

Learning Objectives

- Discuss how environmental, social, cultural, and economic considerations shape our understanding of what is meant by the term *sustainable development*.
- Describe the difference **between renewable and nonrenewable natural resources**, and give examples of each.
- Explain the concept of ecosystem services, and how that relates to environmental sustainability.
- Identify each of the steps of the **waste management hierarchy**, and give examples of engineering methods and practices that reduce and minimize the waste stream.
- Summarize why strategies such as industrial ecology and life cycle analysis provide more sustainable engineering outcomes.
- Recognize the elements of ecological design, and give multiple examples of how this is used in engineering practice.
- Apply biomimicry as a design strategy.
- Analyze a business decision using the principles of sustainable and green engineering.
- Compare and contrast footprint analysis, waste management, ecological design, and the principles of sustainable engineering as models for better design.



* Utilize Chapter 7 slides from:

Engineering Applications in Sustainable Design and Development Striebig/Ogundipe/Papadakis

Reminder Sustainability



- 1987 Brundtland Report: sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”
- Intergenerational ethics

Industrial Ecology

- * Physical, chemical, and biological interactions and interrelationships both within and among industrial and ecological systems
- * Industry mimics nature
 - * Waste from one organism is food for another
 - * Everything is connected
 - * Cyclic processes
 - * Living off nature's interest
- * Shift in thinking
 - * Past: Remediation
 - * Present: Treatment, storage, and disposal
 - * Future: Industrial metabolism
 - * The industrial ecosystem

Brewery



Brewery waste dumped into oceans to destroy coral reefs

Mushroom Growing



Muck dumped on fields

Chicken Raising



Waste piles up

Methane Gas Production



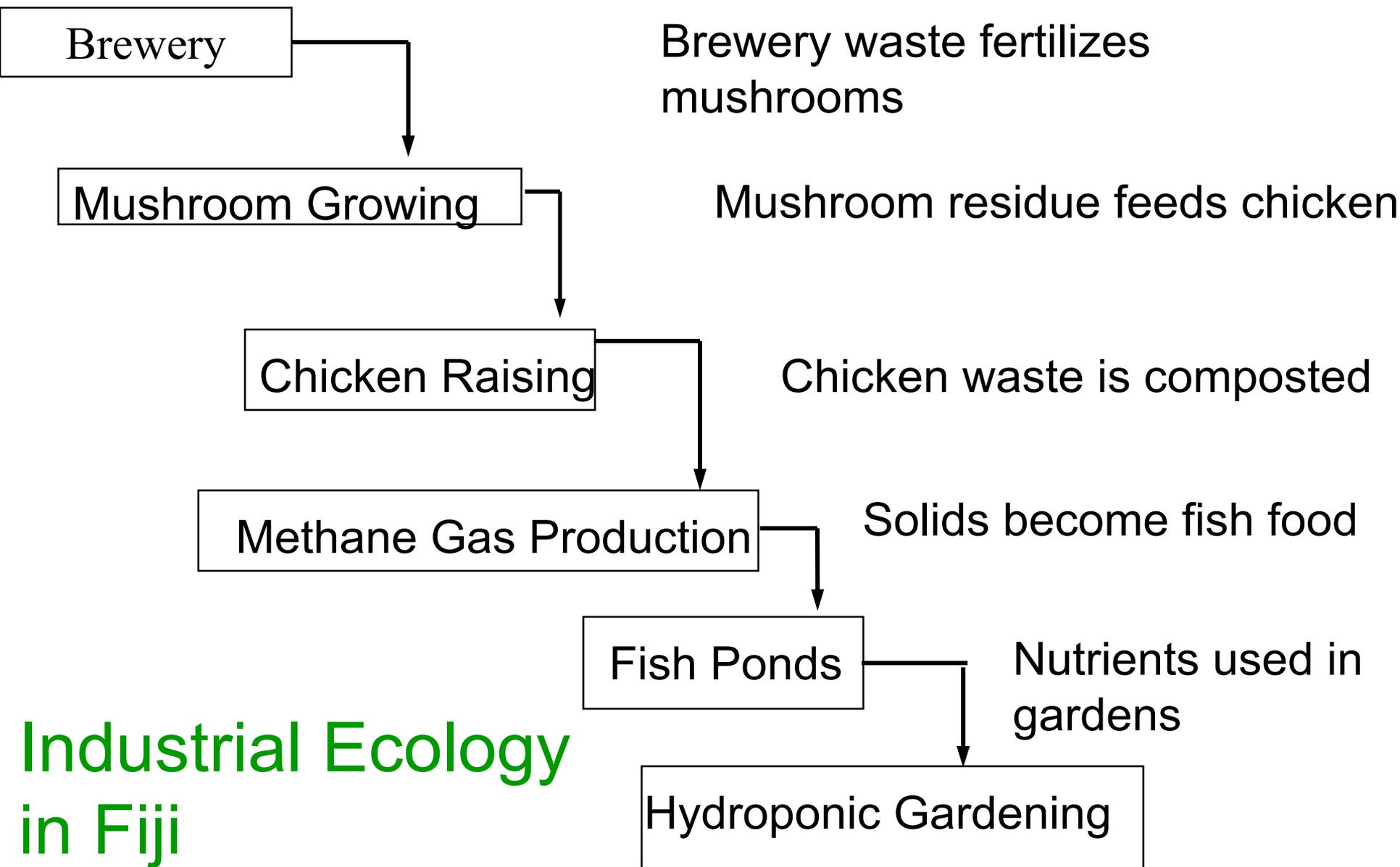
Methane vented

Fish Ponds



Muck cleaned out

Conventional Waste Management in Fiji



Industrial Ecology in Fiji

Industrial Ecology in Kalundborg, Denmark



Waste Management & Material Life Cycles

- DfE practices:
 - Dematerialization, which is the reduction in the amount of materials required for a product without changing its functionality.
 - Design for recyclability, is used to facilitate materials recovery and reuse.
 - Design for disassembly, in which products are designed to readily come apart into their constituent components for reuse or recycling.
 - Remanufacturing, which is the process of recovering product modules and components, repairing and refurbishing them, and then reusing them again in new production or sales.
 - Minimized use of energy, toxic materials, and toxic production processes to limit the environmental release or disposal of contaminants.