AGROFORESTRY

WHAT IS AGROFORESTRY?

Agroforestry mixes trees with other agricultural land-use, such as fields crops and livestock. Besides providing numerous benefits to farmers and their communities, agroforestry can remove carbon dioxide (CO_2) from the atmosphere as trees capture and store carbon themselves and increase soil carbon around them. Agroforestry comes in many varieties. Examples include **wood pasture** or **silvopasture**, in which animals graze under tree cover; **intercropping** and **alley cropping**, in which other crops are planted under or between trees; **hedgerows** and **windbreaks**, in which rows of trees or woody shrubs divide plots of agricultural land; and **grazed orchards**, in which animals graze under fruit-bearing trees.

CO-BENEFITS AND CONCERNS

+ **Food security:** rather than competing with cropland, agroforestry co-exists with food production; it also diversifies crop production and, in some cases, increases yields (e.g., by enhancing soil quality or shading crops).
+ **Commercial products:** agroforestry can diversify income sources for farmers by providing commercial products, such as timber or shade-grown coffee, and non-commercial resources, such as fuelwood.
+ **Environmental benefits:** trees and shrubs can promote biodiversity by providing habitat; reduce erosion; and improve air, water, and soil quality.

— **Reduced yields:** in some cases, agroforestry systems will yield less output per hectare than field crops, potentially reducing farm income, especially in the short term.

— **Saturation:** trees can only hold a finite amount of carbon; they will eventually cease removing additional CO_2.

— **Reversibility:** carbon captured in trees can be released if the trees burn, die, or are destroyed by land-use changes.

— **Difficulty of measurement:** monitoring and verifying carbon removal via agroforestry is difficult and costly.

POTENTIAL SCALE AND COSTS

Different approaches to agroforestry could be deployed at different scales and capture CO_2 at different rates. For instance, planting wind breaks could sequester 20 tons of CO_2 per square kilometer per year, whereas alley cropping could sequester 120 tons of CO_2 per square kilometer per year. Rates of carbon capture also differ across regions, with rates ranging from 954 tons of CO_2 per square kilometer per year in semiarid areas to 3,670 tons of CO_2 per square kilometer per year in humid tropical regions. The Intergovernmental Panel on Climate Change estimates the **global potential for carbon removal via agroforestry at 0.1–5.7 billion tons of CO_2 ($GtCO_2$) per year.** Costs also vary across practices and regions. Many approaches **offer very high returns on investment, but may involve high up-front costs.**

AGROFORESTRY

TECHNOLOGICAL READINESS

Agroforestry is an ancient, well-established practice that is ready for further expansion. While farmers around the world have used agroforestry practices for thousands of years, many countries incorporated it into their national agricultural and forestry agendas in the 1980s and 1990s. As of 2010, agroforestry occupied roughly 43% of global agricultural land, counting any agricultural land with at least 10% tree cover. This amounts to about one billion hectares of land—equivalent to the land area of Canada. **Current barriers to expansion of agroforestry tend to be social, financial, and infrastructural rather than technical:** a lack of financing and technical assistance, inadequate supply chains in parts of the world, and uncertain land tenure all deter adoption by farmers, especially on smaller farms.

GOVERNANCE CONSIDERATIONS

- □ **Overcoming barriers to adoption:** reliable incentives, agricultural extension services, financing, input subsidies, and other policies would help overcome the social and financial obstacles that deter farmers from adopting agroforestry practices.
- □ **Monitoring, reporting, and verification:** processes, standards, and technologies need to be developed to reliably measure carbon sequestration.
- □ **Integration of indigenous knowledge:** tapping indigenous and local knowledge can promote practices that are best suited to local conditions.
- □ For **cross-cutting considerations**, see the What Is Carbon Removal? fact sheet on our web site.

FURTHER READING

Robert J. Zommer et al., "Global Tree Cover and Biomass Carbon on Agricultural Land: The Contribution of Agroforestry to Global and National Carbon Budgets," *Scientific Reports* 6 (2016): 29987, doi 10.1038/srep29987

Dong-Gill Kim et al., "Carbon Sequestration and Net Emissions of CH_4 and N_2O under Agroforestry: Synthesizing Available Data and Suggestions for Future Studies," *Agriculture, Ecosystems & Environment* 226 (2016): 65–78, doi 10.1016/j.agee.2016.06.011

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