

# Agroecology and Sustainable Development

Findings from the UN-led International Assessment of Agricultural Knowledge, Science and Technology for Development

## Agroecology provides a robust set of solutions to the environmental pressures and crises facing agriculture in the 21st century.

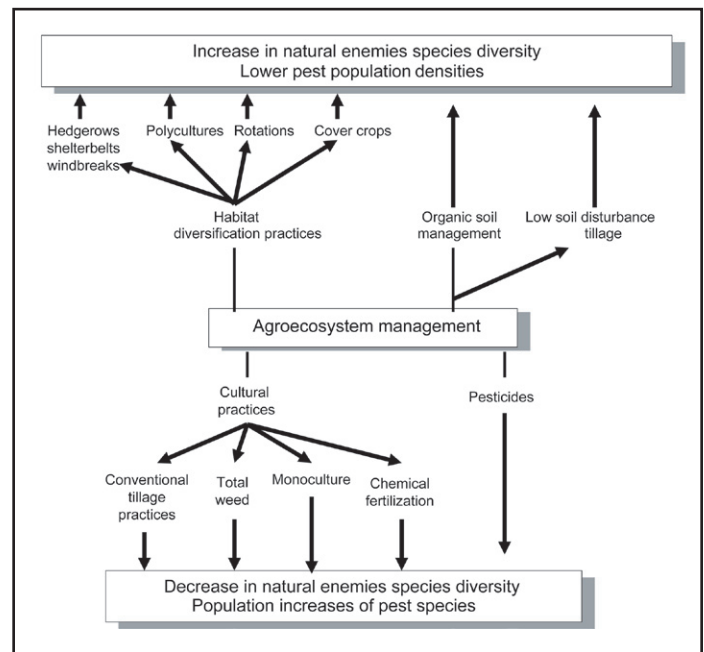
Agroecology is the science behind sustainable agriculture. Drawing on the natural and social sciences, agroecology provides a framework for assessing four key systems properties of agriculture: productivity, resilience, sustainability and equity.

Taking account of agriculture's multi-functionality, agroecology measures sustainability in terms of social, environmental and economic impacts. Because these impacts are context-dependent, agroecology is a place-based, pragmatic science, uniquely suited to delivering on the promise of pro-poor development.

Agroecology combines scientific inquiry with indigenous and community-based experimentation, emphasizing technology and innovations that are knowledge-intensive, low cost and readily adaptable by small and medium-scale producers. These methods are considered likely to advance social equity, sustainability and agricultural productivity over the long term.

Agroecological farming encourages the cultivation of resilience and maintenance of healthy ecosystem function over reliance on external inputs such as synthetic chemical pesticides, fertilizers and fossil fuels that can have high energy, environmental and health costs. The approach is thus well-suited to withstanding environmental and economic stresses posed by climate change, shifting pest pressures

### Ecologically-based management of agroecosystems supports resource conservation and sustainable pest management.



Source: IAASTD Global Report Figure 3-6, from Altieri, M.A., and C.I. Nicholls, 1999. Biodiversity, ecosystem function, and insect pest management in agricultural systems. p. 69-84. In W.W. Collins and C.O. Qualset(ed) Biodiversity in Agroecosystems. CRC Press, NY.

An agroecological approach recognizes the multifunctional dimensions of agriculture and facilitates progress toward a broad range of equitable and sustainable development goals:

- *Increased ecological resilience* and reduced risk in weathering changing environmental conditions;
- *Improved health and nutrition* (more diverse, nutritious and fresh diets; reduced incidence of pesticide poisoning among workers, communities and consumers);
- *Conservation of natural resources* (biodiversity, soil organic matter, water quality and quantity, ecosystem services, e.g. pollination, erosion control);
- *Economic stability* (more diverse sources of income; spread of labor requirements and production benefits over time; reduced vulnerability to single commodity price swings, etc);
- *Climate change mitigation* through increased energy-efficiency, reduced reliance on fossil fuel and fossil fuel-based agricultural inputs, increased carbon sequestration and water capture in soil; and
- *Increased social resilience and institutional capacity* (increased ecological literacy and social support networks).

The International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) provides policy options for how agricultural knowledge, science and technology can reduce hunger and poverty, improve rural livelihoods and human health, and facilitate equitable and environmentally, socially and economically sustainable development. The Assessment was conducted by over 400 scientists and development experts from more than 80 countries. It was sponsored by four United Nations agencies, the World Bank and the Global Environment Facility. The IAASTD findings were approved at an Intergovernmental Plenary in April 2008. For more information on the IAASTD, please see [www.unep.org](http://www.unep.org).



(see Figure), and volatility in petroleum and commodity prices.

## Productive and Profitable

Common assumptions that “alternative” or agroecological methods are necessarily less productive than high-input conventional systems are incorrect. Farmers adopting agroecological methods have produced equal and sometimes substantially increased yields per unit area compared to those using conventional methods in many parts of the world, although research challenges in specific crops and some agroecosystems remain.

Benefits have been greatest for small-scale producers in resource-limited areas of the tropics, i.e. in most developing countries. An Essex University study of 286 resource-conserving projects in 57 countries found that agroecological farming achieved average production increases of 79% per hectare, with all projects achieving increased water efficiency and 77% showing significant reductions in pesticide use.

Similarly, a comprehensive examination of nearly 300 studies worldwide by the University of Michigan concluded that organic agriculture could produce enough food, on a per capita basis, to provide 2,640 to 4,380 kilocalories per person per day (more than the suggested intake for healthy adults). Organic farms in developing countries were found to outperform conventional practices by 57%. These promising findings may underestimate the full potential of agroecological farming to contribute to increased farm-level productivity, household income and food security, as only a very small



**An organic farmer in Mexico practices crop rotation, applies mulch for weed control, uses organic fertilizers and maintains an agroforest to protect local springs that provide clean irrigation water.** Source: Ivette Perfecto

**For economic and nutritionally vulnerable populations, agroecology supports production of both a greater quantity and diversity of high quality food, fiber and medicinal products, both for family consumption and the market.**

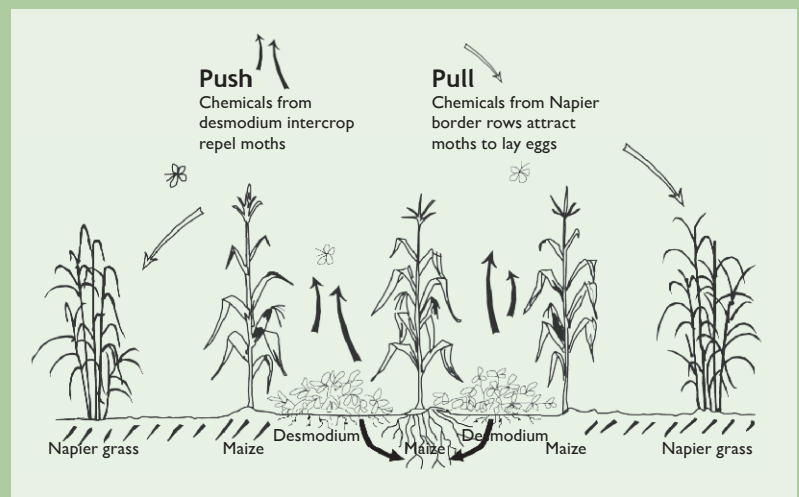
## Push-Pull System of Maize Pest Management in Africa

The push-pull system of ecological pest management in Africa illustrates the productive, economic, food and livelihood security, health and environmental benefits of an innovative agroecological approach.

Kenyan maize farmers have tripled their yields by intercropping maize with plants that deter pests and support pest predators. Farmers plant nitrogen-fixing legumes, such as silver leaf desmodium, that improve soil fertility while inducing ‘suicide germination’ of seeds of the highly damaging parasitic weed, *Striga hermontica*. Napier grass and Sudan grass planted around field borders attract (“pull”) stemborers away from the crop; stemborer larvae trapped inside the Napier grasses’ sticky interior die. Meanwhile, molasses grass planted within the crop chemically repels (“pushes”) stemborers away, while attracting a parasitic wasp of stemborer larvae.

The inclusion of these grasses in the farming system reduces synthetic pesticide use and can help augment livestock feed, providing families with additional milk and meat for consumption or sale.

Additional benefits include reduced run-off and soil erosion, enhanced soil fertility, improved food security and family nutrition, and increased household income. More than 12,000 farmers across eastern Africa have adopted the technology, with another 100,000 expected to do so over the next three years.



Source: [www.push-pull.net](http://www.push-pull.net)



fraction of public and private sector agricultural investment has thus far gone towards agroecological research.

## Knowledge-Intensive and Inclusive

An agroecological approach is particularly well suited for rural communities and developing economies. It recognizes the value of high quality scientific research and of advanced technological exploration and innovation. It also emphasizes the societal and knowledge gains from dialogue between researchers, farmers and indigenous communities. Indigenous knowledge systems and traditional farming practices often yield site-specific insights that would otherwise be outside the purview of formal science.

Successful agroecological research, education and extension programs have been building for decades on local and traditional knowledge systems, often through participatory and experiential learning processes and multi-organizational partnerships that integrate formal and informal agricultural knowledge, science and technology (AKST). Examples include Farmer Field Schools in Integrated Pest Management, Plant Health Clinics, farmer-to-farmer extension programs, and agroecological studies in school and urban gardens.

Collaborative structures that emphasize co-learning, social networks of innovation, and building capacity in flexible place-based decision-making have proven more effective than conventional top-down transfers of technology in the developing world. Partnerships that focus on inclusion and meaning-



**Indonesian Field School farmers discuss the ecological management of insect pests found in their paddy fields.** Source: Hery Christanto

ful participation, particularly by historically marginalized groups, contribute to the design and implementation of solutions that are robust precisely because they are appropriate.

## Resilient

Agroecology improves the adaptive capacity of agroecosystems and reduces vulnerability to natural disasters, climate change impacts, and new and emerging environmental and economic system stresses and shocks. This resilience can be accomplished through physical and biological means (habitat and crop diversification, in situ conservation of local/indigenous seed and germplasm diversity, maintenance of natural enemies' species diversity, increased carbon sequestration, improved water capture and retention, etc.) and socio-cultural and political means (diver-

### Central American Farmers Withstand Hurricane Mitch

In Central America, small-scale farmers using agroecological methods were significantly more able to withstand the adverse effects of Hurricane Mitch than plots farmed conventionally.

A participatory action research study found that in the aftermath of the hurricane, agroecologically managed plots in Guatemala, Honduras and Nicaragua retained more topsoil, field moisture and vegetation and experienced less erosion and lower economic losses than plots on conventionally-managed resource-extractive farms. Furthermore, the difference in ecological resilience and beneficial results experienced in the agroecological plots in comparison with the conventional plots tended to increase with increasing levels of storm intensity and increasing slope of the land. The number of years that a plot had been cultivated with agroecological methods also contributed positively to its ability to withstand and recover from the hurricane.



The study also illustrates the capacity of farmer-based participatory research to provide significant amounts of highly relevant data: 40 NGOs, 99 farmer-technician teams and over 15,000 farmers collaborated to measure agroecological indicators in 360 communities from southern Nicaragua to eastern Guatemala. After analyzing the results from the study, agroecological and conventional farmers together designed strategies for participatory, sustainable reconstruction. This participatory research mobilization was made possible by the existence of a widespread smallholders' network for sustainable agriculture, known as Movimiento Campesino a Campesino (Farmer to Farmer Movement).

sification of farming systems and local economies; technical, legal and social support networks for small-scale farmers, rural communities and indigenous peoples that reduce socio-economic vulnerability and strengthen adaptive knowledge processes, etc.)

**Pro-poor sustainable development in the 21st century requires a redirection of institutional and policy support towards ecologically-sound decision-making by farmers; stronger and enforceable regulatory frameworks to reverse the damaging effects of resource-extractive agriculture; and significant new investments by public sector, donor, and commercial agencies in agroecological research, extension, education, product innovation, and marketing.**

## Growing Agroecology at Home Policy Options to Build Local and National Capacity

### Build local and national capacity in agroecological research, extension and education

- *Establish a national framework for the implementation of agroecological production;* invest in agroecological research, extension and education.
- *Encourage collaboration* among farmers, indigenous peoples, extensionists, educators and researchers in problem-identification, experimentation and innovation.
- *Revise institutional priorities,* professional incentives and budget allocations to support these goals.

### Support small-scale farmers and their organizations

- *Strengthen women's, farmers', indigenous and community-based organizations;* invest in rural areas.
- *Ensure farmers have secure access* to productive resources, information, credit, certification and marketing infrastructure.
- *Provide technical assistance* in agroecological production and agro-processing, and in adjusting to and mitigating climate change and other system stresses.

### Establish supportive economic policies, financial incentives and market opportunities

- *Use full-cost accounting measures* to evaluate and compare the social, environmental and economic costs of different agricultural production systems.
- *Provide financial incentives* (credit lines, crop insurance, income tax exemptions, payment for ecosystem services) for resource-conserving practices, and for reducing reliance on chemical, fossil fuel and water-intensive production methods.

- *Encourage geographic, fair and sustainable production labels, affordable third-party certification, and increased market opportunities* for farmers adopting agroecological practices.
- *Reduce volatility in commodity and food prices* by establishing grain reserves, price bands and other supply management mechanisms. These measures enable farmers to invest in longer-term resource-conserving strategies and support national food security goals.

### Strengthen institutional supports

- *Revitalize local and regional food systems:* Establish democratic food policy councils; encourage urban and peri-urban agriculture projects; regionalize food procurement.
- *Establish fair regional and global trade arrangements* that enable farmers to meet food and livelihood security goals and diversify production.
- *Revise laws of ownership and access:* Implement effective land reform; revise intellectual property rights; devise equitable resource use policies; distribute credit to enable small-scale farmers to compete more effectively.
- *Establish social and environmental standards* for production, food quality and procurement, with liability mechanisms to address health or environmental harms arising when standards are not applied.
- *Guide and regulate private sector:* Reward private investment in safe, sustainable products, technologies, in situ reserves and markets; initiate competitive bidding for public funding based on capacity to meet equitable, sustainable development goals; implement anti-trust and competition regulations.
- *Enhance institutional integrity:* Enforce codes of conduct to preserve public institutions' capacity to perform public-good research.

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