WATER CONSERVATION TECHNICAL BRIEFS

TB3 – Metrics for improving water management in agriculture

SAI Platform

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This document provides a review of mechanical water meter and present indirect methods to estimate water use in irrigation. Knowing how much water an irrigation system uses is an important precursor to effective irrigation management, and is vital to address the recommended indicators in a meaningful way.
Water use can be defined via direct measurements (e.g. water meter) or indirect measurements (e.g. energy used by a pumping plant, timing and estimating flow rate).
There exists many different types of water meters and each of them is based on a specific technology. There are two categories of meter available – mechanical and non-mechanical. Mechanical meters include propeller, paddlewheel and turbine meters. Non-mechanical meters include ultrasonic and electromagnetic meters.

Contents

SECTION 1: RECOMMENDED INDICATORS

Definition	An indicator is a measure of the state of a system that enables us to evaluate the effect of our actions on resources and adjust our actions to meet specified goals. The recommended indicators are easy to measure but are crucial to properly manage water in agriculture. The indicators describe characteristics of a farming system that can be altered by changing irrigation system design or management and they will be ideal for inter-farm comparisons, to give an indication of the most effective systems.

Water use	Daily volume of irrigation water use for each crop (m^3) and (m^3/ha).
Yield	Quantity of crop produced per hectare for each crop (ton/ha).
Water productivity	Quantity of crop produced per unit of water use (including rainfall) for each crop (ton/m^3).

SECTION 2: PROPELLER METER

Cost	Prices range from about $200 for a small one to over $1,000 for a large size.

Description	The main parts of the flow meter consist of a propeller (A) mounted in a short section of pipe and geared to a revolution counter (B) which records the rate of flow and the cumulative total (fig. 1).

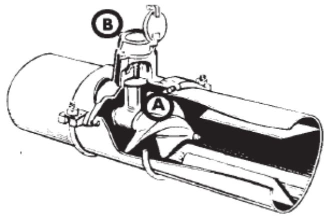
Principle of operation	The flowing water causes the propeller to rotate and each rotation is recorded in the revolution counter. A rotation corresponds to a specific volume of water according to the size (diameter) of the pipe.

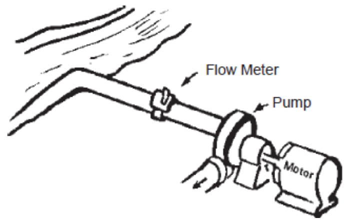
Remarks & Recommendations	
Since the flow meter works on the principle of a given rate of flow through a fixed area of pipe, the pipe must be flowing full for accurate results.	
Propeller meters need to be installed in straight sections of pipeline.Install the flow meter in the pipe at about eight pipe diameters away from any bends, elbows, or turbulence-causing fittings on the upstream side (refer to manufacturer's recommendations)	
Select the proper size of flow meter for the anticipated rate of flow. Meter sizes are generally classified by the diameter of the pipe in which they are mounted.	
Propeller meters require very little maintenance and are usually accurate to within two percent.	
You can install flow meters permanently in a pipeline (fig. 2*)* or make them portable with canvas or plastic hoses to clamp over a well stub to measure flow (fig. 3).	
Rates of flow such as liters per second (or gallons per minute) are then obtained by simply noting the volume of water on the dial for any given length of time as measured by a watch.	
Monitoring the performance of an irrigation system makes it possible to identify changes in flow rate during the season (measured at the same pressure). This change may indicate problems such as clogging of emitters or filters, leaks in the system, or problems with the pump or well.	

Advantages(+) / Disadvantages(-)	
+	Accurate

-	Expensive

Pictures	





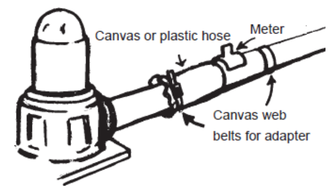


Fig.1 Propeller meter for use in pipes Fig.2 Flow meter permanently installed Fig.3 Portable meter installation

Section 3: Energy use by a pumping plant

Description	For any pumped system, an alternative to measuring flow using a water meter is to relate the quantity of water pumped to the units of electricity used. This method requires volume of water used to be measured by a water meter and noting the electricity used for a given length of time. Volumetric water use can then be directly calculated from units of electricity used. Flow rates can also be calculated by dividing the volumes of water used by the run time of the system. An hour electricity meter related to the pump is necessary to apply this method.

Cost	The only cost arises from the need to rent a portable water meter in order to relate the volume of water pumped to the units of electricity used.

Disadvantage	Taking into account electricity use to calculate water use is accurate only if the operating conditions of the pump or irrigation system do not change significantly.

SECTION 4: CATCH CAN METHOD

Description	Catch can tests are commonly used in drip and micro-sprinkler irrigation to measure the water flow at specific place of the irrigation system and then to estimate the volume of water use on the entire system when running. For drip systems, place the containers under each emitter along the lateral. Run the irrigation for a set period of time (half an hour is normally enough) and collect the water in the catch cans. The volume of water in each container is measured with a measuring cylinder and converted into an hourly discharge rate. Do the same for micro-sprinkler in placing the head of the micro-sprinkler into the measuring cylinder and catch the entire discharge.

Cost	Inexpensive

Example	Assuming the drip irrigation system was running for 30mn and 1500ml (1,5L) was measured in the can, thus: The flow rate is equal to 1,5 L × 2 = 3 L per hour. The volume of water use on the entire system during 1 hour is equal to the flow rate multiply by the number of emitter (dripper).

Remarks	- This system can be used to calculate the distribution uniformity of the system. - Can also be used to identify changes in performance due to poor maintenance or age of the system.

SECTION 5: BUCKET METHOD

Description	Measuring the period of time required to fill a bucket (or container) of a known volume can be used to measure small rates of flow such as from individual tubes in small surface flooding irrigation, sprinkler nozzles.

Cost	Inexpensive. Depend on the price of the bucket and the stop watch.

Recommendation	It is recommended that the measurement be repeated at least three and preferably five times to arrive at a reliable rate of flow per unit of time.

SECTION 6: WATER APPLIED BY SURFACE IRRIGATION

Description	During flood/furrow irrigation, irrigators should not be content merely to get the water to the end of the furrows, but should also consider how much water is applied and how it is distributed. Producers should think about surface irrigation in terms of depth of water applied to the field. The simple relationship AD=QT can be used to determine the amount of water applied by surface irrigation systems (fig. 4).

Remark	The rate of flow has to be known. It can be estimate via the "Bucket method".

Cost	Inexpensive.

Example	1 cubic foot per second (cfs) applied for 2 hours will result in 2 inches of water applied to 1 acre. Note: To convert the volume in m^3, thus: The depth D must be in mm The area A must be in m^2 The flow Q must be in m^3 per unit of time The time T must be in the same unit of time than for the flow

Picture	

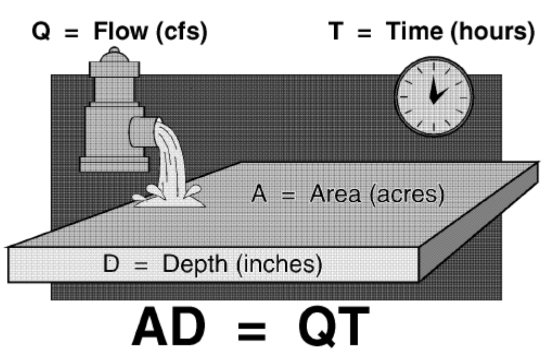


Fig.4 Simple method for determining amount of water applied by surface irrigation

Section 7: References

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