CHAPTER 4

THE FARM AS HABITAT: ENVIRONMENTAL TOPICS
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Use this document in conjunction with the companion website:

Links for New Farmers
http://www.ctahr.hawaii.edu/sustainag/newFarmer/links.asp

hosted by the Sustainable Agriculture Program at the University of Hawaii College of Tropical Agriculture and Human Resources. Extensive additional information and updates are posted there.
THE FARM AS HABITAT: ENVIRONMENTAL TOPICS

Here in our islands of tropical paradise, the Honolulu Board of Water Supply routinely filters out pesticides and nitrates from several wells before delivering drinking water to our homes. The source of the pollution is publicly recognized: “chemicals found in some of Oahu’s Pearl Harbor wells are attributed to decades of pesticide and herbicide application from large-scale agriculture, such as pineapple and sugarcane.” Here researchers study how Hawaii’s children were affected by heptachlor epoxide, a pesticide residue from pineapple green chop fed to dairy cattle, tainting the local milk supply in the ‘80s. Hawaii is often referred to as the “endangered species capital of the world” with 317 threatened and endangered species in the state. Most of these bird and plant “survivors” now grow only in very remote areas.

In Hawaii, the impacts from agriculture on human health and the environment can be detected relatively quickly. Our small island ecosystems are swiftly altered by land use changes. Given our unique plantation history where sugar and pineapple dominated, daily we deal with the legacy of large scale chemical-based agriculture. And daily we continue to demand and consume agriculture’s food and fiber products.

Many of the laws which now govern agriculture were passed to correct these and other startling problems. These laws seek to protect and benefit the resources held in common by all the peoples of Hawaii, our water supplies, our streams and wetlands, our extraordinary plants and animals, and ultimately our health and quality of life.

Fortunately, the beginning farmer who has embraced sustainable agriculture will recognize and already be implementing many practices described later which protect Hawaii’s wealth ~ her natural resources.

HAWAII’S UNIQUE BIOLOGICAL HERITAGE AND NATURAL RESOURCES

Located 2500 miles away from the nearest continental landmass, the islands of Hawaii are some of the most remote on earth. The plants and animals now native to these islands arrived here originally by wave (swimming or on ocean currents), by wind (seeds and spores), or by wing (birds and one bat species). Each island was unique and provided the newcomers with a wide range of homes from which to pick. From cold, lofty mountain ranges to hot sunny coastlines, relatively free of disease pressures.
or predators, the birds and plants grew and evolved together. Each island came to host its own rare wildlife. Many of the plants and animals required each other for survival. As a result, 97% of our native species are found here and nowhere else on earth.

Many of those habitats no longer exist or have been severely altered. Invasive weeds, introduced animals, insects, diseases and human land use changes threaten many species’ existence. Agriculture and forestry have played a major role in this story.

**HAWAIIAN STREAMS**

Our streams have three features which distinguish them from those on the U.S. mainland. Hawaiian streams are much smaller - only 28 of our streams are 10 miles or longer. They are fairly steep and characterized by waterfalls, especially on the younger islands (such as Hawaii Island). They tend to experience short but intense flooding as a result of localized heavy storms, giving them a “flashy” nature (as in the term flash flood).

Our aquatic animals evolved in response to these attributes. Because the Hawaiian archipelago is so isolated, only two fishes are endemic (found only here). One unusual little Hawaiian fish, the goby, developed a muscular fin, similar to a suction cup, adapted to hold on tightly to rocks during storm events and to climb up waterfalls.

There are five species of native stream fish (collectively known as ‘o’opu in Hawaiian). Four are endemic and one is indigenous (native to Hawai’i and other locations). Native stream shellfish, all of which are endemic, consist of two crustaceans (‘opae), and three mollusks (hihiwai, hapawai).

Hawaiian fish require uninterrupted access to the full length of a stream system. They lay eggs in the upland (mauka) areas of the stream system. Upon hatching, the young migrate downstream (makai) and out to sea. They live in the ocean for a time and then return and migrate upstream. Stream channel alterations can interrupt this cycle. Man-made irrigation and stormwater systems have seriously harmed these unique Hawaiian stream animals.

**HAWAIIAN WILDLIFE**

As mentioned earlier, many of Hawaii’s native plants, birds, and insects are truly exclusive to our islands. Some are found on a single island, or in a single valley or hillside of a single island. Truly distinctive organisms, they are adapted to one place on earth.

Another distinguishing feature of our wildlife is that many of our birds and plants co-evolved, requiring each other for survival. There are many examples of native birds with bill structures shaped for pollinating native plants. Changes in the composition of the plant life (which provides food, shelter and habitat for birds) directly affect bird populations. The opposite is true as well. Certain native plants species have lost their pollinators and can no longer survive without man’s intervention.

Hawaii’s native birds and plants have always suffered from the...
unintended consequences of man’s activities. Scientists believe that 35 bird species became extinct after the islands were settled by Polynesians. They blame vegetation changes from Polynesian agriculture plus the introduction of alien species such as pigs, dogs and rats. Further harm occurred when native forests were burned and cut to feed a voracious demand for sandalwood. The forests closest to Honolulu were completely consumed, trying to meet the fuel demands of the whalers. Foresters rushed to restore the forest canopy in the upper reaches of the watershed, importing new fast-growing tree species, often invasive ones. Ranchers raised cattle, goats and sheep on the islands, further damaging native plants with their hooves and browsing. Of Hawaii’s 317 threatened and endangered species, 273 are plants.

The Endangered Species Act applies to many plants and animals here in Hawaii. As a farmer, if you are managing property where these organisms live, you have certain limitations on what you can do. Funding is available to help you preserve habitat for endangered plants and animals. Some farmers are able to develop low impact ecotourism ventures to showcase these Hawaiian plant and animal treasures.

HAWAIIAN WETLANDS

In the past, wetland areas (swamps) were targeted for filling and draining so that they could become “productive,” which usually meant used for agriculture or housing or commercial buildings. As more and more wetlands disappeared, the folly of this policy became apparent. Flooding increased because wetlands which served as water storage areas during big storm events had disappeared. Water quality declined: nutrients and sediment in storm water were no longer being filtered and purified through the wetland areas. Fish and bird populations plummeted because nesting and spawning areas required for their feeding and breeding were dried up.

Hawaii was no exception. For example, there was once a large wetland area in Waikiki. The wetland was filled and the channel named the Ala Wai Canal. Today, water quality in the Ala Wai is some of the worst in the state. The U.S. Army Corps of Engineers has begun a major study to address flooding concerns for this watershed.

The remaining few wetlands in areas such as the Hanalei Valley, Kealia Pond, Kawainui Marsh, and the James Campbell Wildlife Refuge, are essential for the survival of endangered Hawaiian waterbirds. The crisis is so severe that funding is available for landowners to protect and expand wetlands areas on their property. Be aware of state and federal laws which restrict draining and filling of wetland areas on your property.

Some innovative mainland farmers view wetland wildlife as a marketing asset and highlight conservation efforts in their promotional materials. Certain consumers are willing to pay a price premium for products that are “environmentally-friendly.”
HAWAIIAN FORESTS

Without forests, we could not live in the Hawaiian Islands. Virtually all of our fresh water, including all drinking water, comes from the Hawaiian forest. The forest also provides us with a comfortable climate, clean air, recreation areas, plants of medicinal and cultural value, habitats for native species, and woods for commercial forestry and fine arts.

Although Hawaii is probably best known for its lush rain forests, the dry forests found mostly on leeward mountain slopes are also valuable and are in greater danger of extinction. Almost one-fourth of native Hawaiian plant species are found in these dry forests. An alarming 90 percent of Hawaii’s dry forests have been destroyed. What little habitat remains is highly fragmented.

Invasive plants, many of which have escaped from agricultural fields, pose a major problem for Hawaii’s forest resources.

GROUND WATER

Many Hawaii residents on O‘ahu and Maui get their water from underground aquifers. The deep volcanic-rock aquifer in central O‘ahu and Honolulu supplies more than 90 percent of the island’s public water supply. It is highly permeable and unconfined (except near the coast) making it vulnerable to contamination. U.S.G.S reports that contaminants found in untreated water on O‘ahu reflects the historical use of chemicals, and contains solvents (from military, urban and pesticide formulations), fumigants (from pineapple fields), and agricultural herbicides and fertilizers (from agriculture, parks, golf courses and urban areas). These chemicals persist for several decades. Some ground water must be treated to meet drinking water standards.

HAWAIIAN CORAL REEFS

On the mainland, people who work and manage the land tend to forget about their impact on ocean resources. This simply isn’t possible in our islands – the coral reef is central to our local lifestyle. Reefs protect and stabilize our shorelines from seasonal storm damage. Our white sandy beaches were formed from their coral. Our favorite surfing spots are created by the waves breaking over them. Subsistence, commercial and recreational fishermen harvest from the coral reef food chain.

Our marine life is distinct from that of the rest of the Indo-Pacific Ocean. About 25% of our reef fish and algae are endemic (only exist here). One of the most isolated places on earth, Hawaii is also one of the most populated, with 1.2 million inhabitants in close proximity to the coral reefs.

Wide-scale damage to the coral reefs began when livestock grazing and agriculture on O‘ahu, Maui, Moloka‘i and Lana‘i caused excessive erosion and sedimentation on fringing reefs. Dredging and filling for residential, commercial and military use further damaged them. Most recently, polluted storm water (overloaded with sediment and nutrients) from agricultural and urbanized streams have caused algae to overgrow the coral.
### PROBLEM: SOIL EROSION

Soil erosion is a natural geological process - however accelerated soil erosion, exacerbated by man’s activities, is considered a form of pollution. For example, when suspended soil particles wash out to the ocean, smother reef organisms, and result in declines in fish populations, it is a cause for local concern. Nutrients or pesticides attached to soil particles contaminate streams and bays causing water quality problems. Streambank erosion from unwise land uses harm unique endangered Hawaiian stream animals (‘o’opu, ‘opae, and hiihiwai). These impacts have already been well documented throughout the islands of Hawaii.

Be aware of local grading ordinances which apply to farming and are designed to protect off-site areas from sedimentation. Farmers are responsible for the quality of the water leaving their property. You can be fined if the water is excessively turbid.

Fortunately farmers agree that the best place for soil is in the farmer’s field and topsoil is too valuable to allow off-site. There are many things the beginning farmer can do to prevent soil from moving off the farm by wind, water or gravity.

The Natural Resources Conservation Service is the nation’s main source of information about agricultural erosion control. All of their standards and specification information are available to the public in the form of an electronic field office technical guide (eFOTG) which can be accessed via the internet and as a written reference publication available at every NRCS Service Center.

Certain areas on your farm are more susceptible to erosion and will require extra erosion protection (or should be avoided for agricultural and ranching uses):
- Areas with steep slopes
- Areas with very erodible soils
- Areas where water channelizes across the property (waterways, streams, diversion ditches).

Erosion is more of a threat in regions with very heavy rainfall and during the rainy season.

### HOW TO CONTROL SOIL EROSION

- Keep exposed bare soil to a minimum (through mulching, cover crops, buffers, filter strips, conservation tillage, riparian buffers).
- Reinforce areas where water channelizes (using grassed and lined waterways, streambank and shoreline protection).
- Use special measures on slopes (contour farming, terraces).
- Use special measures to limit wind erosion (wind barriers, wildbreaks, shelterbelts).
- Keep vegetated buffer strips between production areas and sensitive features on your property (such as streams, wetlands, wildlife habitat, etc).
O‘ahu, with its urbanization and large agricultural tracts, has the distinction within our state of having more than 30 streams that are considered “water-quality impaired,” primarily for exceeding state standards for nutrients and suspended sediment. Similar problems have been identified on Hawai‘i Island, Kaua‘i, Maui and Moloka‘i. Groundwater supplies under O‘ahu’s central plains have elevated levels of nitrate, attributed in part to over-fertilization of crops. High levels of nitrites in drinking water may affect infants by reducing the oxygen levels in blood, causing what is known as “blue baby syndrome.” Recent research at the University of Hawaii has documented widespread problems with excessive use of phosphorous fertilizers on Hawaii farms. This problem has been traced to using standard fertilizer formulations which over-apply unneeded nutrients.

**REDUCE FERTILIZER NUTRIENT POLLUTION**

- Base your fertilizer rates on crop needs and on soil and tissue testing results.

- Properly calibrate your equipment for accurate fertilizer application rates.

- Use fertilizer formulations to match your crop needs (rather than standard formulations that overapply certain nutrients).

- Consider weather conditions before applying fertilizers. Don’t apply soluble fertilizers right before large storm events. Be more cautious during the rainy season.

- Increase organic matter to help retain nutrients in your soil.

- Leave unfertilized buffer areas along water bodies (streams, ponds, rivers, wetlands).

- Be very careful when applying nutrients on sandy soils (which tend to be more prone to leaching) and on shallow soils (over lava).
PROBLEM: NUTRIENT POLLUTION FROM MANURE

REDUCE NUTRIENT POLLUTION FROM MANURE

- Develop a nutrient management plan with assistance from USDA NRCS or Cooperative Extension.

- Locate manure storage areas away from wells, waterways, ocean, and public drinking water sources (legal setbacks apply).

- Install vegetated buffer strips between manure storage areas and sensitive rivers, streams and wetlands.

- Divert clean water away from manure storage areas.

- Test nutrients in manure to determine appropriate field application rates. Base your manure application rates on crop needs and on soil and tissue testing results.

- Don’t spread raw manure within 100 feet of streams and away from natural drainage swales. Incorporate the manure as soon as possible.

- Watch the weather to avoid spreading raw manure prior to storm events.

- Consider using rotational grazing pasture management to reduce waste problems.

- Consider composting to reduce the volume of manure, kill parasites, reduce odor, and produce a high value organic fertilizer and soil amendment.

Organic farms can cause the same environmental problems as conventional farms. Environmental concerns associated with organic production practices may be related to:

- The transition period from conventional to organic farming
- Improper or incomplete nutrient management practices
- Improper storage of manure or compost materials
- Excessive tillage without adequate soil conservation measures
Pesticides can be dangerous chemicals and need to be used very carefully to protect farm families and workers, farm animals and native wildlife, and the general public. Much of pesticide applicator training involves understanding the health and environmental risks associated with pesticides and learning how to use them without endangering yourself and others.

Pesticides can move away from the farm field and cause health and environmental damage in several ways. They can be transported by air (drift) in the form of particles, droplets, and vapors carried by wind. Water can carry them off-site through leaching and runoff. Hawaii’s freshwater is especially vulnerable to contamination from pesticide leaching into the soil to the aquifers which we rely on for drinking water. Pesticides have also been discovered in Hawaii’s surface waters, carried by runoff into drainage ditches, to streams, ponds and the ocean.

Pesticide residues can also pose health and environmental problems. Persistent pesticides which take a long time to break down in the environment may subsequently harm people, plants and animals. The effects of bioaccumulation of pesticides within the bodies of animals and human beings is also of concern and being researched.

Certain areas are considered to be more sensitive to pesticide damage and require additional caution. These areas include:

- zones near schools, playgrounds, and hospitals
- areas where groundwater recharges (wells, sinkholes, gravelly and sandy soils)
- near surface waters (streams, rivers, wetlands)
- near endangered species habitats
- near apiaries, wildlife refuges or parks.

Pesticide labeling should alert you to concerns in these sensitive areas.

SUSTAINABLE AGRICULTURE PRACTICES FOR PESTICIDE USE

- Use pest control strategies outlined in Chapter 3 to help keep your use of pesticides low.
- Get pesticide applicators training from the University of Hawaii Cooperative Extension Service Pesticide Risk Reduction Education Program.
- Read pesticide labels and apply them strictly according to instructions (using protective equipment, correct mixing rates, calibrated sprayer, etc.). The label is the law.
- Mix and load pesticides in an appropriate area (concrete, located away from streams, wetlands, and wells).
- Leave an unsprayed buffer strip area along streams and wetlands.
- Store pesticides in a safe area.
- Dispose of pesticides and their containers safely.

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PROBLEM: INVASIVE SPECIES AND NOXIOUS WEEDS

One of the major threats to Hawaii’s forest, agricultural and livestock industries is the spread of aggressively growing plants across the state. Whether they are termed “noxious weeds” by Hawaii’s Dept. of Agriculture or “invasive plant species” by the Dept. of Land and Natural Resources, these organisms possess growth characteristics that allow them to outcompete and overwhelm our native forest and agricultural crop species.

Many of these plants possess a climbing or smothering growth habit and can virtually choke out shrubs and trees. They may be nitrogen-fixers, meaning that they can survive well in low fertility soils. They tend to be extremely prolific, quickly producing prodigious supplies of seeds or spores. Their seeds and spores can be easily dispersed by animals such as birds and pigs, or by our tradewinds. They are very fast growing and quickly gain dominance in the search for light, water, food and space.

How did they arrive here? In the past, most of these plants were introduced to our islands by well-meaning foresters, farmers, and horticulturalists. The ornamental plant trade accounts for an estimated 90% of invasive plant introductions to Hawaii. Among the more serious ones currently wreaking havoc are gorse, banana poka, miconia, and ivy gourd.

Plants are not the only invasive species which are arriving at our shores. Scientists and land managers continue to be plagued by notorious amphibians such as coqui frogs, or stinging insects like the red imported fire ant. The Dept. of Agriculture maintains a pest advisory website to help farmers be on the lookout for the latest alien invaders.

How do they get here? These creatures can stow away in a cargo container, be sent to you through the mail, or be carried by your auntie from a neighbor island by plane, hidden on a plant or flower.

CONTROL INVASIVE SPECIES

- Stay up to date on the current invasive species of concern (HDOA Pest Advisories, DLNR & DOH).
- Don’t delay in reporting sightings of new plants and animals.
- Be cautious when ordering plant materials by catalogue. Before you buy, check the plant in the weed risk assessment website to see if it has been ranked as a pest species.
- Respect the importance of having plant materials screened through the Dept. of Agriculture declaration forms and checkpoints. They are there to protect Hawaii agriculture!
- Apply the sustainable pest management strategies described in Chapter 3 to prevent the spread of pests and to keep pest populations low.

Weed Risk Assessment for Hawaii and Pacific Islands
www.botany.hawaii.edu/faculty/daehler/wra/

How can we tell whether a new plant will be invasive to Hawaii? Short of having a crystal ball, botanists are forced to make a “best guess.” They do that with a screening tool known as a weed risk assessment (WRA). Using available information, they evaluate a plant’s invasive characteristics, where it originally came from, and whether it is currently a pest species here in Hawaii or elsewhere.
Livestock producers in Hawaii have made major changes in the way they do business in recent years, largely in response to health and environmental concerns. If not carefully managed, animal production has the potential to negatively affect surface water quality (from pathogens, phosphorus, ammonia, and organic matter); groundwater quality (from nitrate); and air quality (from odors, dust, pests, and aerial pathogens). Allowing cattle to water and graze in riparian (stream) areas can result in loss of vegetative cover (due to consumption or trampling), additions of fecal matter and nutrients, and stream bank erosion.

At the same time, raising animals can complement many small farming operations and diversify income sources. Some farmers use chicken or geese for chemical-free insect or weed control. Larger grazing animals can be used to control invasive weed species such as California grass. Their manure improves the soil by providing nutrients and organic matter.

Innovative farmers and ranchers are trying management methods such as rotational grazing and pasturing poultry and hogs to keep their neighbors happy, their water resources clean, and their profits up.

**SUSTAINABLE LIVESTOCK MANAGEMENT**

- Locate animal housing, pens, stables, corrals and exercise yards away from wells, waterways, ocean, and public drinking water sources (legal setbacks apply).

- Divert clean water away from pens, barns, corrals, and exercise areas.

- Consider using rotational grazing pasture management to reduce waste problems.

- Leave untouched vegetated buffer areas along water bodies (streams, ponds, rivers, wetlands).

- Dispose of dead animals appropriately.

**PROTECT RIPARIAN (STREAM) AREAS**

- Fence livestock out of sensitive riparian (stream) areas.

- To prevent erosion, provide appropriate reinforced stream crossing areas.

- Provide animals with alternate water sources.
PROBLEM: LOSS OF WILDLIFE HABITAT

PROTECT HAWAIIAN PLANTS
Endemic plants are native to Hawai‘i and found nowhere else in the world.
• Grow native trees, shrubs and other plants on your property wherever feasible.
• Never harvest endangered plants from the wild (many are now commercially available). The market for commercially produced native plants for residential and commercial landscapes and government-mandated restoration projects is growing.
• Don’t plant a pest. Invasive alien plant species displace Hawai‘i’s distinctive native flora that support a large array of unique native plants and animals.

As a water source, **streams** and **wetlands** always attract wildlife. Wetlands filter excess nutrients, chemicals, and sediment, and provide habitat for a host of native birds, many of which are threatened or endangered. If you’re fortunate enough to live near a stream or wetland, you can personally help protect many of Hawai‘i’s endangered aquatic animals and water birds.

PROTECT HAWAIIAN STREAM ANIMALS
• Maintain natural water flow levels in streams.
• Don’t alter stream channels from mountain to the sea.
• Prevent toxic chemicals (such as pesticides) and nutrients (from fertilizer or manure) from entering streams.
• Grow vegetated buffer strips of native plants suited to your area along streams to keep stream water shaded, clear and clean.
• Don’t release exotic fish, invertebrates (snails, crayfish, shrimp), or aquatic plants into streams and wetlands. It’s against the law.

PROTECT HAWAIIAN WETLAND ANIMALS
• Grow vegetated buffer strips of native plants suited to your area along wetlands.
• Prevent toxic chemicals (such as pesticides) from entering wetlands.
• Don’t dump trash in streams or wetlands. Stop other people who do.
• Stay away from stream and wetland areas during the breeding season.
• Keep rat populations under control. It’s healthier for your family plus rats eat bird eggs.
• Keep your cats indoors and your dogs leashed. These household pets can kill a nest of young chicks within minutes.
• Don’t release domestic mallards into streams and wetland areas. They compete with native birds for food and habitat.
• Work with your neighbors and conservation agencies to provide a safe wildlife corridor along streams and wetlands. Native birds cannot survive without humanely trapping and removing mongoose and feral animals.

Montane Wetland Restoration for Hawaiian Duck
In 1998, NRCS signed up 3 large landowners on the Big Island for the Montane Wetland Restoration for Hawaiian Duck project. The project entailed restoration and development of wetlands for koloa duck on Parker Ranch, Umikoa Ranch, and Chalan International lands on the Island of Hawaii. NRCS partnered with Ducks Unlimited for financial and technical assistance.
The USDA Natural Resources Conservation Service can provide technical assistance and information about federal cost share programs which assist farmers with conservation efforts of their farms.

- **The Environmental Quality Incentives Program (EQIP)** is used to implement conservation practices to address statewide natural resource concerns of animal waste management, sedimentation and erosion, noxious weed control, and water quality and quantity.

- **The Wildlife Habitat Incentive Program (WHIP)** helps landowners to develop and improve wildlife habitat on private lands. In Hawaii, special emphasis is placed on native forest lands, endangered species habitats, and taro lo‘i restoration.

- **The Wetland Reserve Program (WRP)** helps landowners and leasees restore, enhance or create wetlands on agricultural lands.

- **The Grassland Reserve Program (GRP)** helps landowners to restore and protect grassland, including rangeland and pastureland, while maintaining the areas as grazing lands.

US Fish and Wildlife Service (Pacific Islands Ecological Services Conservation) administers the **Private Stewardship Grant Program (PSGP)**, a national program that provides conservation funding on a competitive basis to individuals and groups engaged in private, voluntary conservation efforts that benefit species that are endangered, threatened, candidates, or species of concern on private lands.

The State of Hawaii Dept. of Land and Natural Resources (DLNR) sponsors a similar program, the **Hawaii Landowner Incentive Program**. Private landowners, individually or as a group, are encouraged to submit project proposals for their properties.

The investments which you make in conservation efforts on your farm may expand opportunities for **Eco-Tourism**. By starting out small, perhaps with a Bed-and-Breakfast and guided nature walks, you may be able to diversify your income sources. For additional information, refer to the resources section at the end of this chapter as well as the ag-tourism section in chapter 2, Direct Marketing.
RESOURCES AND RECOMMENDED READING

COMPANION WEBSITE
Use this document in conjunction with the CTAHR website Links for New Farmers. Additional information and updates are posted there.
<www.ctahr.hawaii.edu/sustainag/newFarmer/links.asp>

TECHNICAL ASSISTANCE
U.S.D.A. Natural Resources Conservation Service (NRCS)
To locate the NRCS office nearest to you, contact:
NRCS State Office
PO Box 50004, Honolulu HI 96850-0050
Tel: (808) 541-2600
Website: www.hi.nrcs.usda.gov
All NRCS standards and specifications for conservation practices are available to the public in the form of an electronic field office technical guide (eFOTG) which can be accessed via the internet. Section IV contains standards and specs.

POLLUTION CONTROL
ATTRA: Protecting Water Quality on Organic Farms
<attra.ncat.org/attra-pub/organicmatters/om-waterquality.html>

ATTRA: Constructed Wetlands
<attra.ncat.org/attra-pub/wetlands.html>

ATTRA: Protecting Riparian Areas: Farmland Management Strategies
<attra.ncat.org/attra-pub/managedgraze.html>

ATTRA: Managed Grazing in Riparian Areas
<attra.ncat.org/attra-pub/managedgraze.html>

Hawaii Pollution Prevention Information (HAPPI) Farm Series. Free downloadable fact sheets prepared by CTAHR about minimizing pollution from farming.
  Water quality and your farm—Introduction to the HAPPI-Farm series
  Mapping your farm to identify pollution risks
  Minimizing pollution risk from land management
  Minimizing pollution risk from nutrient management
  Minimizing pollution risk from pest management
  Minimizing pollution risk from irrigation management
  Minimizing pollution risk from livestock operations
  Minimizing pollution risk from pasture management
  Minimizing pollution risk from storage and disposal of chemicals and fuel
  Minimizing pollution risk from forest and streamside areas management
<www2.ctahr.hawaii.edu/ctahr2001/PIO/FreePubs/FreePubs04.asp>

CTAHR’s Agricultural Diagnostic Service Center (ADSC): This lab conducts plant disease analyses, feed and forage analyses, insect identification analyses, chemical analyses of soils, chemical analyses of plant tissue, and chemical analyses of water and nutrient solutions. College of Tropical Agriculture and Human Resources, University of Hawaii at Manoa, 1910 East West Road, Sherman Lab 134, Honolulu, Hawaii 96822. Ph: 808-956-6706 Fax: 808-956-2592 Email: adsc@ctahr.hawaii.edu <www2.ctahr.hawaii.edu/adsc/>

PESTICIDE POLLUTION
University of Hawaii Cooperative Extension Service Pesticide Risk Reduction Education Program to download or purchase study packets. <pesticides.hawaii.edu/epp/pat.html>
INVASIVE SPECIES AND NOXIOUS WEEDS

Hawaii Ecosystems at Risk Project <http://www.hear.org/>

Weed Risk Assessments for Hawaii and the Pacific
<http://www.botany.hawaii.edu/faculty/daehler/wra/>

HDOA Pest Advisories
<http://www.hawaiiax.org/hdoa/pi_pa.htm>

CONSERVATION FUNDING RESOURCES
For information about the Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentive Program (WHIP), Wetland Reserve Program (WRP), and the Grassland Reserve Program (GRP), contact the U.S.D.A. Natural Resources Conservation Service (NRCS). To locate the NRCS office nearest to you, contact:
NRCS State Office
PO Box 50004, Honolulu HI 96850-0050
Tel: (808) 541-2600
Website: www.hi.nrcs.usda.gov

US Fish and Wildlife Service (Pacific Islands Ecological Services Conservation) Private Stewardship Grant Program. <pacificislands.fws.gov/worg/orghc_conpart.html>

State of Hawaii Dept. of Land and Natural Resources (DLNR) Hawaii Landowner Incentive Program. <www.state.hi.us/dlnr/dofaw/LIP/>

ECO-TOURISM
Making Nature Your Business: Planning and Developing a Nature Tourism Enterprise
<www.tpwd.state.tx.us/nature/tourism/your_business/planning.phtml>

Agricultural Marketing Resource Center (AgMRC): Nature Based Tourism: Links to on line manuals and success stories on eco-tourism.
<www.agmrc.org/agritourism/naturebased.html>

Nature-based Tourism Enterprises. Guidelines for success (pdf), Clemson University. Topics covered in this online document include planning and development, defining your service, start-up costs, administration, operations, creation of an Internet presence and marketing. 2000
<www.strom.clemson.edu/publications/Potts/nbt2000.pdf>