Indicator 6.27:

Revenue from forest-based environmental services

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What is the indicator and why is it important?

Revenue from forest-based environmental services tracks the actual payments to private forest landowners[1] for the environmental services they provide. These payments represent financial incentives for landowners to maintain or increase forest cover, or change management techniques in ways that enhance environmental services. Tracking the actual payments to landowners is essential for designing effective policies for environmental service production, improving forest policy and management decision-making, and for assessing the overall contribution of forests to economies and well-being.

What does the indicator show?

The revenues reported here include direct payments to private landowners such as cost-sharing, rentals, offset and mitigation trading, leases and entrance fees, and easements.[2,3] This indicator is a measure of the amount of revenue private forest landowners actually receive, rather than a measure of underlying environmental service values. Many environmental services have missing or underdeveloped markets or payment mechanisms. Furthermore, payments that do occur are often disconnected from any meaningful measure of supply or societal demand for environmental services. As a result, the revenues reported here should not be confused with the economic value forests provide to society. Also excluded from this analysis are direct expenditures by local, State and Federal agencies to manage public forests for various environmental services.

All dollar values were adjusted for inflation[4] and are reported in constant 2015 dollars, including transactions in all 50 States, but not the U.S. territories or District of Columbia. The payments were classified into four broad groups by the environmental service supported: carbon, water, biodiversity, and bundled services, the latter of which represents payments for a suite of forest-based services or for which no specific service is designated. We further categorized these payments into three transaction mechanisms:

• **Public Payments:** These include payments from Federal, State, and local government agencies to private landowners for the purpose of producing or enhancing environmental services.[5]

• **Compliance Transactions:** These include the payment within market mechanisms developed in response to government regulation, such as the sales of forest carbon offset credits under cap-and-trade programs, water quality trading, and mitigation and conservation banking.

[1]Private landowners include individuals, corporations, and nongovernmental organizations. Payers can be government agencies (Federal, State, and local), nongovernmental organizations, or private individuals and corporations.

[2]This report utilized the most comprehensive, reliable, and publicly available governmental and nongovernmental sources of data. In some cases, it was necessary to estimate payment values where data were missing for specific years or States.

[3]In-kind benefits such as technical assistance were not included as no funds change hands.

[4]Using the GDP Implicit Price Deflator for the United States.

[5]Where possible, we identify forest-related practice or treatment codes for government funding programs. Where not possible to separate practices/treatments, we allocate payments based on the proportion of forest to total rural land in the State. This is narrowed by land cover type where appropriate, for example, when a program focuses on wetlands but specific payments do not specify forested versus non-forested wetlands, we multiplied the total payments by the area of forested wetland area in the State and then divided by total wetland area in the State.

• **Voluntary Transactions:** These include the sales in the voluntary carbon market, leases and entrance fees for hunting and wildlife viewing, and the purchase of conservation easements by nongovernment organizations.

Revenues from forest-based environmental services to U.S. landowners from all transaction types for which data are available were estimated to be $3.6 billion in 2019, with public payments accounting for $503 million (14 percent); compliance transactions providing $1,231 million (34 percent); and voluntary transactions providing $1,899 million (52 percent).

Table 27-1 presents the annual average revenues for the 10-year period 2010–2019. For this period, average annual revenues for forest landowners averaged $3.3 billion including public payments of $605 million (18 percent), compliance transactions of $1,077 million (32 percent), and voluntary transactions of $1,667 million (50 percent). Most public payments in 2010–2019 were for bundled services, $553 million per year (91 percent of public payments); followed by biodiversity, which was $51 million per year (8 percent) (table 27-1). Bundled services payments include cost-sharing and rental payments from well-known programs such as the Conservation Reserve Program (CRP) and the Environmental Quality Incentives Program (EQIP). Carbon- and water-specific payments were only a minor portion of public payments, although those services can be included in bundled services. Governments also provide financial incentives for environmental services through provisions in the tax code, which is not included in this estimate (see box 1).

Most compliance transactions in 2010–2019 were for the sales of watershed protection credits of $889 million per year (83 percent of compliance transactions), followed by carbon offset credits of $170 million per year (21 percent) (table 27-1). Water compliance transactions include trading wetland and stream mitigation banking credits to meet requirements under the U.S. Clean Water Act, as well as other State-level programs. Carbon compliance transactions are related to California's carbon cap-and-trade program.

Most voluntary transactions in 2010–2019 were for biodiversity, which was an estimated $1,463 million per year (88 percent of voluntary transactions). The primary form of voluntary biodiversity transactions is in the form of hunting leases and private entrance fees ($1,332 million per year, or 80 percent of voluntary transactions). Private conservation easements were considered part of the "bundled services" category and accounted for 199 million per year (12 percent) (table 27-1).

Table 27-1—Average annual revenues from environmental services, by service class and transaction mechanism category for 2010–2019 (in millions of constant 2015 dollars).

Transaction mechanism category	Environmental service class				
	Carbon	Water	Biodiversity	Bundled services	TOTAL
Public	0.0	0.5	51.2	553.3	**605.1**
Compliance	170.5	888.6	15.6	2.0	**1,076.7**
Voluntary	5.3	0.0	1,462.6	199.0	**1,666.9**
TOTAL	**175.8**	**889.1**	**1,529.4**	**754.3**	**3,348.6**

Box 1. State property tax incentives for promoting environmental services

Kilgore et al. (2017) reported that all 50 States have some type of preferential property tax programs, which are justified by environmental services from forests. These programs offer a financial incentive to private forest owners in the form of reduced taxes. The authors estimated the magnitude of property tax reductions nationwide in 2014 at $1.61 billion, an average of $7.68 per enrolled acre per year. The average incentives by State for enrolled forestlands ranged from $0.59 per enrolled acre in Colorado to $60.28 per enrolled acre in neighboring Kansas. The total incentives by State ranged from $148,000 in Colorado to $352 million in Mississippi, with an average total tax reduction of nearly $35 million per State. These programs enrolled almost 210 million acres of land nationwide. Enrollments range from 33,000 acres in Delaware to nearly 36 million acres in Alaska, with an average State enrollment of nearly 420,000 acres.

What has changed since 2010?

The previous report on this indicator estimated revenue from forest-based environmental services totaling approximately $2.1 to 2.3 billion per year (after converting to constant 2015 dollars) during the period 2005–2007. By contrast, we estimate values ranging from $2.3 to $4.2 billion per year (constant 2015 dollars), with an average of $3.3 billion, for the period 2010–2019. The peak of $4.2 billion was reached in 2016, thereafter declining to $3.6 billion in 2019.

Figure 27-1 shows the trends of revenues over the period 2010–2019, by environmental service class. Revenues from carbon and biodiversity services both increased over the period, with carbon revenues peaking at $724 million in 2018 and biodiversity increasing steadily up to an estimated $1,785 million in 2019. The increase in carbon revenues has been driven primarily by the implementation of forest carbon offsets in California's carbon cap-and-trade program, the first of which were issued in 2013. The increase in biodiversity revenues is mostly due to a steadily growing voluntary market for leases and entrance fees to hunt and view wildlife on private land. Indeed, revenues from the right to hunt account for the single largest type of forest-based environmental service payments in the United States. Revenues from water services, which include wetland mitigation, stream mitigation, and water quality trading, peaked in 2016 at about $1,461 million. Revenues from bundled services decreased over the period, from a high of $933 million in 2011 to $649 million in 2019. The declines in bundled service revenues largely reflect lower funding (in inflation-adjusted terms) for public payment programs, as well as variability in purchases of new conservation easements.

Figure 27-2 shows trends by transaction mechanism category from 2010 to 2019. Public payments declined in real terms from $673 million in 2011 to $503 million in 2019. On the other hand, compliance transactions increased from $356 million in 2010 to $1,231 million in 2019, peaking in 2016 at a value of $1,591 million. The major contribution of the rise during 2010 to 2017 was from growing markets for wetland mitigation banking and carbon offset trading; however, there was substantial year-to-year variability. Voluntary transactions increased from $1,249 million in 2010 to $1,899 million in 2019.

Are there important regional differences?

Revenues from forest-based environmental services vary significantly by State. The mean annual revenue per State over the period 2010–2019 was $66 million per year, with a median of $53 million per year. The States receiving the

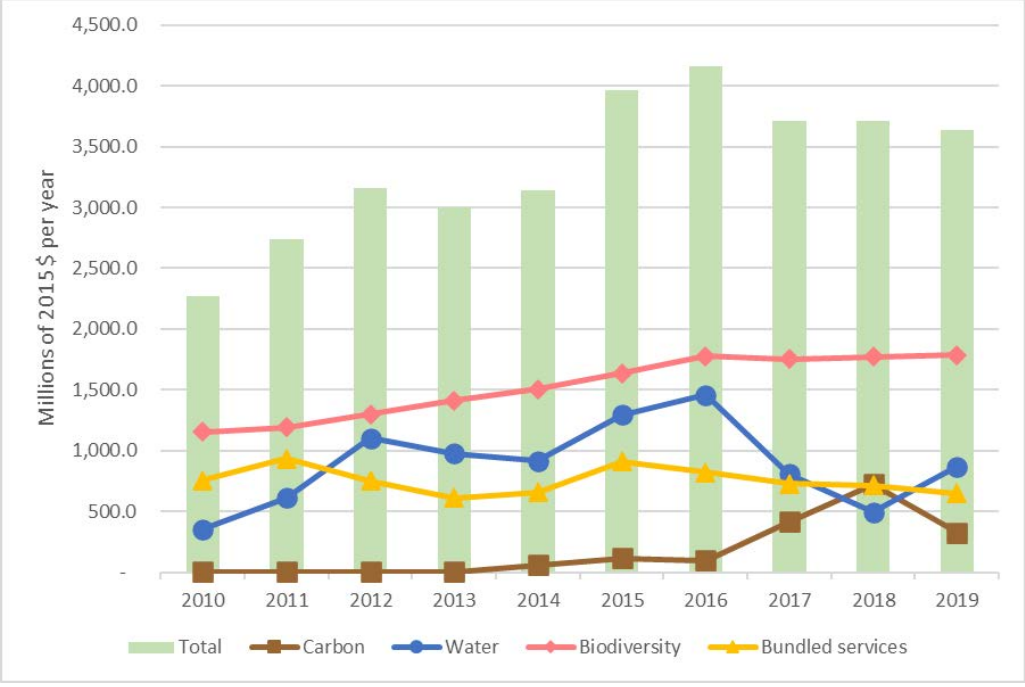

Figure 27-1—Total revenues by environmental service class (millions of constant 2015 dollars).

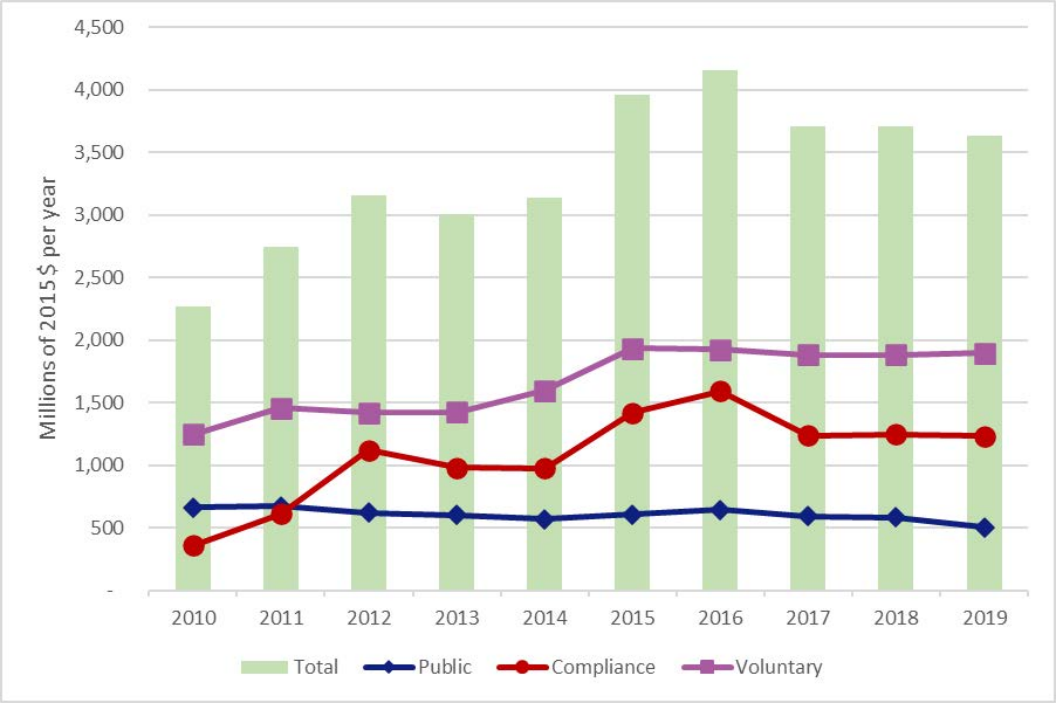

Figure 27-2—Total transactions by transaction mechanism (millions of constant 2015 dollars).

lowest total revenues were Nevada ($2 million per year), Wyoming ($6 million per year), and Delaware ($7 million per year). The highest total revenues occurred in Florida ($519 million per year), Louisiana ($187 million per year), and New York ($156 million per year).

Much of the variation in total revenues per State can be explained by the total land area, proportion of forest cover, and land ownership patterns (public vs. private) in each State. To account for these patterns, we divided total revenues by the private forest land area[6] in each State. Figure 27-3 shows the total environmental service revenues per acre of private forest land for each State. Average revenues received from all sources across the United States was $7.16 per acre of private forest land per year. When comparing across States, private forests in the median State received an average of $7.41 per acre per year. These revenues were lowest in New Mexico ($0.62 per acre per year), followed by Alaska ($0.74 per acre per year) and Texas ($1.48 per acre per year). The States with the highest revenues per acre of private forest land were Florida ($48.29 per acre per year), Rhode Island ($39.83 per acre per year), North Dakota ($34.22 per acre per year), and New Jersey ($29.26 per acre per year).

Strong regional spatial trends are difficult to discern. There is an indication of higher revenues per acre in the "Acela corridor"[7] East Coast States, as well as in a few North-Central and Southeastern States. Lower revenues appear in several States in the South-Central, Rocky Mountain, and Pacific Northwest regions, as well as the more rural Northeastern States. The underlying reasons for these differences are not fully clear, and merit future exploration and research. Many (but not all) of the high-revenue States have small area of private forest, and some have high land values for competing land uses, while the converse is true in some of the low-revenue States.

Why can't the entire indicator be reported at this time?

Our data collection was based on finding data sources for the main known programs. Unfortunately, there is no single database on revenues from environmental services for private forest owners, so piecing together information from numerous sources is challenging. Lack of available data

[6]Private forest land area by State from USDA Forest Service (2021).

[7]"Acela corridor" refers to a high-speed train line between the major eastern U.S. cities of Washington, Philadelphia, New York, and Boston. The region is highly urbanized.

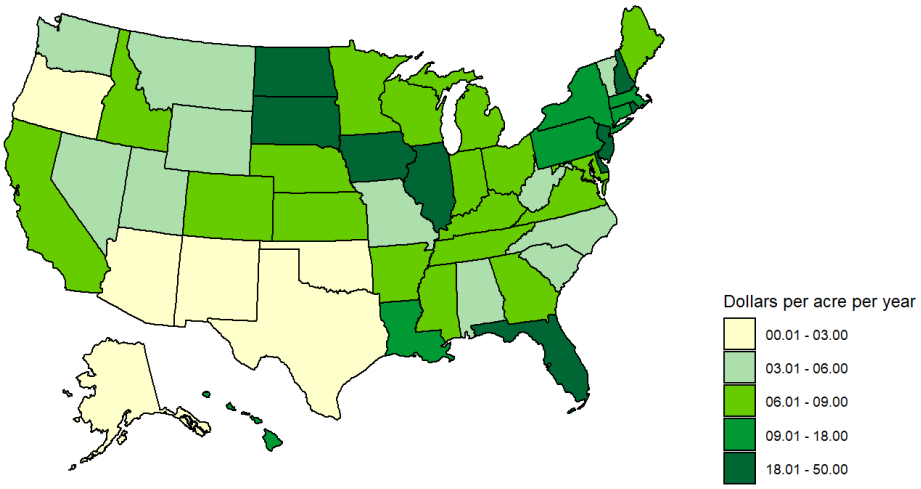

Figure 27-3—Average annual revenues per acre of private forest land, for the period 2010–2019 (constant 2015 dollars).

limits the possibility of providing a complete accounting. Therefore, these results can be considered a lower bound. Also, additional categories such as tax incentives, price premium paid by consumers for sustainable harvested timber and wood products, and incentive payments by forest industry or forest professional associations could not be included in the analysis.

This report includes public payment programs from federal agencies and from State agencies in 24 States. Smaller federal programs and initiatives from other States or local governments, nonprofits, etc., are not all included because of the sheer number of possible contacts and the difficulty of identifying programs and data sources.

Even though we utilized the most comprehensive datasets available, some data are based on surveys or are not frequently updated. Furthermore, acquisition of certain survey data sources was limited by confidentiality concerns, particularly in cases where the number of transactions was small. In cases where data were incomplete for certain programs or transaction types in certain years, we have used interpolation or averaging of values by State or States to estimate revenues in those years.

Tribal forests are 2 percent of the forest area of the United States (Oswalt et al. 2019), but do not fit clearly into the paradigm of private and public forests. Tribal forests may qualify for certain environmental service programs but not for others, or it may depend on the exact legal ownership/tenure status. We were unable to determine the extent of tribal participation in environmental service payment programs.

Data Sources

Data sources and the full data set used in this report are provided in Frey et al. (2021). Sources include:

- Administrative data on public payments from relevant government agencies.

- Carbon offset credits:
  - o American Carbon Registry (ACR). Retired Credits Report, 2020. americancarbonregistry.org.
  - o Climate Action Reserve (CAR). Voluntary Offset Project Registry, 2020. www.climateactionreserve.org.
  - o Verra. Verra Registry, 2020. verra.org.
  - o California Air Resources Board (ARB). ARB Offset Credit Issuance Table, 2020. ww2.arb.ca.gov/our-work/programs/compliance-offset-program/.

- Mitigation and conservation banking and water quality trading credits: U.S. Army Corps of Engineers, Regional In-lieu Fee and Bank Information Tracking System (RIBITS), 2020. ribits.usace.army.mil

- Banking and offset prices: Forest Trend's Ecosystem Marketplace. State of the Voluntary Carbon Markets and State of Biodiversity Mitigation reports, and organizational data.

- Hunting and wildlife viewing leases and entrance fees: U.S. Fish and Wildlife Service and U.S. Census Bureau United States. National survey of fishing, hunting, and wildlife-associated recreation (FHWAR), 2006, 2011, and 2016 reports.

- Conservation easement acreages and prices:
  - Ducks Unlimited and The Trust for Public Land. National Conservation Easement Database (NCED), 2020. www.conservationeasement.us.
  - The Trust for Public Land. Conservation Almanac, 2020. www.conservationalmanac.org.

- Land cover: Multi-Resolution Land Characteristics (MRLC) Consortium. National Land Cover Database, 2011 and 2016 data.

- Private forestland area: USDA Forest Service (2021).

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