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An industrial farm next to the rainforest in the Amazon. *Image by Sam Beebe (CC BY2.0).*

Biodiversity and Agriculture: Nature's Matrix and the Future of Conservation

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When we were children, a long auto trip would require a stop every hour or so to clean the windshield of the insects that had been intercepted. Today's windshields are spared this indignity—a convenience for motorists but a terrifying signpost of danger for the well-being of the planet and humanity. It would be difficult to exaggerate the current peril we face as we push forward into what is now understood as the beginning of a new mass extinction. Yet efforts to curb this potential catastrophe are hindered by limited understanding of the relevant sciences, both natural and social. And a keystone issue is agriculture, both as partial cause of the crisis, and potential contributor to its solution. This is understood technically, but restricted limits of debate continue to force a restricted set of proposed solutions.

To take an extreme example, E. O. Wilson, one of the world's best-known biologists, recently proposed that half of the Earth's surface should be put into protected status for the sole purpose of preserving biodiversity. While his proposal is unusually bold, the general idea of a vast expansion of protected areas is common among some conservationists in the United States and elsewhere. At present, something less than fifteen percent of planetary surface is in some kind of protected status, with various international agencies committed to expanding protected areas to seventeen percent. Implementation of what Wilson calls a "Half-Earth" strategy would require that more than three times as much land than at present be designated as "protected" areas for the primary purpose of biodiversity protection.¹

Wilson acknowledges that a Half-Earth approach would require an extreme intensification of agricultural production on land outside protected areas in order to provide enough food for human needs. He does little to contemplate what kind of intensification would be required. Neither does he acknowledge the impact conventional intensification would have on biodiversity. Since he relies on previous production gains under industrial agriculture as evidence of the possibility of greater gains using similar techniques, he apparently does not see any serious drawbacks to such techniques. Some conservationists who favor strategies similar to Wilson's, speak of agricultural land as "sacrifice zones," in which intensification, making liberal use of pesticides and synthetic fertilizers and other industrial style techniques, would necessarily reduce non-food organisms to a bare minimum, a "sacrifice" necessary for the pesky species *Homo sapiens*. Ironically, these conservationists' support for land-sparing converges with agribusiness' interests to increase industrial agricultural intensification. In the growing scientific literature, this perspective has come to be called "land-sparing," with the idea that agricultural intensification must be used to spare as much land as possible from human activity in order to leave the rest for the flourishing of non-human species.

In contrast to the land-sparing approach, others who are equally as interested in biodiversity conservation have proposed a "land-sharing" approach, in which it is argued that high food production and biodiversity conservation may be achieved most efficiently if pursued simultaneously in a planned fashion. This point of view is suspicious of what they call the "fortress" protection ideology, in which areas are designated to be free

of any human activity, assuming that in such areas all species initially there will survive in perpetuity. The land-sharing point of view is frequently characterized, perhaps incorrectly, as one in which the agricultural activity itself needs to be sufficiently benign for all the biodiversity in the area, such that purely protected areas are unnecessary.

Either-or Versus Both-and:

The land-sparers emphasize increasing agricultural production to minimize land-use devoted to agriculture. The land-sharers emphasize the need to have an agriculture that is favorable for the survival of species. The first sees the protected area as the only place where biodiversity is conserved; the second sees a benign form of agriculture that itself contains the whole of the biodiversity. In the second edition of our book, *Nature's Matrix*, we argue that both sides of this debate are wrong.

Most of Earth's terrestrial surface contains patches of natural, unmanaged, vegetation. The "landscape" is, by definition, those patches plus the "matrix" in which they are located. A simplified summary suggests that for one side, the only thing that matters are the patches of natural vegetation (and thus they need to be protected), while for the other side the only thing that matters is a matrix that is conducive to the survival of species. Both sides are wrong. Very basic ecology acknowledges that local extinctions of species occur regularly, even in the most protected of areas. *Local* extinctions are, in fact, a normal part of nature. What determines ultimate survival is whether the matrix of the landscape allows for migration and/or reproduction. Protected areas are very seldom large enough to provide conditions for the

survival of most species. If species do not move freely through that matrix, then local extinctions can balloon into regional, and even global, extinctions. Thus, the ability for organisms to migrate and reproduce in agricultural areas is critical. The survival of a species in even the most protected areas will be otherwise undermined by surrounding industrial agricultural "sacrifice zones."

What we propose in our second edition of *Nature's Matrix* is not a strictly "land sharing" approach, since we recognize the need for maintaining protected areas. However, we also recognize that the goal of producing enough food to satisfy human nutritional demand does not require the conversion of those protected areas to agriculture, no matter how biodiversity friendly. We agree with Kremen's recent analysis of the debate, noting that instead of an either-or approach, we need a "both-and" approach that "favors both large, protected regions and favorable surrounding matrices."²

We further argue that a matrix favorable to biodiversity can only be achieved by an alliance of diverse social movements and organizations.

Promoting the Nature's Matrix Approach

In the United States and other industrialized nations, there are a variety of organizations that implicitly or explicitly favor this "nature's matrix" perspective, including most environmental organizations. Among the most important are land trust organizations that sign contracts with land owners to create or maintain agriculture that is supportive of relatively high species diversity. Organizations bringing together practitioners and

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researchers of low input or organic agriculture, agroecology, rotational grazing, and production of perennial crops all usually favor species friendly production techniques. In Europe, and to a lesser degree in the United States, governments offer cash payments or other reimbursements to farmers who adopt production plans that directly and indirectly favor wildlife.³ These initiatives are complemented in many urban areas by planning for parks, parkways, and greenbelts that offer wildlife-friendly areas within urban boundaries, and in the best of circumstances, connect urban landscapes directly to biodiversity friendly agriculture.

In the biodiverse tropics, support for high quality matrices include organizations of those who are already practicing biodiversity-friendly agriculture, such as those cultivating shade grown coffee and cacao. These organizations are supported by trade certification schemes for “shade grown” and “bird friendly” products. In Asia, there are smallholder rice systems which support high biodiversity, and organizations which support them. Frequently these organizations include land reform movements, organizations of producers within designated extractive reserves, indigenous peoples, and fam-

ily farm confederations, most of which have officially adopted policies promoting agroecological farming techniques that tend to create high-quality, biodiversity-friendly matrices. The organization *La Via Campesina*, an international alliance of peasant and small-scale agricultural producers, promotes such approaches. There is a general recognition among such organizations that, for a variety of reasons, their members have often practiced agriculture that tends to destroy or degrade species-rich environments, but that understanding strengthens their resolve to support positive change that, they believe, will tend to support more successful, small-scale agricultural production as well as biodiverse landscapes. As in industrialized countries, a substantial portion of the environmental movement in the global south supports policies promoting agroecological approaches to agriculture that promote complex landscapes friendly to high levels of biodiversity.⁴

The Search for Empirical Validation

Empirical study of the two strategies has been less than convincing, due to limitations in both time and space. How long a time period is appropriate? Useful studies must begin with actually occurring landscapes, landscapes in which an intricate dance involving agriculture and species survival has a long history. Counting insect splats on our windshield over the average period of five years will not likely lead us to the same conclusions as 50 year personal observations. Indeed, there is virtually uniform acknowledgment from the community of scientific ecologists that local extinctions are extensive, leading some to refer to the “extinction debt” of particular landscape patterns. This

reality means that we have little idea of when the dance might be declared over, making it exceedingly difficult to set empirically appropriate beginnings and ends to studies. We may be able to measure population density at a given point in time, but knowing whether any given population is decreasing its numbers to near extinction is a difficult empirical problem.⁵

Similarly, if two such landscape level approaches are to be compared, where does one draw the boundary between one approach and the other? Most actually occurring landscapes seem to be a blend of the two strategies in ways that make it very difficult to compare because only an arbitrary spatial boundary can be determined, and yet, if none is determined, what should be measured? In addition, very few advocates of either position insist on a simple either/or dichotomy and are compelled to recognize that all regional landscapes are some kind of a mix. In contrast to Wilson's sharply arbitrary “half-earth” suggestion, most involved in the debate on both sides understand that it is a matter of emphasis rather than a question of choosing between polar opposites. Not surprisingly, a proliferation of carefully designed studies meant to compare sparing and sharing approaches have led to conclusions that add detail to understanding the problem but that fall far short of demonstrating the superiority of one approach over the other.

In spite of a very measured and reasonable effort by Kremen in 2015 to put an end to an increasingly polarized debate, Wilson and others continue efforts to sharpen the idea of an “either-or” approach by vastly increasing the territorial ambitions of the land-



New Coffee Plants at a Rainforest Alliance Certified Coffee Farm in Guatemala. Photo courtesy of USAID Biodiversity and Rainforestry (CC BY-NC 2.0).

sparing advocates while avoiding critical discussion of the damaging effects of industrial agriculture. And the growing attempt to study the problem empirically may confuse rather than enlighten. Despite a significant amount of research, convincing empirical evidence establishing one approach over the other is not to be found. There are a number of reasons for this lack of resolution, reasons that are fundamental to the nature of the problem and unlikely to be resolved.

For those of us who argue for a landscape approach, where both natural vegetation patches and a high quality matrix comprise the

landscape, the essential problem with the land-sparing perspective can be summarized in two related points: first, land-sparing strategies assume that protected areas are far more protective of biodiversity than is the case; and, second, the strategies assume that the negative effect of industrial agriculture on biodiversity is minimal and can remain so even under measures to intensify production. Both of these assumptions rest on an idea of control over nature that is illusory. The insects flying out of a reserve understand little of the poison that awaits them in the neighboring soybean landscape. This false sense of control over both human life and ecological processes derives at



Landscapes of Halimun Salak National Park.
Photo courtesy of Center for International Forestry Research (CC BY-NC-ND 2.0).

least partially from a particular way of thinking shaped by a particular moment in political time and space, and is not likely to serve either humanity or biodiversity well.

Endnotes

¹ Wilson, Edward O. *Half Earth: Our Planet's Fight for Life*. (Liveright: 2016)

² Kremen, Claire. "Reframing the Land-Sparing/Land-Sharing Debate for Biodiversity Conservation." *Annals of the New York Academy of Sciences*, vol. 1355, no. 1, 27 July 2015, pp. 52–76, 10.1111/nyas.12845. Accessed 13 Dec. 2018.

³ Perfecto, Ivette, John Vandermeer, Angus Wright. *Nature's Matrix: Linking Agriculture, Conservation, and Food Sovereignty*, 2nd ed. (Earthscan: 2019) originally published 2009.

⁴ Ibid

⁵ For a quick summary featuring major players, see, Fred Pearce, "Sparing vs Sharing: The Great Debate Over How to Protect Nature." *YaleEnvironment360*, Dec. 3, 2018.

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