Cooperative Extension Service
C/T/A/H/R
College of Tropical Agriculture & Human Resources
University of Hawaii at Manoa

Hawaii's Pollution Prevention Information
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HAPPI-Farm 6

Minimizing Pollution Risk from
Irrigation Management

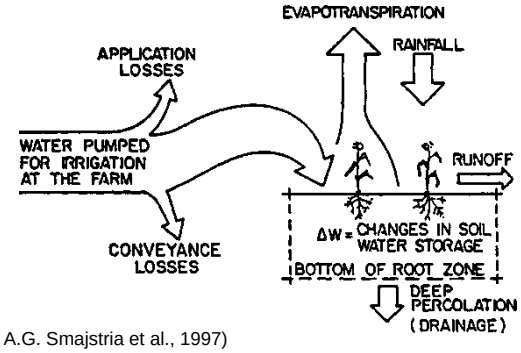
While many areas in Hawaii are rainy and do not require irrigation, other areas are dryer and lack enough rainfall for good crop growth. In the dry areas, irrigation allows agriculture to be productive. Improperly managed irrigation can waste water resources and pollute both ground and surface waters. This worksheet will help you to determine the water pollution risks associated with your irrigation practices and to develop an action plan to reduce those risks.

Do you apply the right amount of water at the right time?

The first step in good irrigation management is to apply the right amount of water at the right time. Applying too much water is costly and increases runoff or leaching. Applying too little water reduces crop yields. Applying water at the wrong time can cause all three of these problems. You should develop an irrigation schedule based on four factors:

- soil moisture conditions and water-holding capacity
- plant needs
- weather conditions
- water application rates.

The water balance of an agricultural field



(From A.G. Smajstria et al., 1997)

Irrigation water applications need to be based on how much water is in the soil now (current soil moisture) and the ability of the soil to hold water (water-holding capacity). If there is plenty of water in the soil, there is no need to apply more water. Soils with high water-holding capacity (clays) generally need less frequent irrigation applications than soils that hold less water (sands).

Different crops vary in their water needs at different growth stages, so the irrigation schedule should change when you change crops and also as individual crops grow. Weather conditions also are important. Plants and soils lose more water on hot sunny days than on cool cloudy days. Irrigation applications should be adjusted accordingly.

Several methods are used to determine irrigation requirements. Soil tensiometers measure soil moisture tension—how strongly the soil holds water—and estimate how much is available to plants. Tensiometers are helpful in keeping soil moisture within a desirable range for a particular crop (for more information, see CTAHR publication L-10, *Using tensiometers for measuring soil water and scheduling irrigation*).

Data collected with weather-recording instruments that measure rainfall, solar radiation, and air temperature can be used to estimate water loss from the soil and the crop (potential evapotranspiration) to determine irrigation needs. The weather data can be used to calculate water requirements of the crop on a daily basis (for more information, see Smajstria et al. 1997, in References, p. 3).

Another approach is to measure water evaporation and estimate the amount of irrigation water required to replace this loss. A simple form of this method is to fill a 5-gallon bucket with water to a set level and then measure the amount of water loss from the bucket. All or

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part of this amount of water (depending on the crop) is then replaced by irrigation.

After determining how much water is needed, compare that amount to the capacity of your irrigation system and determine your irrigation schedule—how long and how frequently you need to run the system to provide sufficient water. CTAHR Cooperative Extension Service personnel can help you develop an appropriate irrigation schedule.

Is your irrigation system well designed?

A poorly designed system can result in excessive or insufficient water application. Some signs of a poorly designed irrigation system are

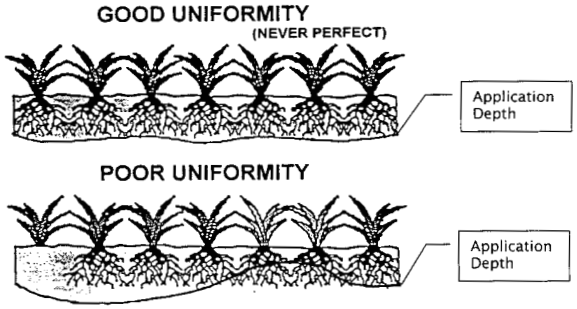
- uneven crop growth or color
- runoff of irrigation water
- surface ponding of water

To avoid distributing water in uneven patterns, have your irrigation system professionally evaluated for efficiency and uniformity. For example, to surface-irrigate uniformly, water should be applied to the field surface for an approximately equal amount of time at all points. In a furrow irrigation system, water should advance from the top of the field to the end of the field in about ¼ of the total irrigation time set. For overhead irrigation systems, pressure and nozzle uniformity should be checked during regular maintenance (for more information on irrigation system efficiency, see Smajstria et al. 1991). Consider using drip irrigation or a similar system that allows you to apply water only to the plant rooting zone. However, drip irrigation systems can be costly to establish and are not appropriate for all crops.

Regular system maintenance can greatly reduce your water costs and also reduce the risks of water pollution. Leaky pipes, hoses, and nozzles can result in wasted water. Leaks can also concentrate large amounts of water in one place. This can create conditions for soil erosion, water runoff containing pesticides and nutrients, and leaching of pesticides and nutrients into groundwater.

If you are a cooperator with your local Soil and Water Conservation District, you can obtain technical assistance in irrigation system design from a Natural Resources Conservation Service engineer.

Aim for good irrigation uniformity



From: *Sprinkler system scheduling*, 1999, The Irrigation Association, p. 20.

Do you apply pesticides and fertilizers through your irrigation system?

If you apply fertilizers or pesticides in your irrigation water, you should review HAPPI-Farm 4, *Nutrient management*, and HAPPI-Farm 5, *Pest management*, and follow the recommended practices. Your nutrient management and pest management plans should include records on all fertilizers and pesticides applied. All equipment should be calibrated and monitored during the entire period of use.

Do you irrigate with liquid manure or mill water?

Manure and sugarcane mill water can be valuable resources to reduce fertilizer purchases. However, the nutrients they contain can cause water pollution if they are applied improperly. If you irrigate with manure or mill water, you should be sure to include the nutrients provided by these sources in your nutrient management plan. If you need more information on nutrient management planning, refer to HAPPI-Farm 4, *Nutrient management*.

Assessing your risks

Complete the risk assessment table on page 3 to determine your water pollution risks. For each category, choose the set of practices that best fits your situation. Then, go to page 4 and develop an action plan to minimize water pollution on your land.

Risk Assessment Table for Irrigation Management

	Low risk	Moderate risk	High risk	Your risk
Irrigation plan and water budget	Have up-to-date irrigation management plan and water budget; regularly revise irrigation schedule based on crop needs and soil moisture status	Irrigation management plan not revised in the past 2 years; irrigation schedule used but not updated in-season	No irrigation management plan or plan >5 years old; irrigation schedule not used	❑ low ❑ moderate ❑ high
System design	System designed to maximize water transport to root zone; drip irrigation and other water-efficient technologies used where possible; water flow constantly monitored	System designed to provide appropriate amount of water to crops; use sprinkler irrigation; water flow regularly monitored	System designed on ad-hoc basis; flood irrigation or other water-intensive technology used; water flow not monitored	❑ low ❑ moderate ❑ high
System maintenance	System regularly maintained and checked for leaks; nozzles and other applicators regularly calibrated and checked for evenness of application	System checked on an irregular basis; nozzles and other applicators calibrated no more often than once a year	System seldom checked for leaks; nozzles and other applicators not checked and calibrated in more than 1 year	❑ low ❑ moderate ❑ high
Fertilizer in irrigation water	If you apply fertilizer in your irrigation water, refer to HAPPI-Farm 4, *Nutrient management*.			
Pesticides in irrigation water	If you apply pesticides in your irrigation water, refer to HAPPI-Farm 5, *Pest management*.			
Liquid manure or sugarcane mill water used	If you irrigate with liquid manure or mill water, refer to HAPPI-Farm 4, *Nutrient management*.			

References

These CTAHR publications can be found at <http://www2.ctahr.hawaii.edu/oc/freepubs/>:

Hensley, D., and J. Deputy. 1999. Using tensiometers for measuring soil water and scheduling irrigation. CTAHR publication L-10, 4 p.

Hensley, D., J. Deputy, and J. Tavares. 1999. Watering lawns. CTAHR publication TM-7, 4 p.

The following are available at <http://edis.ifas.ufl.edu/menu_ae:irr>:

Smajstria, A.G. 2000. Irrigation management. University of Florida, IFAS publication AE260, 9 p.

Smajstria, A.G., B.J. Boman, D.Z. Haman, F.T. Izuno, D.J. Pitts, and F.S. Zazueta. 1997. Basic irrigation scheduling in Florida. University of Florida, IFAS Bulletin 249, 8 p.

Smajstria, A.G., B.J. Boman, G.A. Clark, D.Z. Haman, D.S. Harrison, F.T. Izuno, D.J. Pitts, and F.S. Zazueta.. 1991. Efficiencies of Florida agricultural irrigation systems. University of Florida, IFAS Bulletin 247, 11 p.

Additional information is available from The Irrigation Association, 6540 Arlington Blvd., Falls Church, VA 22042, phone 703-536-7080, fax: 703-536-7019, Web <http://www.irrigation.org/>.

Your action plan

Now that you have assessed your management practices, you can take action to change practices that may be causing water pollution. For areas that you identified as high or moderate risk, decide what action you need to take and fill out the Action Plan below.

Write down all your moderate-risk and high-risk activities below	What can you do to reduce the potential risk for water pollution?	Set a target date for action
Samples of action items:		
Irrigation nozzles haven't been calibrated since they were installed last year.	*Contact Cooperative Extension Service agent to learn how to do a calibration test.*	*By the end of next week.*

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