Promoting Ecosystem Services by Implementing Agroforestry

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Recent literature in the interdisciplinary field of food security has emphasized the need for ecosystem services to preserve food security. Ecosystem services represent the benefits that natural spaces provide to society. [1] These are increasingly important as the growing population of the world and the progression of climate change pose new challenges for food security. As a result, both policymakers and individuals must make tradeoffs between maintaining ecosystem services for the future and gathering more resources to maintain immediate wellbeing. Reaching a sustainable future will require finding a middle ground between these objectives.

Analyzing Food Security

Considering the various factors impacting food security, authors in this field have proposed frameworks to analyze food security issues. Ideally, these approaches can lead to more balanced outcomes, which both promote short-term food security while also conserving ecosystem services for the future. Specifically, University of Southampton professor Guy Poppy notes that this approach is particularly relevant to understanding "agro-ecosystems," which include both managed and natural features. [2] To illustrate the value of this novel framework, this article will provide an example of applying these principles by discussing a specific practice, agroforestry, that aims to preserve the ecosystem services of agricultural land, a goal necessary for long-term food security.

Defining Agroforestry

One recent proposal to enhance the ecosystem services present in agricultural land is agroforestry. A 2017 report from the US Department of Agriculture defines agroforestry as "a unique extensive action involving the integration of woody plants with crop and livestock components." [3] For example, agricultural fields and pastures that would otherwise be a monoculture can be interspersed with trees, as seen in figure 1.

Figure 1: An agroforestry planting in Australia. The tree lines correspond to the slope of the landscape.
Source: Pixture2016, Agroforestry contour planting, January 2, 2017, JPG image, Australia, https://commons.wikimedia.org/wiki/File:Agroforestry_contour_planting.jpg.

Ecosystem Services

Implementing agroforestry would entail various benefits and drawbacks, which can be analyzed through the ecosystem services framework. Agroforestry would provide direct benefits to crops. For example, trees would provide shade that would help reduce the effects of extreme heat as well as providing shelter against damage from high winds. [4] Developing resilience against adverse weather is particularly valuable, since global environmental change has been found to threaten crop yields. [5] Further, the ecosystem services framework explains the value of certain indirect benefits provided by agroforestry. Wooded areas provide ecosystem services that enhance agriculture, including habitats for beneficial wildlife, such as pollinators. [6]

Addressing Tradeoffs

However, the ecosystem services model also notes that food security decisions involve drawbacks as well. Converting conventional fields to the agroforestry model would require an initial investment of money and labor. This could discourage farmers from adopting agroforestry. As suggested by figure 2, the problem could be addressed by incentivizing techniques that promote sustainability. Specifically, the upfront costs could be offset by subsidies provided by the population that benefits from the ecosystem services. A further concern is that including tree lines within fields would reduce the acreage available for planting crops. This could spur the expansion of agriculture into previously natural areas, damaging biodiversity and reducing the availability of ecosystem services. Consistent with the ecosystem services model, different uses of land entail tradeoffs between short-term and long-term interests. [7]

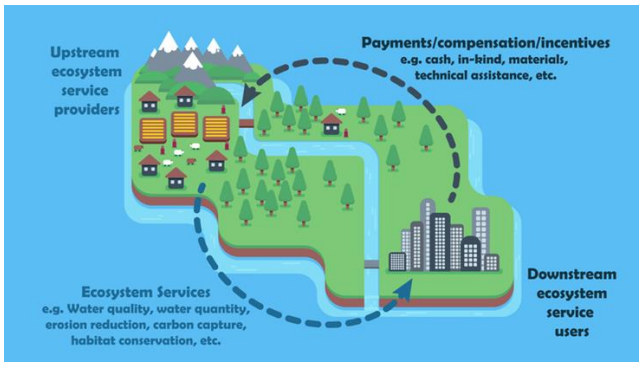

Figure 2: An illustration of the contributions of ecosystem services to the public and the need for investments to maintain those ecosystem services.
Source: Bosco Lliso, Payments for Ecosystem Services (PES), 26 March 2021, PNG image, https://commons.wikimedia.org/wiki/File:Payments_for_Ecosystem_Services_(PES).png

Agroforestry for Resilience

Agroforestry provides various ecosystem services that benefit agriculture. These considerations provide an example of the utility of this modern model of food security. This concept asserts that food security is not a matter of maximizing productivity in the short run. Instead, innovative techniques, potentially including agroforestry, will be required to promote food security into the future, despite the adverse effects of global environmental change. Environmental scientist Josée Méthot notes that "ecosystem services are key building blocks of ecological resilience, and that our ability to support stable food security in the long-term hinges on agricultural systems that provide multiple ecosystem services." [8] In line with this proposition, agroforestry provides various ecosystems services, including shelter for crops and habitat for pollinators. In conclusion, examining agroforestry through the lens of ecosystem services reveals the potential for this practice to promote long-term food security.

Notes

[1] Josée Méthot, "Managing Food Security for Resilience: The Role of Ecosystem Services," Institute for the Study of International Development, 3, accessed 4 March 2022, https://www.mcgill.ca/isid/files/isid/methot.pb12.pdf.

[2] Guy M Poppy et al., "Food security in a perfect storm: using the ecosystem services framework to increase understanding," *Philosophical Transactions: Biological Sciences* 369, no. 1639 (April 2014): 6, https://doi.org/10.1098/rstb.2012.0288.

[3] Patel-Weynand, Toral, Gary Bentrup, and Michele M. Schoeneberger. *Agroforestry: Enhancing Resiliency in U.S. Agricultural Landscapes Under Changing Conditions*. Washington, DC: U.S. Department of Agriculture, Forest Service, 2017, https://doi.org/10.2737/WO-GTR-96.

[4] Schoeneberger, 10.

[5] John Ingram, "A food systems approach to researching food security and its interactions with global environmental change," *Food Security* 3, no. 4 (2011): 422, https://doi.org/10.1007/s12571-011-0149-9.

[6] Poppy, 3.

[7] Poppy, 4.

[8] Méthot, 12