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College of Tropical Agriculture & Human Resources
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Hawaii's Pollution Prevention Information
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HAPPI-Farm 4

Minimizing Pollution Risk from
Nutrient Management

Fertilizers provide the additional plant nutrients that often are necessary for optimum crop production. Both chemical (inorganic) and organic fertilizers (including animal manure) are major sources of the nitrogen and phosphorus that pollute streams and coastal waters. Although it is not now a major problem in Hawaii, inorganic nitrogen fertilizer is the major source of nitrate pollution in groundwater. The public health standard for nitrate-nitrogen in drinking water is 10 milligrams per liter (mg/L, equivalent to 10 parts per million [ppm] for water measurement).

This worksheet provides information on nutrient management for your agricultural activities. It will help you identify the level of risk from your current practices and develop an action plan to establish practices that reduce the risks of contamination to surface waters and groundwater.

How do you use nutrients?

Thinking about how you apply nutrients and how much to apply will help you to save money and reduce pollution risks. Some things to consider when making a nutrient management plan are

- The location, soil type, and soil characteristics for each of your fields.
- The amount and availability of soil nutrients or the levels of plant nutrients for each field. Soil nutrient analysis is usually best for annual crops, while tissue nutrient analysis is best for perennial crops.
- The types and amounts of fertilizer (both organic and inorganic) applied to each field over the past 3–5 years, and the crop yields from each field during that time. Be sure to include nutrient inputs from animal manure or irrigation with mill water if you apply these to your fields.
- The amount and nutrient content of any fertilizers you plan to apply in the next growing season.
- How you will apply each type of nutrient formulation.

Field location and soil properties

The location of your field influences the pollution risk associated with nutrient applications. Fields located next to streams are more likely to be a source of nutrient pollution. Strips of vegetation between cropped areas and streams can greatly reduce pollution risks. Be especially careful on fields with steep slopes, because nutrients can be carried away with eroded soil particles.

Soil properties also influence nutrient behavior. Some soils hold nutrients such as calcium, potassium, and magnesium better than others. Soils that don't hold nutrients well, including sandy soils and some highly weathered soils, are at higher risk of nutrient leaching. Another important soil property is its ability to hold phosphorus. Many Hawaii soils, particularly volcanic ash soils, bind phosphorus into the soil structure, making it unavailable to plants. This factor needs to be considered when determining optimum phosphorus fertilizer application rates. HAPPI-Farm 3, *Land management*, contains more information on how to determine soil properties.

Nutrient application rates

Nutrient applications should be based on a comparison between available nutrients and plant requirements. The amount of added nutrients should be equal to the plant requirement minus the nutrients currently available in the soil. If you apply the amount of nutrients necessary to meet plant needs, only small amounts will be lost and cause water pollution. Base your estimates of plant needs on realistic target yields for the climatic conditions at your site, not on the maximum possible yield for the crop.

Soil tests can measure soil nutrient status for annual crops. More information on soil testing can be found in CTAHR publication AS-4, *Testing your soil—why and how to take a soil-test sample.*

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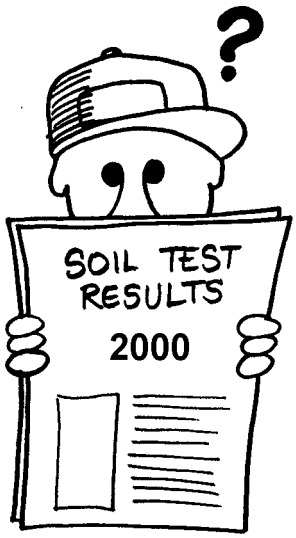

For perennial crops, plant tissue tests are believed to be a better indicator of current nutrient status. Cooperative Extension Service agents can provide information to help you interpret tissue nutrient levels for perennial species important in Hawaii, such as macadamia nut and papaya.

Types of chemical fertilizer

"Complete" fertilizers are blends containing nitrogen, phosphorus, and potassium (N, P, and K). Applying complete fertilizers based on crop needs for only one nutrient can result in over- or underapplication of the other nutrients they contain. In many cases in Hawaii, growers have applied complete fertilizers based only on crop nitrogen needs. This has led to overapplication of phosphorus. The best way to avoid this problem is to apply appropriate amounts of single-nutrient fertilizers based on crop requirements and soil and tissue analysis.

Animal manure

Some people believe that because animal manure and other sources of organic fertilizer are not "chemical" fertilizers, they cannot cause water pollution. This is not true. You should include the type and nutrient content of organic nutrient sources in your nutrient management plan. The nutrient content of organic materials such as manure can vary widely among different sources and at different times of the year. You should also consider the ratio of nutrients in organic sources. If animal manure applications are calculated based only on plant nitrogen requirements, for example, this may result in excessive phosphorus being applied.

When do you apply fertilizer?

If fertilizer is applied before or after the plant is best able to use it, it will not be taken up and may leach through the soil or be carried away in eroded soil or runoff water. Rather than a single application, you should apply smaller amounts of fertilizer several times during the growing season, and adjust the applications to make nutrients available when the plants most need them. Depending on your situation, slow-release fertilizers may be a good option to control nutrient availability.

Fertilizer handling and mixing

Never mix fertilizers using water from a hose attached directly to a well or other water source without using a backflow prevention device and maintaining an air gap between the hose end and the water already in the tank. If you do not maintain an airgap, the fertilizer solution could flow backward into your water supply. Fertilizer solution tanks should be rinsed in the field, with the wash water applied to crops. Tanks should never be rinsed or directly emptied into streams or other water bodies. Both granular and liquid fertilizers should be mixed on a level concrete pad where any spills can be quickly contained and cleaned up.

Fertilizer storage

If stored properly in a secure location, fertilizers pose little danger to groundwater and surface water bodies. On larger farms, you should store all liquid fertilizers on an impermeable floor, such as concrete. The floor should have a curb that will hold up to 125 percent of the volume stored in case of a spill. A mixing and loading concrete pad with secondary containment should be provided for all liquid fertilizers. Store piles of dry bulk fertilizer on an impermeable surface under cover or in a building. For smaller farms, simple storage cabinets and concrete mixing areas may be adequate. In all cases, keep fertilizer storage areas away from streams and lakes, and be sure all fertilizer storage is secure from children, animals, and theft.

Assessing your risks

Complete the risk assessment table below 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 Nutrient Management

	Low risk	Moderate risk	High risk	Your risk
Nutrient management planning	Have an up-to-date nutrient management plan	Have a nutrient management plan but it is >3 years old or it doesn't reflect current practices	No nutrient management plan	❑ low ❑ moderate ❑ high
Soil testing	Have soil tested at least every year and more often if switching crops	Had soil tested >1 year ago, or haven't had soil tested since switched crops	Had soil tested for nutrients >3 years ago, or never had soil tested	❑ low ❑ moderate ❑ high
Tissue testing (if appropriate)	Have plant tissue tested at least once for each crop	Have plant tissue tested occasionally for some crops	Don't use plant tissue testing	❑ low ❑ moderate ❑ high
Soil properties	Soil properties including texture, organic matter content, and slope are always considered when making fertilizer application decisions	Soil properties are sometimes considered when making application decisions	Soil properties are not considered when making application decisions	❑ low ❑ moderate ❑ high
Organic fertilizer applications	Include nutrients from organic fertilizers in all nutrient input calculations; consider potential impacts on nutrient availability	Reduce fertilizer applications after organic fertilizer application, but do not systematically assess impact on soil nutrients	Apply organic fertilizers without considering their nutrient content or potential impact on nutrient availability	❑ low ❑ moderate ❑ high
Animal manure nutrient content	Regularly test manure for nutrient content, or have consistent manure compositions	Occasionally test manure for nutrient content	Seldom or never test manure for nutrient content	❑ low ❑ moderate ❑ high
Type of fertilizer applied	Fertilizers applied as single-nutrient forms according to test requirements	Complete fertilizers supplemented with individual nutrients as required	Complete fertilizers used regardless of soil or plant test results	❑ low ❑ moderate ❑ high
Fertilizer application frequency	Fertilizer applied in small amounts throughout the growing season to match plant requirements	Fertilizer applied in at least 2 or 3 applications spread over the growing season	Fertilizer applied in one application either before planting or at planting	❑ low ❑ moderate ❑ high
Fertilizer storage and handling	Fertilizer stored in secure location with concrete floor and spill barriers; fertilizer mixed and loaded on concrete pad with secondary containment	Fertilizer stored off the soil in a secure location with low flood risk; fertilizer mixed and loaded on concrete pad	Fertilizer stored on the ground, in an area that may flood, or in an insecure location; fertilizer mixed and loaded on bare ground or grass surface	❑ low ❑ moderate ❑ high

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:		
Don't know soil nutrient status for all fields.	*Collect soil sample(s) and send to private lab or CTAHR Agricultural Diagnostic Service Center for analysis*.	*By the end of next week*

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