

Human Dimensions: Agroecology for Just and Sustainable Food Systems

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Agroecology has grown to be more inclusive in its definition since it first appeared in the scientific literature. From initial formulations as simply the application of ecological science to agricultural crops (Bensin 1930) to a much more expansive understanding as “the ecology of food systems” (Francis et al. 2003), the term’s meaning has varied considerably across different places and times.

Today, many agroecologists ascribe to the tripartite definition forwarded by Wezel and colleagues in 2009. Agroecology is simultaneously:

1. a practice of environmentally friendly farming,
2. a scientific research discipline that examines ecological principles in the context of agroecosystems, and
3. a global social movement for just and sustainable food systems (Wezel et al. 2009).

Ecological science remains fundamental to each of these components, but the modern definition also emphasizes the human dimensions of agroecology. This is only appropriate, as agriculture is an inherently socio-ecological endeavor (Altieri 2018). In this article, we highlight how human dimensions have been vital to the past, present, and future of the Agroecology Section of the Ecological Society of America (ESA).

History of the Section

Ecologists have recognized humans as a consequential component of the natural environment since the beginning of the 20th century. However, the formal application of ecological principles to manage agroecosystems, and the study of agroecosystems to generate new ecological knowledge, had to wait almost 100 years. It was not until the 1980s that textbooks and articles with this focus began appearing in the ecological literature, and it was not until 2000 that the Agroecology Section of the Ecological Society of America was established.

Two symposia were precursors to the formation of the Section: “Agroecology and Sustainability” was held in 1998 in the INTECOL Meeting in Florence, Italy; and “Ecological Processes in Agricultural Landscapes” was held in 1999 at the ESA meeting in Spokane, Washington. Following the success of these symposia, and with the encouragement of Elaine Ingham and other ESA representatives, a group of agroecologists applied to the ESA Council to form a new section.

On 8 August 2000, during the 85th ESA Annual Meeting in Snowbird, Utah, the first official meeting of the new ESA Agroecology Section was called to order by Acting Chairperson Deborah Neher. Following a heavily attended symposium entitled “Ecology and Agriculture,” the meeting began with an enthusiastic group of agroecologists. Steve Gliessman, Matt Liebman, and Ivette Perfecto were elected chair, vice-chair, and secretary, respectively. The objectives of the Section as stipulated in the bylaws were (and remain to this day).

1. to promote an understanding of the importance of the application of ecological concepts and principles to the design and management of sustainable agroecosystems among ecologists, agriculturists, and members of related disciplines
2. to encourage education and research in agroecology
3. to sponsor meetings and publications for the communication of research and educational activities in agroecology
4. to increase student participation in the Society.

There have now been over 20 years of ESA Annual Meetings, with at least one Symposium or Special Session devoted to agroecology each year, reflecting the excitement about this topic within the Society.

The Importance of Agroecology

In the face of increasing demand for agricultural goods and accelerating environmental degradation in many parts of the world, the Agroecology Section’s objectives are more relevant than ever. Understanding how to manage agricultural systems that produce adequate food, fuel, and fiber, conserve natural resources, and are resilient to global change is vital for meeting these challenges.

More sustainable agricultural production and resilient agroecosystems are paramount to future global food security, environmental protection, and human well-being (Vandermeer et al. 2018). Accelerating rates of resource exploitation (in combination with persistent inequality and increasing per-capita consumption) risks worsening many already-serious environmental, economic, and societal challenges. Increased agricultural production is frequently associated with practices that degrade land, water, and biodiversity (Rasmussen et al. 2018). In addition, suburban expansion and cross-sector competition for resources will likely degrade some agricultural production systems, threatening their long-term ecological sustainability (Satterthwaite et al. 2010, Haberl 2015) as well as the persistence of rural and farming communities.

All of this occurs in the context of global environmental change; farming systems must increasingly be designed to be resistant and resilient to rising temperatures, changing precipitation regimes, and extreme weather events (Altieri et al. 2015). To stop environmental degradation and increase food accessibility, agricultural production must use ecological principles and innovative management practices that help

conserve soil, water, and biodiversity (Pretty 2008, Foley et al. 2011, Davis et al. 2013, Bommarco et al. 2013). Furthermore, researchers increasingly recognize that simply producing plant biomass is not the final goal of an agricultural system. Whether the harvest is used or wasted, for what purpose it is used (e.g., human food, animal feed, fuel, or industrial products), and to whom the benefits accrue all figure prominently in the sustainability of the system. Agroecology as a field is well suited to meet these challenges because of its emphasis on applying ecological principles to understand and design better farming systems, as well as engaging with agriculture's broader human context.

Diverse Perspectives on Human Dimensions in Agroecological Research & Practice

Agroecologists tend to emphasize understanding agriculture as a system, embedded in complex physical, biological, and social contexts. The breadth and interdisciplinarity of the field also mean that from outside (or even sometimes within) the field, it can be challenging to get a clear impression of its central concerns.

There is a divergence of opinions on the appropriate extent of political, social, economic, and philosophical considerations in agroecology. For example, debates abound on topics such as the role of digital information technologies in agriculture (Altieri et al. 2017, Maurel and Huyghe 2017, Clapp and Ruder 2020), the acceptability of genetically engineered crops (Montenegro de Wit 2019, Lotz et al. 2020), the difference in yields between organic versus conventional agriculture (Pretty et al. 2006, Badgley et al. 2007, Seufert et al. 2012, Ponisio et al. 2015), and the role of private corporations in sustainable agricultural systems (Holt-Giménez and Altieri 2013, Giraldo and Rosset 2018). These tensions highlight how many of the motivating questions in agroecology are not just about ecological principles, but about how they interact with human values.

Agroecological emphases also vary geographically. In North America and Europe, most agroecological research focuses on reducing negative environmental impacts and/or enhancing ecosystem services of agriculture, while maintaining or even increasing yield and profitability (Morandin and Kremen 2013, Smith et al. 2013). In tropical regions that rely on commodity crops such as cocoa and coffee, including many parts of Latin America and Southeast Asia, agroecological research often focuses on cost-effective methods to prevent crop damage and/or improve crop quality, ideally with side benefits of stewarding tropical biodiversity (Tscharntke et al. 2011). In regions characterized by small-scale subsistence agriculture, agroecological research usually prioritizes achieving stable, sustainable yields of staple crops with minimal expenditure on purchased inputs (Bezner Kerr et al. 2007).

Human dimensions are particularly significant when farmers' lives and livelihoods are tied closely to the land. In these conditions, top-down research is of questionable value; farmers with narrow safety margins may be reluctant to try an intervention devised by a researcher under potentially unrealistic conditions. The risk of disconnect between farmers' needs and top-down research has long been recognized in the developing-world context (Farrington 1989, Holt-Giménez 2006), but it is increasingly recognized as an important consideration in developed countries as well (e.g., Schneider et al. 2009, Snapp et al. 2019). Facilitating not only farmer-to-researcher communication, but also peer-to-peer communication between farmers, is essential in developing, sustaining, and improving agroecological best practices.

Examples of successful agroecological collaborations that avoid the pitfalls of more hierarchical research approaches include “mother and baby” farmer-led trials for soil health and productivity in Malawi (Snapp et al. 2002), the *campesino a campesino* movement in Latin America (Holt-Giménez 2006), and alternative extensions for agroecological pest management in California orchards (Warner 2008). Agroecological innovations can spring from traditional and Indigenous knowledge as well as new scientific knowledge (Altieri 2004, Vandermeer and Perfecto 2013). For example, Davis et al. (2019) draw upon traditional uses of plants with crassulacean acid metabolism (CAM) across the globe to show how these underutilized species can contribute to more sustainable and resilient crop production systems. When incorporating Indigenous knowledge into agroecology, it is vital to ensure that efforts are truly collaborative and place-based, rather than extractive.

Activities of the Agroecology Section

While the Agroecology Section of ESA initially attracted scientists asking basic and applied ecological questions in agricultural systems, section membership increasingly reflects the complex interdisciplinary nature of the field, including practitioners and social scientists. Recent events hosted by the Section have explicitly focused on the human dimensions of agroecology, including engagement with farmers and other non-academics working directly with communities and the land.

At the 2019 Annual Meeting in Louisville, KY, Section members learned about local urban agriculture (Fig. 1) and hosted several events related to the human dimensions of agroecology. A symposium titled “Agroecology with Communities: Cross-disciplinary collaborations among ecology, agriculture, and social science” brought together academic researchers conducting interdisciplinary and participatory research that included not only biology, but also fields such as sociology and economics (Fig. 2). A workshop on “Diversified Agroecosystem Management” provided a forum for scientists and practitioners to review examples of (1) agricultural innovations that successfully harmonize ecological conditions with agricultural production, and (2) community-based research that supports sustainable agroecosystems. The workshop included a panel discussion and survey, which (along with an online survey) showed that Section members view farmer engagement in agroecological research as the highest future priority for the Section’s community-focused activities. Members and non-members who stopped by the Agroecology booth received their choice of free heirloom vegetable seeds (from okra to rainbow chard) as a reminder of the characteristically applied and local nature of agroecology.

Between the annual meetings in 2019 and 2020, the section officers reached out to project leaders that were nominated for recognition by Section members. Each project leader was invited to participate in a panel discussion and to prepare a video considered for an award (funded by a Long Range Planning Grant). The videos were featured during a workshop hosted by the Section during the 2020 virtual meeting. The workshop also included a panel discussion on “Farmer Engagement in Agroecology Research: Harnessing data in practice,” followed by a small-group discussion. These recent activities involved both passionate and data-based revelations that Agroecology Section members see a growing need to engage in the human dimensions of ecology.

Many of the Section members identified a need for systemic changes in both agricultural management strategies and research priorities in agriculture, noting that human health, cultural identities, governance, and economics are all intimately involved with agroecological changes. A shift toward more participatory



Fig. 1. On a field trip organized by Ked Stanfield (right) of Louisville Grows, participants of ESA's 2019 Annual Meeting in Louisville, KY, listen to a farmer explain how he has implemented traditional Southeast Asian vegetable production systems at this community garden. Photograph credit: Amber Kerr.

research that involves growers with hands-on knowledge of site conditions, soil history, and social dynamics is necessary. Research investments in technical advances for agriculture are not warranted without stakeholder understanding and support.

Future Collaborations Beyond and within the Society

The Agroecology Section plans to continue expanding the scope of our work to include the perspectives of farmers and other stakeholders outside of academia. For example, we are planning online webinars where we will invite section members to hear from innovative farmers who are implementing novel agroecological designs on their land, as well as from other research networks outside of ESA.

The Agroecology Section is also eager to pursue new opportunities to advance diversity, inclusion, and justice within ESA and in agriculture more broadly. While the section has occasionally undertaken such efforts in the past (for example, collaborating with the Environmental Justice section to host field trips and other events at ESA meetings), it is important that they become a more regular part of our work. Agriculture, particularly in the United States, can only be fully understood in the context of



Fig. 2. Presenters Amber Kerr, Jennifer Blesh, Sieglinde Snapp, Claire Kremen, Stacy Philpott, and Lev Jardón Barbolla at the 2019 symposium “Agroecology with Communities: Cross-disciplinary collaborations among agriculture, ecology, and social science.” Photograph credit: Ben Iuliano.

historical injustices such as slavery and land appropriation (Horst and Marion 2019); environmental conservation is similarly marred by a history of racism, classism, and imperialism (Chaudhury and Colla 2020). Our section seeks to confront this history, redress ongoing harm, and contribute to more just food systems. For example, in many parts of the world agroecology is closely associated with movements for food sovereignty and food justice. These movements emphasize the work of peasant farmers and poor communities of color, recognize the benefits of local control over food systems, and affirm the right of all people to nourishing and culturally appropriate foods (Alkon and Mares 2012, Clendenning et al. 2016). We hope to help deepen those connections within the Society to attract a wider audience and reflect the rich diversity of agroecologists across the globe.

Finally, our section cannot and should not work in isolation. Our work is intimately related to that of many other sections, including Applied Ecology, Biogeosciences, Microbial Ecology, Physiological Ecology, Rangeland Ecology, Soil Ecology, Human Ecology, and Environmental Justice, Policy, and Education. In our research, members apply the same tools and principles as other ecologists: for example,

predicting and manipulating outcomes of interspecies competition; enhancing net primary production by adjusting levels of limiting resources; using tritrophic interactions to mediate plant-herbivore dynamics; studying how microbial diversity correlates with nutrient cycling processes; and observing effects of interannual climate variability on ecosystem productivity. We approach these fundamental ecological processes through the lens of sustainable agricultural production and human wellbeing. Many of our section members incorporate these ideas into the courses they teach (e.g., Fig. 3) in hopes that the next generation of scholars will enter the field with a full understanding of its interdisciplinary complexity. The coming century will be a challenging one for reconciling ecosystem functions and human livelihoods. Agroecologists can use the tools of ecology to play an important role in overcoming that challenge.



Fig. 3. Students in ENERES 101 (Ecology and Society) visit the Student Organic Garden at Oxford Tract, UC Berkeley, in August 2019. Photograph credit: Amber Kerr.

Conclusion

Novel research methods, the integration of traditional/local and scientific knowledge, new knowledge-intensive technologies, and better on-farm management practices have the potential to improve agricultural production, reduce environmental impacts, increase yields, and increase accessibility to healthy food. However, the long-term sustainability and resilience of agroecosystems, and the services that they provide, depend a great deal on the human dimension. Public and stakeholder dialogue with researchers is key to addressing current and future challenges. As ESA enters its second century, the

Agroecology Section is making connections across diverse groups to align ecological principles with human needs.

Literature Cited

- Alkon, A. H., and T. M. Mares. 2012. Food sovereignty in US food movements: radical visions and neoliberal constraints. *Agriculture and Human Values* 29:347–359.
- Altieri, M. A. 2004. Linking ecologists and traditional farmers in the search for sustainable agriculture. *Frontiers in Ecology and the Environment* 2:35–42.
- Altieri, M. A. 2018. *Agroecology: The science of sustainable agriculture*. Second edition. CRC Press, Boca Raton, Florida, USA.
- Altieri, M. A., C. I. Nicholls, A. Henao, and M. A. Lana. 2015. Agroecology and the design of climate change-resilient farming systems. *Agronomy for Sustainable Development* 35:869–890.
- Altieri, M. A., C. I. Nicholls, and R. Montalba. 2017. Technological approaches to sustainable agriculture at a crossroads: An agroecological perspective. *Sustainability* 9:349.
- Badgley, C., J. Moghtader, E. Quintero, E. Zakem, M. J. Chappell, K. Avilés-Vázquez, A. Samulon, and I. Perfecto. 2007. Organic agriculture and the global food supply. *Renewable Agriculture and Food Systems* 22:86–108.
- Bensin, B. 1930. Possibilities for international co-operation in agroecological investigation. *International Review of Agriculture* 21:277–284.
- Bezner Kerr, R., S. Snapp, M. Chirwa, L. Shumba, and R. Msachi. 2007. Participatory research on legume diversification with Malawian smallholder farmers for improved human nutrition and soil fertility. *Experimental Agriculture* 43:437–453.
- Bommarco, R., D. Kleijn, and S. G. Potts. 2013. Ecological intensification: harnessing ecosystem services for food security. *Trends in Ecology & Evolution* 28:230–238.
- Chaudhury A., Colla S. 2020. Next steps in dismantling discrimination: Lessons from ecology and conservation science. *Conservation Letters*. <https://doi.org/10.1111/conl.12774>
- Clapp, J., and S.-L. Ruder. 2020. Precision technologies for agriculture: Digital farming, gene-edited crops, and the politics of sustainability. *Global Environmental Politics* 20:49–69.
- Clendenning, J., W. H. Dressler, and C. Richards. 2016. Food justice or food sovereignty? Understanding the rise of urban food movements in the USA. *Agriculture and Human Values* 33:165–177.
- Davis, S. C., R. M. Boddey, B. J. R. Alves, A. L. Cowie, B. H. George, S. M. Ogle, P. Smith, M. van Noordwijk, and M. T. van Wijk. 2013. Management swing potential for bioenergy crops. *GCB Bioenergy* 5:623–638.
- Davis, S. C., J. Simpson, K. D. C. Gil-Vega, N. A. Niechayev, E. V. Tongerlo, N. H. Castano, L. V. Dever, and A. Búrquez. 2019. Undervalued potential of crassulacean acid metabolism for current and future agricultural production. *Journal of Experimental Botany* 70:6521–6537.
- Farrington, J. 1989. Farmer participation in agricultural research. *Food Policy* 14:97–100.
- Foley, J. A., et al. 2011. Solutions for a cultivated planet. *Nature* 478:337–342.
- Francis, C., et al. 2003. Agroecology: The ecology of food systems. *Journal of Sustainable Agriculture* 22:99–118.
- Giraldo, O. F., and P. M. Rosset. 2018. Agroecology as a territory in dispute: between institutionalization and social movements. *Journal of Peasant Studies* 45:545–564.
- Haberl, H. 2015. Competition for land: A sociometabolic perspective. *Ecological Economics* 119:424–431.

- Holt-Giménez, E. 2006. *Campesino a Campesino: Voices from Latin America's Farmer to Farmer Movement for Sustainable Agriculture*. New York, NY: Food First Books.
- Holt-Giménez, E., and M. A. Altieri. 2013. Agroecology, food sovereignty, and the new green revolution. *Agroecology and Sustainable Food Systems* 37:90–102.
- Horst, M., and A. Marion. 2019. Racial, ethnic and gender inequities in farmland ownership and farming in the U.S. *Agriculture and Human Values* 36:1–16.
- Lotz, L. A., C. C. van de Wiel, and M. J. Smulders. 2020. Genetic engineering at the heart of agroecology. *Outlook on Agriculture* 49:21–28.
- Maurel, V. B., and C. Huyghe. 2017. Putting agricultural equipment and digital technologies at the cutting edge of agroecology. *OCL* 24:D307.
- Montenegro de Wit, M. 2019. Gene driving the farm: who decides, who owns, and who benefits? *Agroecology and Sustainable Food Systems* 43:1054–1074.
- Morandin, L. A., and C. Kremen. 2013. Hedgerow restoration promotes pollinator populations and exports native bees to adjacent fields. *Ecological Applications* 23:829–839.
- Poniso, L. C., L. K. M'Gonigle, K. C. Mace, J. Palomino, P. de Valpine, and C. Kremen. 2015. Diversification practices reduce organic to conventional yield gap. *Proceedings of the Royal Society B: Biological Sciences* 282:20141396.
- Pretty, J. 2008. Agricultural sustainability: concepts, principles and evidence. *Philosophical Transactions of the Royal Society B: Biological Sciences* 363:447–465.
- Pretty, J. N., A. D. Noble, D. Bossio, J. Dixon, R. E. Hine, F. W. T. Penning De Vries, and J. I. L. Morison. 2006. Resource-conserving agriculture increases yields in developing countries. *Environmental Science & Technology* 40:1114–1119.
- Rasmussen, L. V., B. Coolsaet, A. Martin, O. Mertz, U. Pascual, E. Corbera, N. Dawson, J. A. Fisher, P. Franks, and C. M. Ryan. 2018. Social-ecological outcomes of agricultural intensification. *Nature Sustainability* 1:275–282.
- Satterthwaite, D., G. McGranahan, and C. Tacoli. 2010. Urbanization and its implications for food and farming. *Philosophical Transactions of the Royal Society B: Biological Sciences* 365:2809–2820.
- Schneider, F., P. Fry, T. Ledermann, and S. Rist. 2009. Social learning processes in Swiss soil protection—The 'From Farmer - To Farmer' project. *Human Ecology* 37:475–489.
- Seufert, V., N. Ramankutty, and J. A. Foley. 2012. Comparing the yields of organic and conventional agriculture. *Nature* 485:229–232.
- Smith, J., B. D. Pearce, and M. S. Wolfe. 2013. Reconciling productivity with protection of the environment: Is temperate agroforestry the answer? *Renewable Agriculture and Food Systems* 28:80–92.
- Snapp, S. S., J. DeDecker, and A. S. Davis. 2019. Farmer participatory research advances sustainable agriculture: Lessons from Michigan and Malawi. *Agronomy Journal* 111:2681–2691.
- Snapp, S., G. Kanyama-Phiri, B. Kamanga, R. Gilbert, and K. Wellard. 2002. Farmer and researcher partnerships in Malawi: developing soil fertility technologies for the near-term and far-term. *Experimental Agriculture* 38:411–431.
- Tscharntke, T., et al. 2011. Multifunctional shade-tree management in tropical agroforestry landscapes – a review. *Journal of Applied Ecology* 48:619–629.
- Vandermeer, J., et al. 2018. Feeding prometheus: an interdisciplinary approach for solving the global food crisis. *Frontiers in Sustainable Food Systems* 2. <https://doi.org/10.3389/fsufs.2018.00039>
- Vandermeer, J., and I. Perfecto. 2013. Complex traditions: intersecting theoretical frameworks in agroecological research. *Agroecology and Sustainable Food Systems* 37:76–89.

- Warner, K. D. 2008. Agroecology as participatory science: emerging alternatives to technology transfer extension practice. *Science, Technology, & Human Values* 33:754–777.
- Wezel, A., S. Bellon, T. Doré, C. Francis, D. Vallod, and C. David. 2009. Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainable Development* 29:503–515.