrigation on rice	Technological	IT_08

Adaptation Measure Examples

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Adaptation Need	Adaptation Measure	Best Practice Type	Best Practice Number
Responding to floods and droughts	Wetlands and pools	Technical	CZ_03
	Weir	Technical	BE_01
	Controlled drainage	Technical	BE_02
	Farming insurance	Economic	ES_03

Adaptation Measure Examples

Adaptation Need	Adaptation Measure	Best Practice Type	Best Practice Number
Responding to increased irrigation requirements	Mulching in tropical crops	Agronomic	ES_04
	Change Variety/Breed	Agronomic	ES_06
	Water harvesting with pits	Technical	ES_07
	Soil coverage	Agronomic	CY_01
	Subsoiler	Agronomic	CY_03
	Hydroponics	Agronomic	CY_04

Adaptation Measure Examples

Adaptation Need	Adaptation Measure	Best Practice Type	Best Practice Number
Responding to deterioration of water and soil quality	Construction of contour trenches (swales)	Technical	CZ_01
	Diversified agriculture	Agronomic	CZ_06
	No tillage	Agronomic	CY_02
	Agroforestry	Agronomic	DE_02
	Improved soil management	Agronomic	IT_01

Adaptation Measure Examples

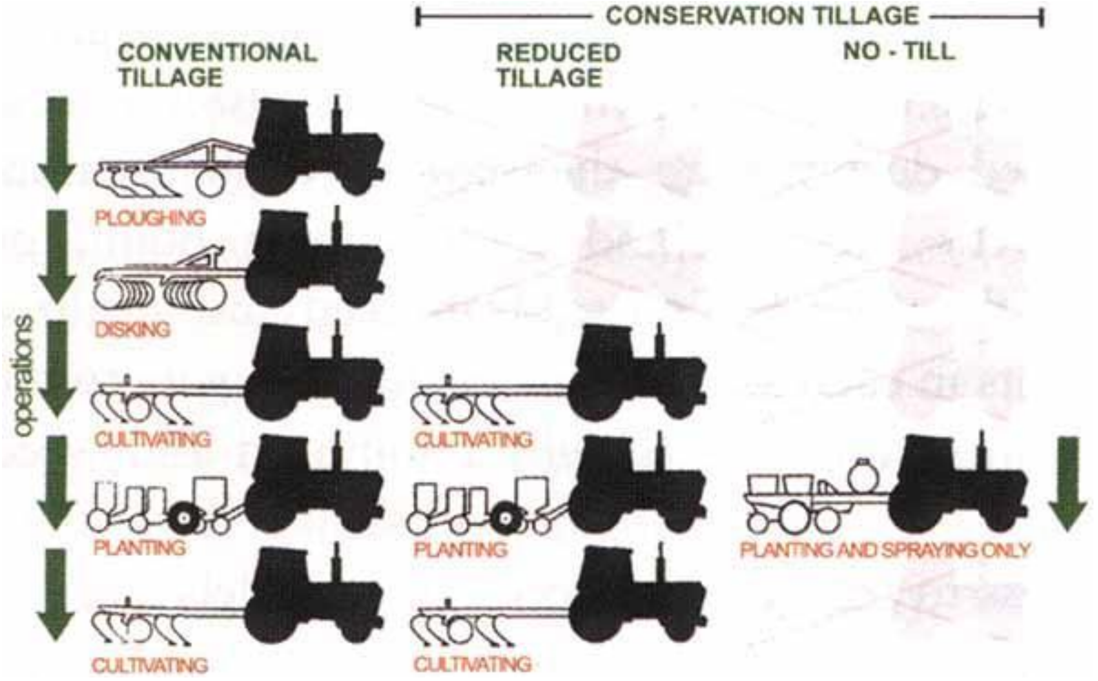
Adaptation Need	Adaptation Measure	Best Practice Type	Best Practice Number
Responding to loss of biodiversity	Innovative agronomic practices	Agronomic	CZ_02
	Stream and wetland revitalisation	Technical	CZ_07
	Regenerative farming	Agronomic	DE_03
	Utilization of landraces and evolutionary populations	Agronomic	IT_04

Basic Calculations and Examples

Agronomic practices: No-tillage

- **AGRIWATER Best Practice: https://learning.agriwater.eu/case-studies/theodoros-orchard-2**
- **Conventional or full tillage** rearranges the entire topsoil. It may require several passes to turn the soil and then break it down into a friable seedbed prior to sowing.
- **Minimum tillage (reduced tillage)** is generally a one-pass tillage operation at sowing synchronous with seed placement, typically achieved using total cut-out points or full cut-out one-way or offset discs to break up the entire soil surface. It may include shallow cultivation between seasons to control weeds; it may be called reduced tillage.
- **No-tillage or zero-till** involves one pass during which a part of the soil surface is disturbed or "opened", and the seeds are placed concurrently in that disturbed zone. The seeder opener may be a knife-point as little as 5 mm wide on a tine or a single, double or triple-disc set at a slight angle to the direction of travel.
- In general, we can use "**conservation tillage**" as a generic term that covers any tillage system that reduces soil and water loss compared with conventional tillage. Some have defined it more tightly to include treatment of residues specifying that at least 30 per cent of the soil surface should be covered with residues after sowing to reduce erosion by water. It is likely to include zero, minimum and reduced tillage systems within the definition.

Basic Calculations and Examples



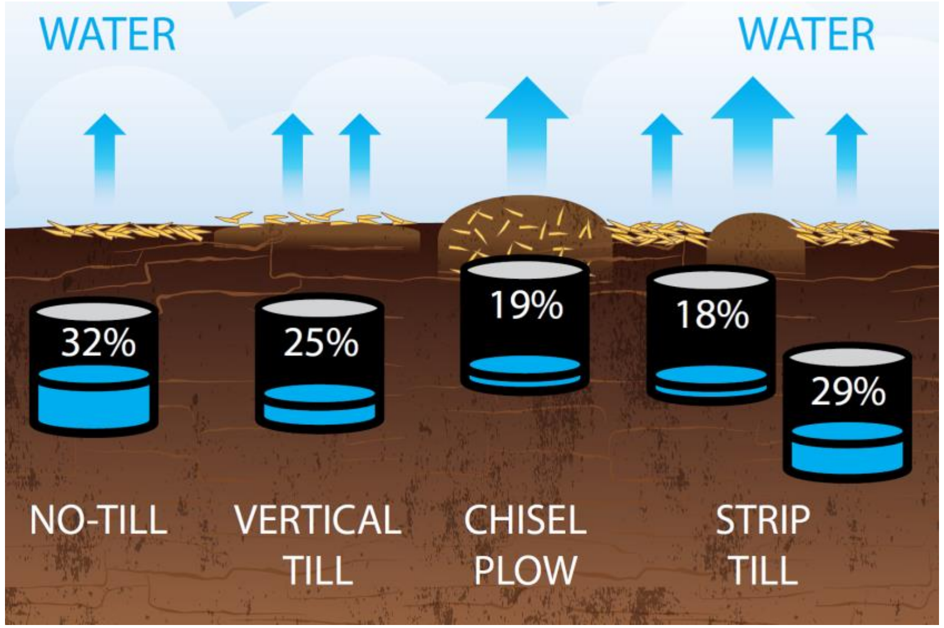
Source: FAO

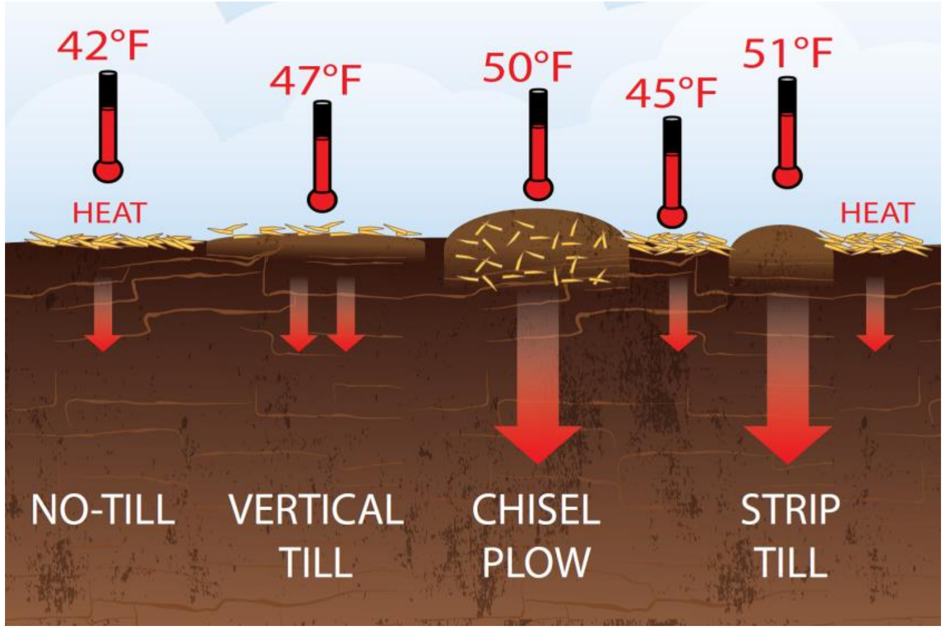
Effects of no-tillage:

- It can reduce labour, fuel, irrigation and machinery costs.
- No-till can increase yield because of higher water infiltration, storage capacity, and less erosion.
- Another possible benefit is that because of the higher water content, instead of leaving a field fallow, it can make economic sense to plant another crop instead.

Basic Calculations and Examples

- No-tillage and conservation tillage measures have considerable benefits also in terms of a decrease in soil temperatures if combined with mulching





Basic Calculations and Examples

Technological practices: sub-irrigation

- **AGRIWATER Best Practice:** https://learning.agriwater.eu/case-studies/purificacion-a-valderrama

- Before the system is designed, the **systems' goals or expectations** should be identified: increased manageability, better crop quality and uniformity, increased yields, uniform application of water and nutrients water savings, and/or increased profits.

- **Field:** an undulating or sloped field will require pressure compensating emitters, and a flat field will use non-pressure compensating emitters. The tubing diameter is also critical to supplying the system's flow. We want to achieve no more than a 7% difference between the highest and lowest emitter flow rate from a design point.

- **Soil:** Clay soils allow water to travel much further (upward and laterally) than sandy soils. Clay soils also hold much more water and absorb water much slower. Therefore, drip lines and emitters are generally installed closer together in sandy soils, while in clay soils, these spacings can be increased but with lower emitter flow rates due to the lower absorption rate.

Source: https://southernirrigation.com/2020/10/29/designing-an-sdi-system-with-southern-irrigation/

Basic calculations and examples

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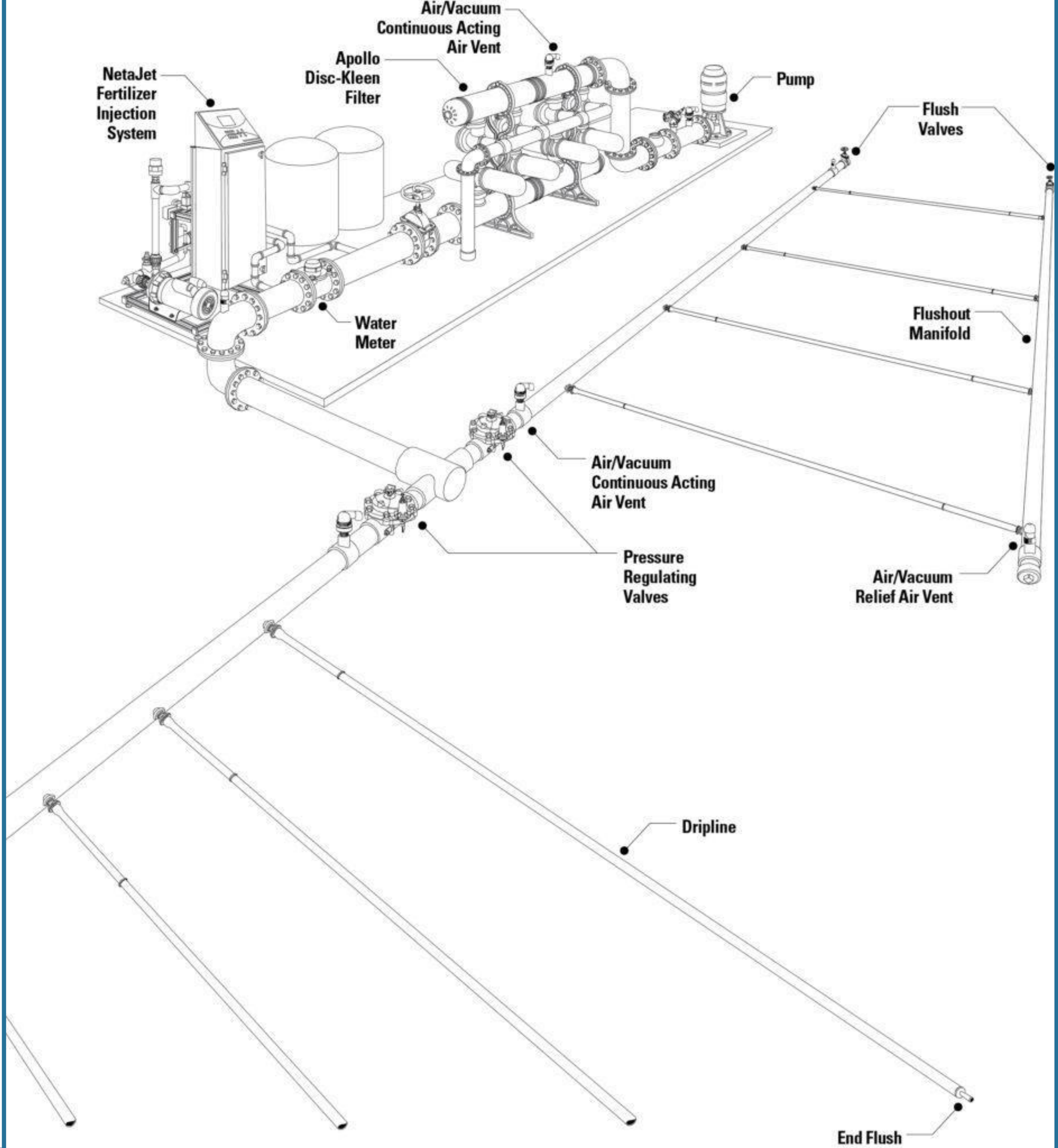
Technological practices: sub-irrigation

- **AGRIWATER Best Practice:** https://learning.agriwater.eu/case-studies/purificacion-a-valderrama
- A water analysis needs to be carefully reviewed to understand **the level of filtration and treatment required to prevent the dripline from clogging or calcifying**. In most cases, the quality of the water can be easily corrected.
- It is good practice to monitor the system's operation flow and the crops' water use.
- **Fertilizer injection**: Fertilizer injection systems inject nutrients and chemicals into the system for maximum crop performance and maintain the dripline over a long time. Flexible fertigation capabilities will help the system pay for itself faster than any other component in the system. Injection systems should meet expected demands for all chemicals, be easy to operate and calibrate and have provisions to prevent unwanted precipitates.
- **Winterizing the system** is a necessary maintenance procedure as water will freeze and expand, possibly damaging plastic and metal system components. Water from filters, valves, chemigation equipment, pressure regulators, and subsurface pipes **should be emptied** – especially at the lower ends of the field where water typically accumulates. Polyethylene drip lines are not subject to damage from freezing since the drippers provide drainage points and polyethylene is flexible.
- **Routine maintenance** of all system parts (such as filters, pumps, valves and fertilizer injectors) will extend the system's life. Maintenance should follow a regular schedule and should be recorded for later reference.

Source: https://southernirrigation.com/2020/10/29/designing-an-sdi-system-with-southern-irrigation/

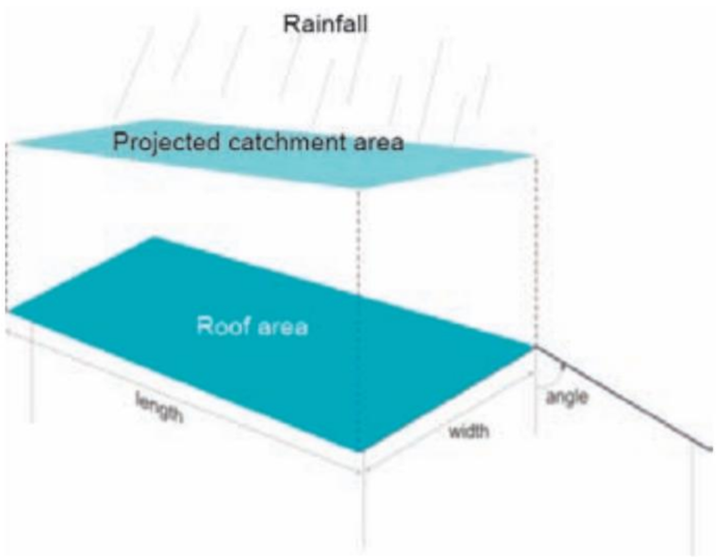

Air/Vacuum
Continuous Acting
Air Vent
Apollo
Disc-Kleen
Filter
NetaJet
Fertilizer
Injection
System
Pump
Flush
Valves
Flushout
Manifold
Water
Meter
Air/Vacuum
Continuous Acting
Air Vent
Pressure
Regulating
Valves
Air/Vacuum
Relief Air Vent
Dripline
End Flush

Basic calculations and examples

Technical practices: Rooftop water harvesting from greenshouses
AGRIWATER Best Practice: https://learning.agriwater.eu/case-studies/azienda-agricola-poeta-otello

Basic calculations and examples

Technical practices: Rooftop water harvesting from greenshouses



Catchment Area (m^2) = Length (m) × Width (m)

Where:

- Length = length of the catchment surface (m)
- Width = width of the catchment surface (m)

Supply (litres/year) = rainfall (mm/year) × greenhouse roof area (m^2) × runoff coefficient of polyethylene film (PE)

The runoff coefficient is the amount of water that drains free of the surface relative to the amount of rain that falls on the surface. It reflects how much of the rainfall is lost to infiltration and other abstractions. In the case of greenhouses, the materials typically used are various forms of plastic (polyethylene film (PE)) which have little to no infiltration capacity, and thus nearly all the water runs off. However, there are losses to evaporation and splashing and detention such that the general runoff coefficient for the polyethylene greenhouse film is estimated to be 0.8. This means that of the total volume of rain that falls on the catchment surface, 80% drains off the surface; the other 20% stays on the surface.

Basic calculations and examples

AGRIWATER

Technical practices: Rooftop water harvesting from greenshouses

	Maximum Rainfall Rate				
Diameter of gutter sloping 5.2 mm/m	**50.8 mm/hr**	**76.2 mm/hr**	**101.6 mm/hr**	**127 mm/hr**	**152.4 mm/hr**
101.6 mm	*66.9 m^2*	*44.6 m^2*	*33.4 m^2*	*26.8 m^2*	*22.3 m^2*
127 mm	*116.1 m^2*	*77.5 m^2*	*58.1 m^2*	*46.5 m^2*	*38.7 m^2*
152.4 mm	*178.4 m^2*	*119.1 m^2*	*89.2 m^2*	*71.4 m^2*	*59.5 m^2*

Note: For figures associated with larger-diameter gutters see the Uniform Plumbing Code Table 11-3.

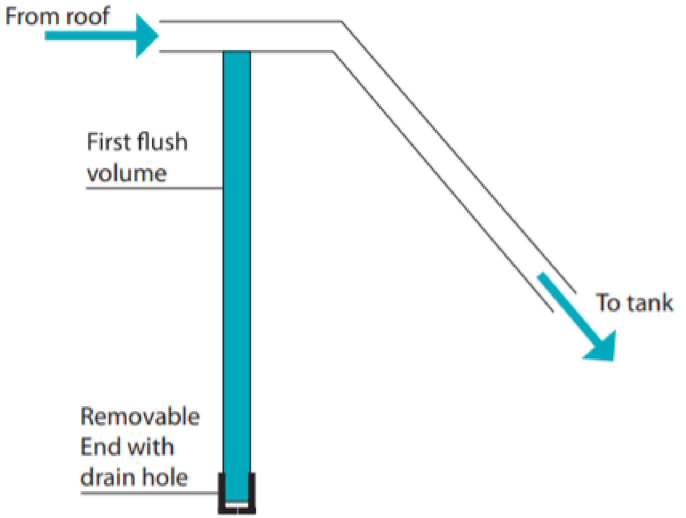
Basic calculations and examples

Technical practices: Rooftop water harvesting from greenshouses

Sizing of rainwater pipe for roof drainage

Diameter Of pipe (mm)	Average rate of rainfall in mm/h					
	50	**75**	**100**	**125**	**150**	**200**
50	13.4	8.9	6.6	5.3	4.4	3.3
65	24.1	16.0	12.0	9.6	8.0	6.0
75	40.8	27.0	20.4	16.3	13.6	10.2
100	85.4	57.0	42.7	34.2	28.5	21.3
125	-	-	80.5	64.3	53.5	40.0
150	-	-	-	-	83.6	62.7

mm/ h - millimeters per hour; m - meters

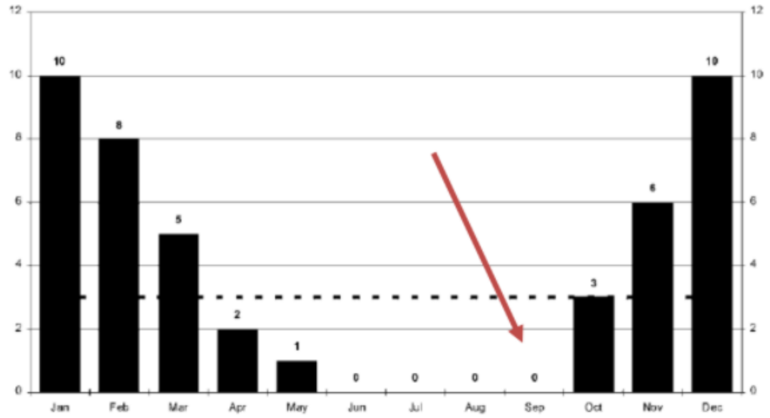


First flush diverter

Basic calculations and examples

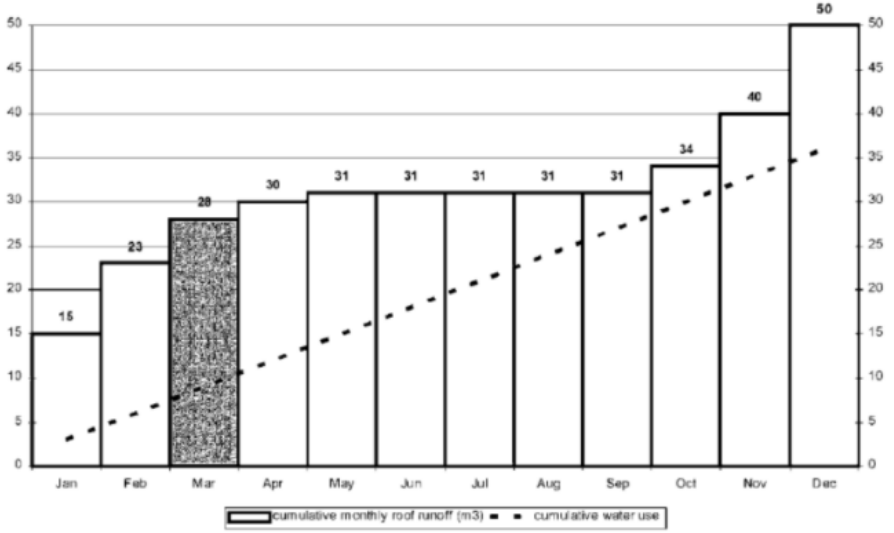
Implementation

Sizing your storage reservoir
Method 2: Supply side approach (graphical methods)



- Single rainy season (from October to May).
- The first month when the collected rainfall (RWH) meets the demand is **October.**
- If it is assumed that the tank is empty at the end of **September**

- Plot a cumulative roof run-off graph, by summing the monthly runoff totals.
- Add a dotted line showing cumulative water use (water withdrawn or water demand).
- A residual storage of 5 m^3 should be incorporated for the rainwater remaining in the tank at the start of the wet season



Basic calculations and examples

Cost considerations – typical costs

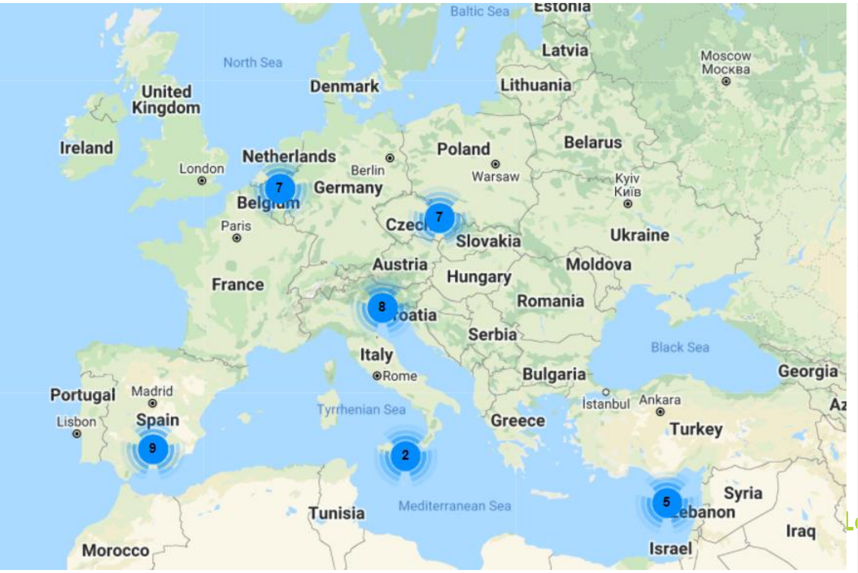
- Design costs
- Cost for legal authorizations
- Land preparation
- Eventual machinery rent
- Materials and spare parts
- Labor
- Ordinary maintenance
- Extraordinary maintenance
- Disposal of materials (used plastic pipelines, chemicals storage, etc.)

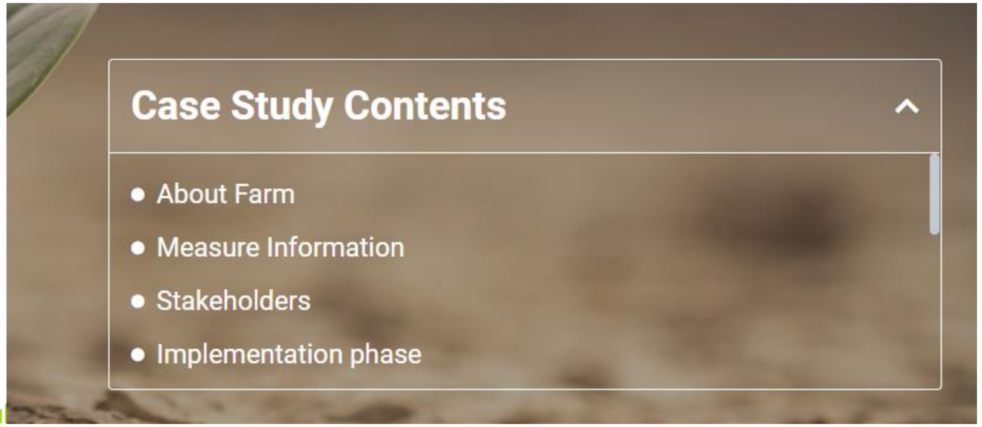
Some examples (check AGRIWATER's learning hub for more)

- **Drip irrigation on rice:** 800 – 1300 E/ha for the materials (The 1300 € /ha cost include the assistance from the provider); 200 € /ha/y for the maintenance
- **Pit based water harvesting for trees:** the hourly cost of the operator is €35, resulting in a cost of €1.3 per tree, at a rate of 25 trees/hour. This measure requires biannual maintenance at a rate of €0.65 per tree.

AGRIWATER Learning Hub

https://learning.agriwater.eu/





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