Poly- and Monocultures: The Good, the Bad, and the Ugly

Trees for Improving Sustainability, Resource Conservation, and Profitability on Farms and Ranches

Kona, Hawai‘i May 16-19, 2006

Scot Nelson, PhD, University of Hawai‘i at Mānoa

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Poly- and Monocultures: The Good, the Bad and the Ugly (by Dr. Scot Nelson, University of Hawaii at Manoa)

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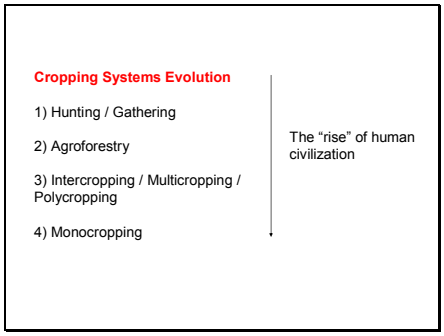

Cropping systems have evolved throughout human history. First there were hunting and gathering, which evolved into carefully managed agroforestry systems, more intensive intercropping and multicropping systems, and finally monocropping. Today, all of these systems still exist, but the world is now dominated by monocropping systems. This evolution of cropping systems is closely linked with the “rise” of human civilization.

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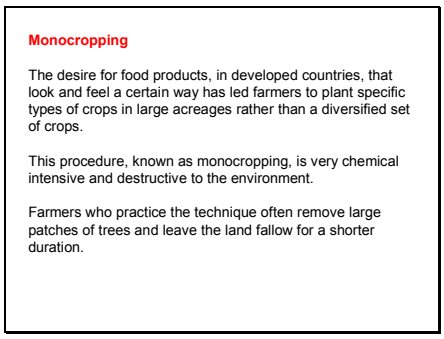

The desire for food products, in developed countries, that look and feel a certain way has led farmers to plant specific types of crops rather than a diversified set of crops. This procedure, known as monocropping, is very chemical intensive. Monocropping also raises problems because farmers who practice the technique often remove large patches of trees and leave the land fallow for a shorter duration.

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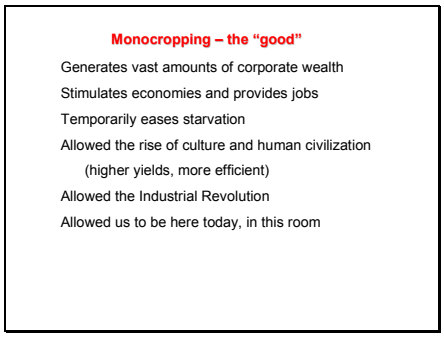

"Good" aspects of monocropping systems include the following: 1) it generates vast amounts of corporate wealth; 2) it stimulates economies and provides jobs for the working classes; 3) it temporarily eases starvation (but allows huge increased in population growth that can result in famines); 4) it allowed the rise of culture and human civilization (higher yields, more efficient); 5) it allowed the Industrial Revolution to occur; 6) it allowed the spread of certain economic and religious systems and the colonization and conquest of people around the globe for the betterment of the world; 7) it allowed us to be here today, in this room.

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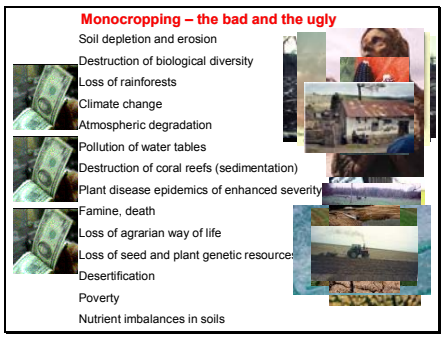

"Bad and Ugly" aspects of monocropping include: 1) Soil depletion and erosion; Destruction of biological diversity; 3) Loss of rainforests; 4) Climate change; 5) Atmospheric degradation; 6) Pollution of water tables; 7) Destruction of coral reefs (sedimentation); 8) Plant disease epidemics of enhanced severity; 9) Famine, death; 10) Loss of agrarian way of life and displacement of agrarian populations; 11) Loss of seed biodiversity and plant genetic resources; 12) Desertification; 13) Poverty; 14) Nutrient imbalances in soils

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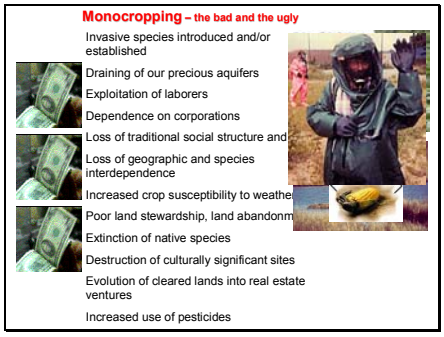

More "Bad and Ugly" aspects of monocropping include: 1) Invasive species introduced and/or established; 2) Draining of our precious aquifers; 3) Exploitation of laborers; 4) Dependence on corporations; 5) Loss of traditional social structure and values; 6) Loss of geographic and species interdependence; 7) Increased crop susceptibility to weather; 8) Poor land stewardship, land abandonment; 9) Extinction of native species; 10) Destruction of culturally significant sites; 11) Evolution of cleared lands into real estate ventures; 12) Increased use of pesticides

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Focus of today's presentation (effects of monocropping):

■ **Increased susceptibility to plant disease epidemics (Hawaii)**
- Noni
- Banana
- Papaya
- Kava

■ **Deforestation, loss of biodiversity and reef and ecosystem damage**
- Pohnpei
- Palau

■ **Contamination of soil and water supplies from pesticides**
- EPA Superfund sites
- Kunia problem (Hawaii)

The focus of today's presentation is on a few negative effects of monocropping in the Pacific: 1) Increased susceptibility to plant disease epidemics; 2) Deforestation, loss of biodiversity and and reef damage due to sedimentation; and 3) Contamination of soil and water from the increased need and use of chemical pesticides.

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	Development of Severe Epidemics?	
Crop & Disease (pathogen)	**Monocropping**	**Polycrop/Agroforestry**
Kava		
• Kava dieback (CMV)	Yes	No
• Shot hole (*Phoma*)	Yes	No
• Root knot (*Meloidogyne*)	Yes	No
Noni		
• Black flag (*Phytophthora*)	Yes	No
• Root knot (*Meloidogyne*)	Yes	No
Banana		
• Panama wilt (*Fusarium*)	Yes	No
• Sigatoka (*Mycosphaerella*)	Yes	No
• Bunchy top (BBTV)	Yes	No
Papaya		
• Ringspot (PRV)	Yes	No
• Phytophthora blight	Yes	No

Most crops that are common to agroforestry and polycropping systems do not suffer from severe epidemics of plant diseases until they are begun to be cultivated as monocrops (Examples: kava, noni, banana, papaya).

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Host: *Carica papaya*
Disease: Phytophthora blight
Pathogen: *Phytophthora palmivora*

• Proximity of adjacent plants increases the chance of infection from spores produced on neighboring plants and increases the power of the pathogen population to adapt to the host and to the environment.

Left: Spraying of the fruit columns with fungicides is done 25 or more times per year.

Right: Symptoms of the disease on papaya fruits

There are many effects of monocropping on plant disease epidemics. Monocrops favor disease development due to the proximity and genetic uniformity of plants in populations, and favors the development of new and more virulent strains of plant pathogens.

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Often times land is cleared of forest to plant papaya and after an epidemic occurs, the land is abandoned

Aerial view of a papaya monocrop papaya field that was devastated by Phytophthora blight in the Puna district on the island of Hawaii (The Big Island).

Monocrops are planted on land that has been cleared of forests. Devastating epidemics can develop very easily. Some lands are often abandoned after that in Hawaii. Papaya is an example of this phenomenon, where epidemics of papaya ringspot and Phytophthora blight cause huge losses and motivate farmers to pack up and leave, or spray pesticides almost on weekly basis.

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Polycropping methods - Micronesia

Agroforestry-type cultivation

Breadfruit, banana, taro, yam, papaya, cassava, noni, kava

Pest pressure: very low, sustainable without much input

Intercropping-type cultivation

Banana, taro, cassava, sweet potato

Pest pressure: moderate

More intensive effort to control weeds and pests, some clearing required

Yields: higher than agroforestry setting

A typical agroforestry setting in the pacific includes such staple crops as breadfruit, banana, taro, yam, papaya, cassava, noni, kava. Pest pressure: very low, sustainable without much input. A more intensively managed system (intercropping) is also commonly found on land that has been cleared. Pest pressure is moderate but more so than in agroforestry setting, more intensive effort to control weeds and pests, some clearing required, and yields: higher than agroforestry setting.

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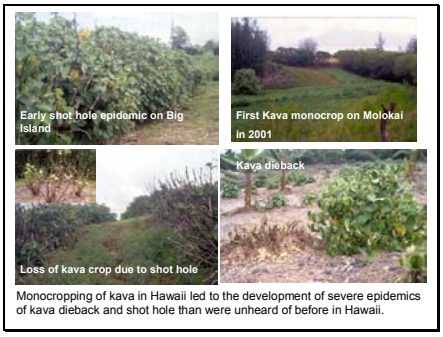

Monocropping of kava in Hawaii led to the development of severe epidemics of kava dieback and shot hole than were unheard of before in Hawaii.

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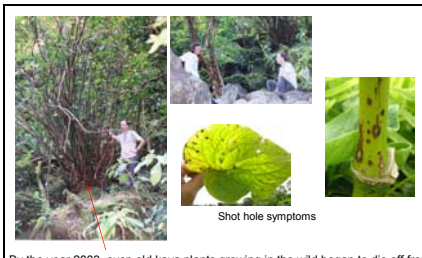

By the year 2003, even old kava plants growing in the wild began to die off from the more virulent form of *Phoma* that had evolved thanks to monocrops. This ancient plant, planted by Hawaiians, died about a year after this photo was taken.

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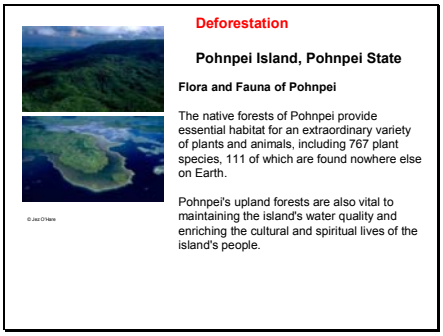

Deforestation in Pohnpei, due mainly to kava monocropping as the result of increased population growth and the conversion to a cash economy by waves of colorizations by Spanish, Japanese and the Americans. **Location of Pohnpei.** Pohnpei State has 133.4 square miles of land area, of which 117 is accounted for by Pohnpei island, the largest in the Federated States of Micronesia. **Flora and Fauna of Pohnpei.** The native forests of Pohnpei, which provide essential habitat for an extraordinary

variety of plants and animals, including 767 plant species, 111 of which are found nowhere else on Earth. Pohnpei's upland forests are also vital to maintaining the island's water quality and enriching the cultural and spiritual lives of the island's people.

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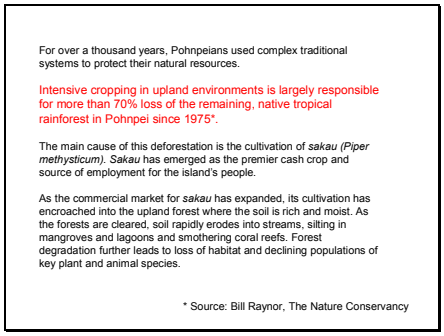

For over a thousand years, Pohnpeians used complex traditional systems to protect their natural resources. Intensive cropping in upland environments is largely responsible for more than 70% loss of the remaining, native tropical rainforest since 1975. The main cause of this deforestation is the cultivation of *sakau (Piper methysticum),* a plant is used in Pohnpei to make a traditional beverage that produces a calming effect while at the same time sharpening the senses. Marketed in the United States and Europe as the health supplement *kava, sakau* has emerged as the premier cash crop and source of employment for the island’s people. As the commercial market for *sakau* has expanded, its cultivation has encroached into the upland forest where the soil is rich and moist. As the forests are cleared, soil rapidly erodes into streams, silting in mangroves and lagoons and smothering coral reefs. Forest degradation further leads to loss of habitat and declining populations of key plant and

animal species.

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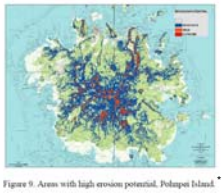

Figure 9. Areas with high erosion potential, Pohnpei Island.*

Clearing the rainforest for crops results in decreased biodiversity, erosion, reef damage and climate change.

*Source: Pacific Science, April 2005

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Negative effects of erosion and sedimentation at Arai Bay in Palau.

This is happening throughout the Pacific.

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Increased Use of Fertilizers and Pesticides

Chemicals that seep into the ground as a result of monocrop farming are weakening ecosystems around the planet. The chemicals kill helpful organisms, pollute water supplies, and impact the oceans.

Pesticides sprayed into the air and fertilizers that find their way into rivers and streams are leading into larger bodies of water such as the Gulf of Mexico and the Pacific Ocean where harmful algae can bloom.

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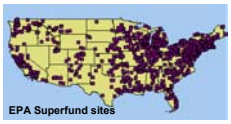
Del Monte agrees to EPA's $13 million plan for Superfund cleanup in Hawaii

For Immediate Release: August 10, 2005

HONOLULU - The U.S. Environmental Protection Agency recently reached an agreement with Del Monte Fresh Produce that requires the company to clean up soil and groundwater contamination at the Del Monte Superfund site in Central Oahu.

Under the terms of the consent decree, Del Monte Fresh Produce will carry out the EPA-approved cleanup plan, estimated to cost approximately $13 million with a completion date expected in 2014. The company has also agreed to pay the EPA's past and future oversight costs at the site.



EPA Superfund sites

Del Monte agrees to EPA's $13 million plan for Superfund cleanup in Hawaii. HONOLULU - The U.S. Environmental Protection Agency recently reached an agreement with Del Monte Fresh Produce that requires the company to clean up soil and groundwater contamination at the Del Monte Superfund site in Central Oahu. Under the terms of the consent decree, Del Monte Fresh Produce will carry out the EPA-approved cleanup plan, estimated to cost approximately $13 million with a completion date expected in 2014. The company has also agreed to pay the EPA's past and future oversight costs at the site.

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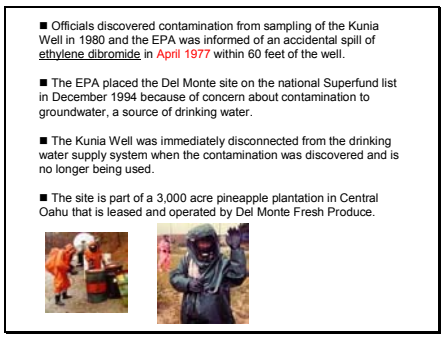

Officials discovered contamination from sampling of the Kunia Well in 1980 and the EPA was informed of an accidental spill of ethylene dibromide in April 1977 within 60 feet of the well. The EPA placed the Del Monte site on the national Superfund list in December 1994 because of concern about contamination to groundwater, a source of drinking water. The Kunia Well was immediately disconnected from the drinking water supply system when the contamination was discovered and is no longer being used. The site is part of a 3,000 acre pineapple plantation in Central Oahu that is leased and operated by Del Monte Fresh Produce.

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Remember: large corporations want to help us.