

# Sustainable Farming

**Instructions:** Students will read, "Raising Crops Sustainable" and define vocabulary, answer questions from the article, and/or do other activities connected to the reading. The article will be broken down into sections so that it may be easier to do, print, and comprehend.

**Sections will be broken up accordingly:**

**Section 1:** "What is Sustainable Crop Production" and Specialized Farming Practices for Sustainable Crop Production

**Section 2:** Sustainable Crop Production Techniques:

Soil Health

Tilling Practices

Weed Control

Planting Methods

**Section 3:** Sustainable Seeds and the myth of, "Feeding the World"

**Section 4:** Benefits of Sustainable Crop Production and Transition to Sustainable Farming

**Submission of work:** Students can submit work by Uploading to google classroom (Ho'ola students), email directly ([mpokipala@hurricanes.k12.hi.us](mailto:mpokipala@hurricanes.k12.hi.us)), or hard copy to the office. If accessing through google doc, please make a copy of the lesson and work from that document.

**Due dates:** **As of now the lessons are to be done and turned in upon the scheduled return of students and teachers (April 30th).** These lessons are covered in quarter 4. For some students this is review, for others this information is new. In any case, we have and will implement these techniques when we are outside working hands on with our plants. Please make sure to keep up with the work so we can transition back to school as effectively as possible.

**PLEASE EMAIL with any questions or concerns. For those that do this lesson as a hard copy, please do your best to answer the questions. If you can't due to internet access, please skip questions and continue where you can**

**Resource: "Raising Crops Sustainable"**

<https://foodprint.org/issues/raising-crops-sustainably/?cid=249>

\*\*\*\*\*Other links connected to document can be found on the website

# Sustainable Farming

## Section 1: “What is Sustainable Crop Production” and Specialized Farming Practices for Sustainable Crop Production

### Reading

**“What is Sustainable Crop Production”:** The industrialization of agriculture artificially divorces two parts of a naturally closed-loop and renewable cycle – nature’s balanced system in which crops feed animals and, in return, the waste from animals feeds (fertilizes) crops. In an industrial system feed for animals is grown in large monoculture systems that rely on chemical fertilizers and pesticides, while animals are raised separately in concentrated facilities where they create huge amounts of waste. This system results in depleted soils on the one hand and toxically excessive animal wastes on the other.

Sustainable crop production reintegrates this cycle, using animal manure, compost and other natural fertilizers to improve soil health and ecosystem-based pest controls instead of chemical pesticides. Sustainable crop farmers include growers of vegetables, fruit, flowers, grains, nuts, fiber (like cotton) or any other farmed plant. While they do not always necessarily raise animals alongside their fields, they do often purchase manure and other natural soil amendments from off-farm neighbors.

Farmers may use a variety of techniques to raise their crops, including *organic*, *beyond organic*, *biodynamic*, *permaculture*, *regenerative* and *agroecology*. [USDA Organic](#) is the only government-regulated of these, carefully defined by the US Department of Agriculture (which, for crop production, includes requirements, such as no synthetic fertilizers and a limited list of pesticides), but here all related terms are encompassed by “sustainable crop production.”

While industrial methods focus on addressing what are considered isolated problems like low soil fertility or weeds, sustainable crop production is focused on building soil and managing an integrated ecosystem, encouraging beneficial insect and plant relationships and looking at how the farm functions as a whole. Often this also includes consideration of workers, consumers and the larger community.

**Specialized Farming Practices for Sustainable Crop Production:** Some forms of sustainable production can look quite different than a typical farm. Some of these include:

- **[Aquaponics](#):** Fish and aquatic plants are grown together in tanks. The fish are fed a high-protein food source such as worms or insects and the fish waste nourishes the plants, which in turn clean the water. Aquaponically-grown fish can be an excellent, low-cost source of protein.
- **[Agroforestry](#):** Integrates trees and shrubs into crop and animal farming, for the benefit of all species in the system.
- **[Permaculture](#):** A farming philosophy that integrates landscape and people according to holistic principles. Permaculture is generally more appropriate for gardens than production farming.

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- **Rooftop farms and other urban agriculture:** Agriculture that brings food production closer to communities by growing on city rooftops, in small backyard plots and in vacant lots.
- **Agroecology:** The application of ecological concepts to the design and management of sustainable agro-ecosystems – farming in cooperation with nature. Many farming practices considered here, such as crop rotations and agroforestry, are agroecological practices. The term applies to farming methods, a scientific discipline and a social movement working for a new relationship between agriculture and society.
- **Regenerative:** A farming philosophy and set of methods that go beyond organic by aiming to regenerate the air, soil, water, local environments and communities. Regenerative agriculture methods usually also include a philosophy of fairness and humane treatment to both people and animals.

## Section 1 Activity after Reading

What is Sustainable Crop Production? List as many differences that you have read from the article.

Industrial Crop Production	Sustainable Crop Production
<b>Difference</b>  	<b>Differences</b>  
<b>Similarities</b>  	
<b>Questions</b>  What were 3 things that you learned from this section?  What 2 new words did you learn?  What question do you have? You need a question!	

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## Section 1 Activity after Reading (Cont.)

Rewrite the vocabulary below. It can be extended, or shortened, but rewrite so the definition is clear to you.

Vocabulary Word	Rewritten Definition
<p><u>Aquaponics</u>: Fish and aquatic plants are grown together in tanks. The fish are fed a high-protein food source such as worms or insects and the fish waste nourishes the plants, which in turn clean the water. Aquaponically-grown fish can be an excellent, low-cost source of protein.</p>	
<p><u>Agroforestry</u>: Integrates trees and shrubs into crop and animal farming, for the benefit of all species in the system.</p>	
<p><u>Permaculture</u>: A farming philosophy that integrates landscape and people according to holistic principles. Permaculture is generally more appropriate for gardens than production farming.</p>	
<p><u>Rooftop farms and other urban agriculture</u>: Agriculture that brings food production closer to communities by growing on city rooftops, in small backyard plots and in vacant lots.</p>	
<p><u>Agroecology</u>: The application of ecological concepts to the design and management of sustainable agro-ecosystems – farming in cooperation with nature. Many farming practices considered here, such as crop rotations and agroforestry, are agroecological practices. The term applies to farming methods, a scientific discipline and a social movement working for a new relationship between agriculture and society.</p>	

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<p><u>Regenerative</u>: A farming philosophy and set of methods that go beyond organic by aiming to regenerate the air, soil, water, local environments and communities. Regenerative agriculture methods usually also include a philosophy of fairness and humane treatment to both people and animals.</p>	
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## Section 2: Sustainable Crop Production Techniques

### Reading

**Soil Health** - Managing and building the health of the soil is the most critical element of sustainable crop farming. The structure, organic matter, insects and microbes of healthy soil retain water, deliver nutrients to roots and keep plants healthier and more resilient under stress than those fed with chemical fertilizer. A teaspoon of healthy soil contains as many as one billion bacteria, which break down organic matter; pull nitrogen from the air and make it available to plant roots (called “fixing”); help with the movement of water in soil; help with plant communication and defense; and perform many other functions.

To restore depleted soil nutrients and microorganisms, farmers use organic amendments such as manure, compost, worm castings and seaweed. In the winter or off-season, it is common to plant cover crops like oats, rye or clover. This “green manure,” as it is also called, adds organic matter, fixes nitrogen, improves soil structure and reduces erosion by keeping the soil covered, with other beneficial effects. When it is time to plant, the cover crop is either plowed under or the new crop is planted directly into its residue without tilling (disrupting the soil by digging or overturning).

**Tilling Practices** - Low- or no-till practices are becoming increasingly popular, because soil can sequester a great deal of carbon (estimates range from potentially offsetting the [entire emissions of the US](#) to [much less](#) than that). Plowing the land, on the other hand, releases carbon into the air, disrupts microorganisms, compacts the soil and can even hasten its erosion.

Reducing tillage increases organic matter and the amount of carbon a soil can store, as well as improving its structure and water retention capacity. With the advent of [herbicide-resistant crops](#), industrial corn and soybean farmers have become some of the biggest practitioners of no-till farming. The technology allows them to spray a field with pesticide and leave crop residues to decompose into the soil rather than the former practice of removing weeds by mechanical tillage. This practice is marketed as being environmentally friendly, even though it relies on high doses of herbicides. There is a [growing movement](#) among some of these farmers to go further and transition to no-till farming without chemicals, more along the lines of organic methods.

**Weed Control** - Without tilling or pesticides, weeds must be managed by farmers using sustainable methods. Sometimes a cover crop can be used as weed control; mulching, or spreading a cover layer over unplanted soil, is another common way to control weeds, maintain soil temperature and retain moisture. Materials from straw and leaves to sheets of black plastic are used as mulch. Flaming weeds (e.g., burning them with specialized equipment) is another method of dealing with weeds that some sustainable farmers employ.

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**Planting Methods** - Sustainable systems focus on plant diversity rather than monocultures. Repeatedly planting the same crop in the same place makes it vulnerable to a wide array of pests, exhausts the soil of nutrients, makes it more susceptible to erosion and decreases yields, requiring use of fertilizers and pesticides to address the problems. In a sustainable system, crop rotation – changing what is planted in a given location from season to season – can replenish soil and prevent pests from getting established.

In the Midwest corn belt, partial crop rotations are gaining in popularity, including strip cropping: planting alternating rows of a row crop like corn or soybeans with small grains or hay to reduce erosion. Other methods of preventing runoff of water and nutrients, including contour buffers and prairie strips, which use native prairie grasses to retain water, are also becoming common even in landscapes dominated by industrial-style crops. Using a variety of plants increases the biodiversity of the farm ecosystem, attracting pollinators like butterflies and bees, as well as birds and insects that prey on pests. Pesticides kill the good with the bad, eliminating plants' best natural defenses.

Plants that attract pests can be grown as trap crops in close proximity to the main crop, protecting it by luring away predators. Plants can benefit each other in many other ways, including by attracting beneficial insects, fixing soil nitrogen, providing shade or support, emitting growth-enhancing chemicals and more; intercropping places beneficial crops near each other.

## Section 2 Activity after Reading

For each technique share 1 thing new that you learned and do we practice these techniques when outside?

<b>Soil Health</b> <b>Example</b> - A teaspoon of healthy soil contains as many as one billion bacteria. Yes, we practice good soil health because we use compost to amend (fix) the soil.
<b>Please answer for the next three techniques</b> ↓
<b>Tilling</b>
<b>Weed Control</b>
<b>Planting Method</b>

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## Section 3: Sustainable Seeds and the myth of, “Feeding the World”

### Reading

**Sustainable Seeds:** Sustainable crop farmers use a wide range of seeds, from heirloom to hybrid — everything but genetically modified varieties (or known as GMO). Hybrids are bred through conventional plant breeding, cross-pollinating two varieties of a plant to produce an offspring with the best traits of each parent. Hybrids are bred for disease resistance, uniformity, productivity, ease of growing and other popular traits. The offspring of hybrids may revert to traits more like one parent or the other, so saving seeds can yield unpredictable results.

Heirloom varieties, instead, are the descendants of seeds grown before about 1950, when hybrids began to dominate the commercial market. Heirlooms are open pollinated (rather than bred by humans) and keep their traits from one generation to the next. This means that farmers can save their seeds, selecting for whatever traits are most desirable. These old varieties have had a resurgence in recent decades, from farmers and consumers excited about heirloom flavors and their stories.

Farmers growing fruits or vegetables for farmers markets or on a larger scale may save some heirloom seeds and purchase hybrids or a hybrid-heirloom mix, as both kinds have their place in sustainable systems.

Sustainably and independently produced seed stock is under threat, as seed companies have been bought up at an alarming rate. From 2005 to 2015, Monsanto (now known as Bayer) spent \$2 billion acquiring two major fruit and vegetable companies, including Seminis, formerly the world’s largest vegetable seed seller. This does not mean that all vegetables will become genetically modified, but many food and farm advocates worry about long-term food security if one company controls the vast majority of the genetic information for the world’s major crops. Some independently owned seed companies still remain and are the chief suppliers of sustainable farmers. Additionally, with the increasing interest in heirloom seeds, new seed companies have started in recent years, with a mission to revive old plant varieties and their accompanying food and cultural traditions.

**The Myth of, “Feeding the World”:** There is a myth that agricultural technology and biotechnology will increase yields, eradicate pests, adapt to climate change and improve nutrition – in short, that industrial agriculture is the only way to “feed the world.” While some chemical-dependent and genetically engineered crops have improved yields and fulfill some of their other promises, in many cases they do not. Research has shown that various kinds of sustainable agriculture produce similar yields as those of chemical-dependent farming. Depending on the circumstances and crop, yields from sustainable practices have been shown to be equivalent, slightly greater (particularly in drought conditions, which is increasingly important as the climate changes), or 15 to 20 percent lower than those of chemical agriculture.











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Given the notable lack of support for research and development of sustainable agriculture techniques as compared to conventional, these yield differences are relatively small, suggesting that further investment in research would have the potential to reveal dramatic productivity gains.

## Section 3 Activity after Reading

What does a Hybrid and Heirloom Tomatoes look like? Take a look at the information below.

Hybrid Tomatoes		Heirloom Tomatoes	
<b>Goliath</b> 	<b>Tonopah</b> 	<b>German Queen</b> 	<b>Cherokee Purple</b> 
<b>Tomato Jelly Bean</b> 	<b>Early Girl</b> 	<b>Marriage Genuwine</b> 	<b>Black Krim</b> 

1. Describe what characteristics you see in the Hybrid Tomatoes.
2. Describe what characteristics you see in the Heirloom Tomatoes.
3. Which tomato would you like to try and why?

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Now, it's your turn to look up Hybrids and Heirlooms! Choose a fruit or vegetable, copy and paste the picture with the name of the variety at the top of the picture. It should look similar to the Tomato table. Skip this section if you are doing this work as a hard copy, or if you can find info, draw a picture of what you find, and write the name.

Hybrid		Heirloom	

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## Section 4: Benefits of Sustainable Crop Production and Transition to Sustainable Farming

### Reading

**Benefits of Sustainable Crop Production:** There are many benefits to sustainable farming methods, including: enriched soil that better retains water and stores carbon, clean water and air, greater biodiversity and the ability to continue these practices indefinitely because they do not rely on finite resources. For rural communities, keeping land in sustainable farms preserves open spaces and also keeps money circulating in the local economy.

It should be noted that the promise of sustainable farming supporting the earth and community often falls short when it comes to on-farm labor. Farming is difficult, strenuous work, and it is such a low-margin business that high production is often key. Recent research in upstate New York has found that many workers on farms that sell to New York City's famed Greenmarkets are underpaid, living and working in substandard conditions, not reporting their situation because so many are undocumented immigrants and fear deportation. Farmers, squeezed by high input costs and low consumer prices, often feel that the only area in which they can save money is in worker wages. Consumers who care about the welfare of farm animals and the environment must also demand living wages and humane working conditions for workers – and be willing to pay a little more for it.

**Transition to Sustainable Farming:** A broad spectrum of practices falls under the “sustainable” umbrella. It is important to uphold the standards developed for these practices, like the USDA Organic label or newer third-party certifications coming onto the market, or like the new Regenerative Organic Certified label, currently in pilot – and it is also important to support farmers making the often-difficult transition from conventional, chemical-based farming to more sustainable methods.

For some farmers, this may mean simply switching from genetically modified seeds to conventional non-GM seeds or planting prairie buffer strips. These changes may appear minimal from the outside, but for farmers in communities where all the neighbors plant only GM seeds and farm every possible acre, these beginning steps are significant.

Many farmers use Integrated Pest Management (IPM) techniques as a way to wean off of chemicals and transition to more sustainable practices. IPM focuses on prevention and uses pesticides sparingly only when needed. Practices include monitoring and identifying pests, intercropping and crop rotation to prevent pests from becoming established, use of natural repellents and managing pests using a tiered system of control, including manual removal (e.g., weeding or trapping) and chemical pesticides as a last resort.

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## Section 4 Activity after Reading

Answer the following questions

1. List the benefits of Sustainable Crop Farming:
2. Please explain in your words what, "Farmers, squeezed by high input costs and low consumer prices, often feel that the only area in which they can save money is in worker wages."
3. Do some research....Look up how many organic farms we have on 'Oahu and list them:
4. Define what Integrated Pest Management means:
5. Overall, write a reflection about this article. Include examples of what you learned, your feelings about the topic, prior knowledge you may have had prior to reading this article, and questions you have. The reflection response needs to be at least 150 words.