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Introducing Agroecology[1]

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This document aims to introduce the foundational ideas and main concepts of agroecology to a general audience with some specific examples for implementing agroecology on farms and gardens in commercial, hobby, and educational contexts. The primary objectives for the reader are to think expansively about agriculture and food systems and to take action on their land and in their communities to improve production sustainability and community resilience through agroecology.

What is agroecology?

Agroecology in a Summary

"*The integration of research, education, action and change that brings sustainability to all parts of the food system: ecological, economic, and social. It's transdisciplinary in that it values all forms of knowledge and experience in food system change. It's participatory in that it requires the involvement of all stakeholders from the farm to the table and everyone in between. And it is action-oriented because it confronts the economic and political power structures of the current industrial food system with alternative social structures and policy action. The approach is grounded in ecological thinking where a holistic, systems-level understanding of food system sustainability is required*." - Gliessman, 2018

Agroecology in a Sentence

"*A field of study motivated to understand ecological, evolutionary, and socioeconomic principles and use them in an improvement process that sustains food production, conserves resources, and maintains social equality*." - Brym and Reeve, 2016

Agroecology 101

While there are multiple definitions of agroecology, the term is often used to encapsulate farming that works with nature to maintain production, economic, and environmental well-being. The goal of agriculture is the production of food and materials; however, agroecology also values factors linking production with environmental conservation and social responsibility (Francis et al. 2003). The science, practice, and philosophical movement of agroecology aims to integrate and balance biological interactions among plants, animals, humans, and the environment for reliable and sustained production (Wezel et al. 2009). Today's most common form of agriculture generally relies on economies of scale, external agrochemical inputs, and globally distributed supply chains, resulting in challenges that agroecology addresses.

While the overall output and efficiency of today's most common form of agriculture are impressive and produce an abundance of affordable and accessible food, up to 1 billion humans suffer from hunger (FAO et al. 2022). Furthermore, globalized industrial food systems have displaced local farmers and disrupted public access to land and food (Vandermeer 2011). In addition to social disparities, the resource-intensive industrial model can also degrade ecosystems and threaten biodiversity when implemented without environmental considerations (Clark et al. 2022; Perfecto, Vandermeer, and Wright 2009; Raudsepp-Hearne et al. 2010; Tilman et al. 2002). The environmental harm from today's industrial system results from an excessive reliance on external sources of energy and nutrients derived from nonrenewable sources (Millennium Ecosystem Assessment 2005). Over time, large monocropping systems can also contribute to growing pest populations and high disease pressure (Perfecto, Vandermeer, and Wright 2009).

Agroecologists deploy solutions inspired by the natural world to affect the balance of productivity, biodiversity, and resilience. Targeting long-term sustainability of agricultural systems, agroecologists address negative consequences of agriculture and build in benefits for nature and society through a deep knowledge of the unique aspects of their place, plants, and people. Achieving agroecology's goals requires solutions and practices that are specific to local contexts, constraints, and opportunities.

There is no single way to practice agroecology, so we describe four "foundational principles" of agroecology that guide its implementation.

Productivity: Materials and wealth generated through both biological and economic currencies such as biomass, carbon, nitrogen, yield, and income

Diversity: The collection of plants, animals, microbes, fungi, and cultures coexisting in an environment that promotes the beneficial interaction among the varieties of life

Resilience: The ability to maintain or rebound productivity, biodiversity, and community in response to hardship or disturbance such as extreme weather events, disease or pest incidence, or market failures

Systems thinking: Reflection and planning in a way that broadly looks at how agricultural, ecological, and social factors are interconnected

Agroecology connects dynamic plant and animal productivity with environmental health and the well-being of communities. Thinking as an agroecologist, farms are "agroecosystems" and markets are "food systems." Practicing agroecology through the foundational principles looks like a design around concepts such as scavenging, recycling, adaptive management, cooperative governance, and circular economies.

In practice, agroecologists ask many questions specific to their place, plants, and people:

- What makes agriculture and my food system more sustainable?
- How can I promote the biodiversity and biocomplexity local to my community while maintaining agricultural productivity?
- How can I produce food in a manner that respects the land, its ecology, my community, and the consumer?
- How can we better care for the farmworkers and culture in our community?
- How does my land mimic and advance ecosystem services from the natural landscapes in my region?

The goal of agroecology is productivity that is environmentally and socially responsible, and therefore secure, resilient, and lasting. Food must reach people, and people must care for the land. Agroecological farming through the lens of the natural world enriches resources from the environment and beneficial interactions among living organisms. Innovations in agroecology amplify synergies in ecology and society to prioritize food production, natural resource conservation, and social responsibility.

Agroecologists often reference nature to identify and observe aspects of the specific place and plants that make up a functional design for the specific target production or conservation outcome. Nature is recognized as relationships between biodiversity and the environment that work across scales of space, time, climate, and geopolitics. Yet, agroecologists also recognize the conceptual and practical challenges of identifying the "natural" in human-modified and managed systems. Management can be a complementary *and* competing actor to nature in the context of resilience and sustainability. For example, management selecting for internally sourced nutrients can facilitate healthy functioning of agroecosystems but may result in periods of reduced yield volume and stability. Such a management choice may also be labor intensive compared to mechanized applications of concentrated fertilizers. However, management for internal nutrient cycling may be integrated with localized optimization of biological diversity that together could have a synergistic effect on overall biological productivity and labor requirements. The relative value of production, environmental, and social targets must be balanced with nature and management in a robust agroecological design.

Understanding Farms as Agroecosystems

Agroecosystems are ecosystems managed for production of food, fuel, fiber, or medicines. These ecosystems include the interconnected components of agriculture and nature (Figure 1). Agroecosystems are dynamic across space and time, influenced by external features of the neighboring area and connected systems.



Figure 1. This agroecosystem diagram depicts how agricultural land is often located between and within natural and urban land. These surrounding areas influence resource availability, biological diversity, and ecosystem services.
Credit: Heather Griffith, UF/IFAS Communications

Environmental and biological offerings of agroecosystems are broadly considered "ecosystem services." Universal agroecosystem services include natural functions such as nutrient and water availability, plant and animal diversity, pollination, and pest control. If an agroecosystem is exploited and compromised, declines in ecosystem services can require costly inputs to maintain productivity. Additionally, the prospect of long-term sustainability becomes more challenging.

Agroecological practices enhance ecosystem services by the management of on-farm environmental and biological interactions in strategic locations around land in production.

Add plant diversity. Go beyond a focal crop. Planting hedgerows within crop fields or forested buffers around field boundaries can lessen the movement and erosion of soil, slow and filter the movement of water, disrupt extreme temperatures and winds, and encourage and increase the movement of wildlife.

Add animal diversity. Integrate livestock. Insect and wildlife diversity can increase the likelihood that beneficial insects will be present to pollinate crop flowers or predators will be present to feed on harmful pests.

Establish corridors. Connect biodiversity. Corridors of different sizes and composition can help the movement of pollinating insects or large wildlife such as the Florida panther. Effective biodiversity corridors reflect appropriate boundaries, scales, and connections at which the agroecosystem functions.

Reduce. Reuse. Recycle. Adaptive and resource-conscious management can increase the internal cycling of energy, nutrients, and matter for conservation, restoration, and regeneration, or decrease the internal cycles and external pressures of environmental and biological pests.

Support humanity. Provide a living wage and healthy food. Food and shelter are human rights that enlist land managers to be stewards of the land and their community.

Applying Agroecology

Adopting agroecological practices begins with setting complementary agricultural, biological, and economic goals. Common agroecological goals and related practices include nutrient recycling and retention (e.g., composting, cover crops), biological diversification (e.g., crop rotation, cover crops, intercropping), and agroecosystem development (e.g., pollinator and predator rearing, conservation zones).

Specific agroecological practices should reflect your local environment and culture. For example, when adopting a crop diversification strategy such as cover cropping, consider selecting a cover crop that is known to improve soil and attract beneficial insects in your region. As well as being a participant in your local economy, a local supplier may have access to seeds and insight specific to your region. Refining your goals and making them as specific as possible will allow you to evaluate the success of your management practices. Economic productivity and biological diversity are key indicators of success during an agroecological transition.

To design and apply agroecological practices at your specific place, consider a survey of similar places in your region. Find examples of agroecosystems on a spectrum from natural to intensively managed. Observe how these systems express trade-offs in productivity, biodiversity, and resilience. Each has the opportunity to advance towards sustainability but will likely do so along a different path. Through observation, reflection, and adjustment, agroecology can be adapted and applied to dynamic environments and diverse farming systems across many unique settings.

Figure 2 shows a few local examples of how agroecology can be practiced in Florida.

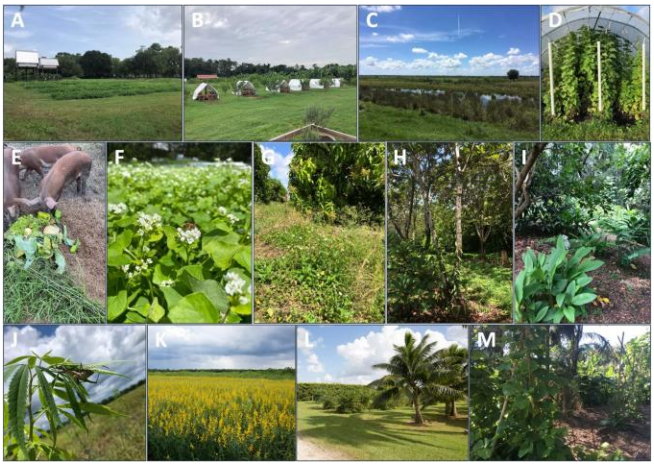


Figure 2. Examples of agroecology in Florida. A) Row crop under bat houses. Field and Fork Farm and Gardens, UF, Gainesville, FL. B) Mobile chicken tractors around fruit trees. Everoak Farm, Orlando, FL. C) Riparian buffer and semi-native pasture. Buck Island Ranch, Lake Placid, FL. D) High tunnel and trellis. Everoak Farm, Orlando, FL. E) Pigs and garden scraps. Everoak Farm, Orlando, FL. F) Bees and cover crop. Everoak Farm, Orlando, FL. G) Mango flower
Credit: Zack Brym, Tyler Jones, and Everoak Farm

Getting Started

Are you ready to apply agroecological strategies on your farm, garden, or local food system? Start by getting to know your agroecosystem.

1. **Map the agroecosystem.** Draw and list environmental, biological, and economic resources on your farm and those available externally. Consider lands, zoning, infrastructure, and equipment.
2. **Plan your agroecosystem.** Define productivity, biodiversity, and resilience targets. Balance target outcomes, expectations, and risks with agroecological design and practices. Detail and map your agroecosystem target for 1 year and 5 years in the future.
3. **Take action.** Design, develop, and deploy place-based agroecological solutions. Try an agroecological practice and evaluate the effectiveness of your plan and resulting changes to your agroecosystem.

Practicing agroecology should result in management choices and customized outcomes reflecting your agroecosystem characteristics, grower-specific abilities, and available resources. Set and monitor targets that reflect your production, biodiversity, and resilience goals. Plan and deploy agroecological practices in a way that encourages a healthy agroecosystem with progress towards sustainability and resilience. In the long term, sustainable agroecosystems will be rich in resources and resilient against disturbance while requiring limited inputs and interventions. Such sustainable agroecosystems will be supported by a diversity of agroecological solutions and by the biological and cultural diversity of your food system.

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