# Digging Into Sustainable Agriculture

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As one would expect, large scale agriculture today looks vastly different than even just a century ago, with technology and innovation driving the industry forward in an effort to maximize food production. Notably, however, agriculture and food production still rely on the same thing they always have: natural resources, which are in a steady decline across the globe largely due to climate change.[1] In her research and work, Cornell University's Dr. Alison Power champions the notion that an increased focus on preserving ecosystem services is absolutely essential to the future of sustainable and resilient agricultural practice in the effort to feed humanity for the next century and beyond. According to the Institute for the Study of International Development, ecosystem services are "the benefits that humans get from nature,"[2] which includes but is not limited to pollination by wild bees, timber and wood harvested from forests, environmental disease and pest regulation, nutrient cycling via decomposition and resulting soil fertility, and more.[3] In recent years, the main focus in agriculture has been on increasing productivity and thus ameliorating food insecurity by simply producing more food. This strategy, however, has a major fault as it fails to account for the huge dependency of these agroecosystems on the ecosystem services provided by nature.[4] Moreover, agroecosystems can result in both ecosystem services and disservices depending

Figure 1 (Above): Cover crops reduce agricultural impacts on climate change. (Source: "Cover cropping at Granton Vineyard (fava beans)" by Stefano Lubiana Wines is marked with CC BY 2.0.)

upon the specifics of their operation.[5] In order for truly sustainable agriculture to come to fruition, focus must shift towards practices that preserve and contribute positively to ecosystem services.

## *Agricultural Impacts on Climate Change*

Importantly, the ecosystem disservices brought about by agriculture both contribute to and are exacerbated by global climate change. Currently, a lack of resilient food production systems has resulted in highly sensitive agricultural practices which are not able to quickly bounce back from the hindrances brought about by climate change. These deficiencies include declining soil nutrients, ocean acidification, and loss of biodiversity and its resultant lack of pest resistance, which ultimately decrease agricultural productivity and thus reduce crop yields.[6] This ultimately has the potential to cause food insecurity for future generations, especially in developing countries, should climate change and a lack of resilient food production proceed. While fighting climate change is a battle of its own, the focus of many agronomists and biologists such as Dr. Power has been to reduce agriculture's contribution to the depletion of natural ecosystem services. Dr. Power has investigated several ways in which food production is harmful to the environment, particularly pertaining to nitrogen pollution of waterways, greenhouse gas emission, and loss of biodiversity.[7]

While the lack of resilient food production in agroecosystems harms the environment and exacerbates climate change in numerous ways as Dr. Power has investigated at length, I would like to focus on the impacts that are closest to home here at Purdue University. The main way that agroecosystems, particularly clonal crops, directly harm the global environment is through the introduction of extreme amounts of nitrogen to waterways through runoff of nitrogen-based fertilizers. In fact, approximately 20 percent of all nitrogen fertilizers used for farming end up in waterways, which ultimately results in widespread algae-induced hypoxia and dead zones in rivers and oceans.[8] A perfect example of this type of environmental harm is the Wabash River, which runs along Purdue's campus. A Notre Dame study has reported that the Wabash River watershed (pictured in Fig.2) contributes approximately 11 percent of the total nitrogen pollution causing a 6,000 square mile dead zone in the Gulf of Mexico,[9] which has implications for marine wildlife and the ecosystem services it provides.

Figure 2: The Wabash River watershed collects runoff from Indiana farmland that is polluted with nitrogen fertilizers. (Source: "Wabash River, Indiana" by Ken Lund is marked with CC BY-SA 2.0.)

## *Steps Towards Sustainable Agriculture*

Looking to the future, Dr. Power recommends a transition to more sustainable and resilient agricultural practices to reduce nitrogen pollution such as cover cropping (Fig.1) to help eliminate standing nitrate on farmlands as well as increasing the variety of nutrients provided to crops.[10] During her visit to Purdue in spring 2022, Dr. Power discussed her work in Ethiopia studying the agricultural practices of local farmers and working alongside Ethiopian agronomists to maintain the rich biodiversity of legume crops boasted by the country's many regions. The intercropping and cover cropping utilized by local communities serves as a proof of concept for their efficacy in maintaining biodiversity and reducing nitrogen pollution, thus ameliorating the contribution of agriculture to climate change. During her talk, Dr. Power remarked that these practices, in conjunction with reduced usage of nitrogen-based fertilizers in favor of green manures, can help decrease the volume of nitrogen runoff resulting from agriculture.[11] If adopted in Indiana alone,

changes like these would have major impacts on the health of the Wabash River and the Gulf of Mexico, as well as any parties who rely on the ecosystem services they provide. Ultimately, prioritizing increased biodiversity through cover cropping and intercropping on a global agricultural scale is one very promising way to decrease the pollution of our waterways and work towards a healthier planet and more sustainable food production.

## *Notes*


1. Josée Méthot, "Managing Food Security for Resilience: The Role of Ecosystem Services," *Research to Practice Policy Briefs*, Policy Brief no.12, Institute for the Study of International Development, 6.
2. Méthot, 3.
3. Méthot, 29-30.
4. John Ingram, "A food systems approach to researching food security and its interactions with global environmental change," *Food Security* 3 (2011): 418.
5. Alison G. Power, "Ecosystem services and agriculture: tradeoffs and synergies," *Philosophical Transactions of the Royal Society B Biological Sciences* 365 (2010): 2964, 10.1098/rstb.2010.0143
6. Méthot, 8.
7. Power, 2959
8. Power, 2965
9. University of Notre Dame, "Work Ongoing to Improve Water Quality in the Wabash River," Environmental Change Initiative, Notre Dame Research, September 19, 2014, accessed March 9, 2022, https://environmentalchange.nd.edu/news-events/news/work-ongoing-to-improve-water-quality-in-the-wabash-river/
10. Power, 2965
11. Alison G. Power, "Global Crop Diversity in Farming Communities," HONR 29900: Visiting Scholars Seminar, Visiting Scholars Series Keynote Lecture and Q&A, Purdue University Honors College, February 28, 2022.