Forest Policy and Economics 97 (2018) 33–40

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Private forest owners and property tax incentive programs in the United States: A national review and analysis of ecosystem services promoted, landowner participation, forestland area enrolled, and magnitude of tax benefits provided

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ABSTRACT

Forest ecosystems provide services that can be promoted by state property tax incentive programs. A 50-state review in 2014–2015 determined that such programs were used to foster services such as protection of soil and water resources, habitat for fish and wildlife, aesthetically pleasing landscapes, and the production of timber and wood fiber. The review determined that nearly 210 million acres (85 million hectares [ha]) were enrolled in 58 different state property tax programs, an estimated 44% of private forest area eligible for enrollment. Over 3.85 million participants benefited from the programs and collectively received more than $1.61 billion in reduced annual property taxes. The average annual value of the reduction was $7.68 per acre ($19.00 per ha).

1. Introduction

Of the 766 million acres (310 million ha) of forestland in the United States, more than 58%, or 445 million acres (180 million ha), is in private ownership (USDA Forest Service, 2016). Estimated to total 11.5 million in number, private forest owners include individuals and families, corporate organizations, Native American tribes, nongovernmental conservation organizations, unincorporated partnerships and associations, and others (Butler et al., 2016a). These private forests provide a wide variety of benefits for individuals and for society in general, benefits which are known as ecosystem services, of which recreational opportunities, supply of timber and wood fiber, availability of quality water, open space and scenic vistas and habitat for fish and wildlife are but a few examples. Many government programs — including tax incentive programs — are focused on encouraging owners of private forests to engage in activities that will promote the sustained availability of these services.

1.1. Objectives

Comprehensive information about property tax programs and the ecosystem services they promote is often neither complete nor fully understood, especially regarding the type(s) of ecosystem services promoted, forestland area and number of participants involved, and magnitude of annual tax incentives granted to those participating in such programs (Brockett and Gebhard, 1999; Fortney et al., 2011; Hibbard et al., 2003; Kilgore et al., 2007; Kluender et al., 1999; Ma et al., 2014; Polyaakov and Zhang, 2008; Rathke and Baughman, 1996; Sendak and Sendak, 1992). These information voids were addressed through a nationwide state-by-state review of forest property tax programs conducted in 2014 and 2015. The objectives of this review were to determine the:

- Type and breadth of ecosystem services promoted by state property tax programs.
- Area of private forestland and number of participants enrolled in property tax programs that promote ecosystem services.
- Magnitude of payments made by property tax programs annually to produce ecosystem services from private forest lands.

The objective of the research was not to evaluate the efficiency or effectiveness of property tax programs as a means of increasing the availability of ecosystem services, nor was it to quantify the amount and value of the ecosystem services that might result when property tax programs are focused on private forests. These lines of inquiry are valuable in their own right. This research, however, focused on the ecosystem services that state governments are statutorily required to promote through property tax incentives and on the extent to which those incentives have been utilized by their state's private forestland owners.

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https://doi.org/10.1016/j.forpol.2018.08.015
Received 19 March 2018; Received in revised form 27 August 2018; Accepted 28 August 2018

2. Background: ecosystem services from private forests

2.1. Types and definitions

Ecosystem services are benefits that humans value, which are derived from the functions and processes of ecosystems (Brown et al., 2007; Costanza et al., 1997; de Groot et al., 2002; Daily, 1997; Wainger et al., 2010;). Although other groupings of ecosystem services have been suggested (Brown et al., 2007; de Groot et al., 2002; Deal et al., 2012), current emphasis is on: provisioning services (such as food and fiber, fuel, genetic resources, pharmaceuticals, fresh water), regulating services (such as air quality, climate regulation, erosion control, water purification and waste treatment), cultural services (such as cultural diversity, recreation, aesthetic beauty), and supporting services (such atmospheric oxygen, nutrient cycling) (Millennium Ecosystem Assessment, 2003, 2005; Wallace, 2007). Supporting services are of fundamental importance, although they typically are not directly utilized. They provide the underlying support for the provision of services that occur within the other three classes of ecosystem services (Millennium Ecosystem Assessment, 2003, 2005).

Forest ecosystems are an important component of ecosystem services generally. The services they provide are acknowledged to be extensive in number and scope. It is suggested that they provide services such as the protection of soil and water resources, sustaining high quality wildlife habitat, providing wood fiber and related materials, ensuring diversity among plant and animal communities, offering aesthetically pleasing landscapes, storing carbon, controlling erosion and regulating stormwater (Brown et al., 2007; Costanza et al., 1997; Mercer et al., 2011). Also suggested are watershed services (quantity and quality, soil stabilization), recreation and tourism services (hunting and fishing, wilderness recreation), development services (timber and nontimber products), and cultural value services (aesthetic experiences, heritage preservation) (Krieger, 2001). Others view them as sources of water services, biodiversity services, carbon sequestering services, timber and wood services, and aesthetic and spiritual services (Watson, 2008), while yet others suggest that forest ecosystem services include carbon sequestration services, water quality regulation services and biodiversity habitat services (Mercer et al., 2011). Adding to the challenge of defining categories of ecological services is the reality that most ecosystems provide not one, but a very large variety of bundled services (Deal et al., 2012; Engel et al., 2008; Mercer et al., 2011). Production of multiple forest ecosystem services often overlap in time and space and may be either complementary or create trade-offs (Nelson et al., 2009; Rodríguez et al., 2006). For example, production of timber may be compatible with aesthetic beauty while trees are growing, but less so immediately after timber harvest unless prudent management practices are applied (Ribe, 1989). From a complementary perspective, timber harvest may promote wildlife that depend on early-successional habitat thereby enhancing wildlife as an ecosystem service (Rose and Chapman, 2003). Similarly, management of trees for timber can be blended with the production of ecosystem services considered to be non-timber forest products (Chamberlain et al., 2013).

2.2. Ecosystem service promotion

Private forestland owners that engage in the production of services from forest ecosystems are often not compensated by competitive market systems for the services they provide. As a result, decisions to increase the availability of these services are often less financially competitive when compared to decisions that result in products that can be sold through competitive markets. These market failures can be addressed in various ways, including public production and distribution of desired services, private contracts between providers of services and the entities demanding them, payments for ecosystem services, voluntary provision of ecosystem services by suppliers, and government action requiring individuals and communities to make ecosystem services readily available (Kemkes et al., 2010). Many of these approaches have been made part of existing government policies and programs, notably landowner information and education programs, professional advice and technical assistance programs, financial incentives and enticements (loans, grants, cost-sharing), legally binding easements and covenants, regulatory laws and rules requiring the production of ecosystem services, and various types of preferential tax programs (Cubbage et al., 2007; Ellefson et al., 2004; Kilgore and Blinn, 2004; Kilgore et al., 2007; 2008). Owners of private forestland in the United States received in 2007 an estimated $1.9 billion in direct government payments for purposes of promoting various ecosystem services (Mercer et al., 2011). The value of property tax incentives made available to landowners for the same purposes are not included in this estimate.

2.3. Property tax incentives

The owners of private forest land in the United States are subject to a variety of taxes, notably property, income, and estate taxes (Butler et al., 2012; Hibbard et al., 2003; Hickman, 1992). Reduced or favorable tax rates can be regarded as an incentive that encourage greater availability of ecosystem services. In the United States, property tax laws have traditionally made special provision for reduced taxation of private forest land and have been persuasively encouraged since the 1920s: “Efforts to induce forest owners to protect and care for their forests, to prevent destructive exploitation of virgin forests, and to encourage the reforestation of cut- over lands have always, sooner or later, encountered difficulties in connection with taxation” (Fairchild, 1935, p. 3). Although program eligibility requirements vary considerably across states, all 50 states currently have property tax programs that seek to promote the availability of forest- based ecosystem services (Butler et al., 2012; Ellefson et al., 2004; Kilgore et al., 2007; 2017).

Property taxes can be a burden to the provision of ecosystem services. For example, they must be annually paid by forest landowners even though income from forests may be infrequent due to the long planning horizons associated with some forest benefits, notably timber production. Furthermore, private forest landowners often report that high property taxes can cause them to sell their forest properties or to develop them for non-forest purposes (Butler et al., 2010; Butler et al., 2012). Property tax incentives have also been shown to positively affect profits from private forest land and affect certain types of forest management decisions (Kilgore et al., 2007). Overall, however, there is limited direct empirical evidence that defines the extent to which property taxes affect landowner behavior and the services that forest ecosystems can provide (Brockett and Gebhard, 1999; Kilgore, 2014). In contrast, and as an alternative to property tax incentives, research has determined that financial cost-sharing programs are an effective way of promoting the reforestation of private forestland (Andrejczyk et al., 2016; Li and Zhang, 2007; Ruseva et al., 2015; Sun, 2007).

3. Framework and methods

3.1. Ecosystem services promoted

A state-by-state analysis of the language set forth in state property tax laws and administrative rules was undertaken to determine the ecosystem services that state and local governments were legally obligated to promote. Content analysis was chosen as the preferred analytical approach because of its past success in identifying consistent intentions, preferences and purposes among diverse statements presented in written documents of individuals and organizations, especially in the fields of marketing, political science and legal research (notably involving administrative and statutory rules and regulations). The approach provides a systematic way of condensing a plethora of words and phrases into logical categories that can be more easily understood and analyzed (Gaudet and Robert, 2018; Neuendorf, 2017;

Stemler, 2001). Not without fault, content analysis takes little notice of the technical and economic context within which statutory language was originally established. Since the text in some forest property tax laws may have been legislatively established 50 or more years ago, it may reflect earlier legislative intentions which may be quite different from the intent of legal text used today (Krippendorff, 2013).

The content analysis applied here required that property tax laws and rules for each state first be searched for words and phrases that broadly depicted germane concepts, including forest, woodland, forestland, timberland, and forest resources. Once identified, the text was copied using standard word-processing software and then carefully recorded word-for-word for each state. And lastly, the multitude of textual statements were carefully grouped into broader categories which encompassed similar goals, meanings, and intentions. The results of the analysis revealed that the text consistently coalesced around four broad categories of ecosystem services (Millennium Ecosystem Assessment, 2005) and seven subcategories therein: Provisioning Services: Production of Timber and Fiber Products; Protection and Supply of Water; Protection and Supply of Fish and Wildlife; Cultural Services: Open Space and Scenic Resources; Recreational Uses and Resource Preservation; Regulating Services: Conservation of Soils and Wetlands; and Supporting Services: Integrity and Sustainability of Forests. In some states, not all subcategories were specified in property tax laws and rules. A lack of mention was considered to be a sign that these states did not wish to promote such categories through property tax programs, or that a state had yet to formally enact laws directing attention to them (in no state did property tax programs focus on all seven categories). Additionally, the content analysis focused on statutory language that required certain ecosystems services be made available, not on whether the services actually became available because of the application of forestry practices in a field setting.

In addition to identifying ecosystem services that are legally promoted by property tax programs, content analysis was also used to distinguish between those ecosystem services considered important and those to be emphasized. When states identify an ecosystem service in law or administrative rule, they are explicitly declaring that such an ecosystem service is important and that it should be promoted via a property tax program (example, "… promote sustainable forest management on private forest lands …," "encourage landowners to make long-term commitments to sustainable forests…"). However, in some states the text contained in law and rule clearly and unmistakably identified an important ecosystem service that should also be emphasized (example, "… purpose is to ensure reforestation necessary to produce future crops of timber…," "… purpose is to provide for quality water through the application of best management practices…"). For purposes of this review and analysis, important infers categories worthwhile and meaningful to state interests in private forests, while emphasized infers categories central or dominant to accomplishing such interests.

3.2. Participants and area enrolled

The number of participants and the forestland area enrolled or eligible for enrollment in property tax programs was obtained primarily from publicly available information provided by state and local tax agencies, or was determined by estimation using information from government tax agencies and the National Woodland Owner Survey (Butler, 2008; Butler et al., 2016a, 2016b; Kilgore et al., 2017). The latter provided state-by-state information about the area (one acre or larger) of private forest and woodland ownerships (corporate, family, other private and tribal ownerships), an area that was considered eligible for property tax incentives.

Reliable information about the number of participants and area enrolled in property tax programs was not always available. Especially troublesome were inconsistencies in the type, availability, and form of information across and within states, the mixing of forestry program information with information about other economic and commercial sectors (such as agriculture, industrial, municipal), and the lack of clarity and uniformity in definitions, especially regarding "persons," "owners," "ownerships," "parcels," "enrollees," and "participants" involved in property tax programs. As used here, the term "participant" is used synonymously with individually enrolled properties, not a count of the number of individuals enrolling properties in preferential tax programs. When reported as such, parcels, contracts, or forest plans were considered a participant.

3.3. Financial benefits provided

The net financial benefit of property tax programs giving preference to private forests was obtained by: (a) determining the annual per acre tax liability for forest land enrolled in a preferential tax program (such as a timberland productivity program); (b) determining the annual per acre tax liability in a nonpreferential tax program for such property (such as an agricultural cropland property tax program); and (c) comparing the preferential and nonpreferential tax liabilities, the difference between which was used as an estimate of the annual per acre net financial benefit (tax savings) available to participants in the preferential tax program. The classification chosen for comparison purposes was the one to which private forest land would most likely be assigned if a preferential forestland classification was not available. The statewide average benefit estimate is not an estimate of the worth or value of an ecosystem service per se, but rather is the reduction in annual property tax liability received by those participating in a preferential tax program.

For regional comparisons, states were grouped according to the regions used by USDA Forest Service (2012) (see https://www.fs.fed.us/research/rpa/regions.php). This grouping resulted in 20 states in the North, 13 in the South, 12 in the Rocky Mountain, and five in the Pacific Coast regions.

4. Analysis and results

4.1. Ecosystem services

4.1.1. Important services

A nationwide average of three ecosystem service categories per state received the attention of forest property tax programs in 2014. Extremes around this average ranged from Washington and Wisconsin with six categories per state, to ten states each focusing on a single ecosystem service category (Arizona, Arkansas, Iowa, Kentucky, Louisiana, Mississippi, Nebraska, North Carolina, South Carolina, South Dakota) (Table 1). The most frequently cited (47 states) as an important ecosystem service nationwide was the production of timber and fiber products. Although reported far less frequently than the latter, other notably important categories were the use of property tax programs as a way of ensuring the integrity and sustainability of forests (26 states), preserving open space and scenic resources (21 states) and protection and supply of fish and wildlife (20 states). Property tax laws and rules in relatively few states specified the conservation of soil and wetlands (six states) and the protection and supply of water (13 states) as important ecosystem service categories.

Regional patterns of ecosystem services considered important largely follow national state-by-state conditions (Table 1). In the North, property tax laws in nearly all states cited timber and fiber products as an important focus for property tax programs (19 of 20 states), while a similarly high portion of states in the South (12 of 13 states) identify the same ecosystem service as important. Regional differences do occur, especially regarding open space and scenic resources which are identified as important by more than half the states in the North (11 states), but less than one-third of the states in the South and Rocky Mountain regions. In the latter region, conservation of soils and wetlands as an ecosystem service was not identified in law or rule by any state.

Table 1
Ecosystem services promoted on private forest lands by state property tax incentives as specified in state law or administrative rules in the United States, by importance, emphasis and region, 2014.

Major ecosystem service category	Region, importance and emphasis placed on major ecosystem category[a]									
	North		South		Rocky Mountain		Pacific Coast		National Total	
	Imp.	Emph.	Imp.	Emph.	Imp.	Emph.	Imp.	Emph.	Imp.	Emph.
	Number of states									
Integrity and sustainability of forests	11	4	3	1	7	3	5	1	26	9
Open space and scenic resources	11	3	4	1	3	0	3	0	21	4
Conservation of soils and wetlands	3	0	2	0	0	0	1	0	6	0
Production of timber and fiber products	19	12	12	11	11	9	5	4	47	36
Protection and supply of fish and wildlife	9	0	3	0	4	0	4	0	20	0
Protection and supply of water	5	1	4	0	2	0	2	0	13	1
Recreational uses and resource preservation	8	0	1	0	3	0	3	0	15	0

Imp. = Important; Emph. = Emphasized.
Number of states in region: North: 20, South: 13, Rocky Mountain: 12, Pacific Coast: 5.
[a] Individual states may focus on more than one ecosystem service category.

Although the number of states in the Pacific Coast region is modest, all five states had statutory language that clearly identifies the protection and supply of fish and wildlife and the integrity and sustainability of forests as important ecosystem services to be promoted with property tax incentives.

4.1.2. Emphasized services

An ecosystem service is considered important if it is identified in the property tax laws and rules adopted by a state. In some states, property tax laws and rules explicitly identify one or more ecosystem services to be especially important and therefore to be emphasized. Legal text in state laws or rules that clearly indicates an ecosystem service is to be emphasized is revealed by the following examples.

- Alabama: "declared policy of the state to encourage reforestation of cutover lands and timber culture generally…" "[focus on] all real property used for harvesting or for the growing and sale of timber and forest products…"
- California: "…[purpose is to] encourage the continued use of timberlands for the production of trees for timber products, and provide for restricting the use of timberland to the production of timber products…"
- Connecticut: "… [purpose is to] prevent the forced conversion of… forestland to more intensive uses as a result of economic pressures caused by the assessment of property tax values incompatible with the preservation of forestland…"
- Indiana: "[focus on] [forest plantation] land growing a good stand of timber producing trees … at least 400 timber producing trees per acre of any size but well-established …," "native forestland must contain 40 square feet of basal area per acre or 1,000 timber producing trees per acre…"
- Louisiana: "… [focus on] land stocked by forest trees of any size and species, or formerly having such tree cover within the last three years and not currently developed or being used for nonforest purposes, and devoted to the production, in reasonable commercial quantities, of timber and timber products, and timberland under a contract with a state or federal agency restricting its use for timber production…"
- West Virginia: "[focus is on] timberland meaning any real property not less than ten acres which is primarily forested and which has sufficient number of commercially valuable species of trees to constitute at least forty percent normal stocking well distributed over growing site…"
- Wyoming: "… [focus on] land being used for an agricultural purpose, including production of timber products…"

Ecosystem service categories emphasized most frequently for special property tax reductions were the production of timber and fiber products (36 states) and the integrity and sustainability of forests (nine states) (Table 1). Notable is the void of states that lack legal text emphasizing attention to the conservation of soils and wetlands, protection and supply of fish and wildlife, and recreational uses and resource preservation. Also noteworthy is the occurrence of sharp differences between some ecosystem service categories considered important versus those emphasized. By such measures, open space and scenic resources drops from 21 states to four states (80% decline), integrity and sustainably of forests from 26 states to nine states (65% decline), and protection and supply of water from 13 states to one state (92% decline). The least change from an important to an emphasized ecosystem service occurred for the production of timber and wood fiber. Of the 47 states for which the latter is judged to be important, 36 have laws and rules calling for it to also be emphasized (77% of 47 states).

The frequency with which states specify an ecosystem service to be important versus emphasized indicates that state property tax laws and rules often present a broad menu of ecosystem services to be promoted, yet law and rule they single out a very modest number (frequently only one) of ecosystem services to be emphasized. For example, state property tax laws in Washington and Wisconsin each identify six ecosystem categories to be important and worthy of special property tax treatment, yet both states emphasize only one ecosystem service, namely integrity and sustainability of forests in the case of Washington and timber and fiber products in Wisconsin. Similarly, state law and administrative rules in Massachusetts, Georgia, Virginia, Utah and California clearly specify that among the five ecosystem service categories identified by each state's property tax law or rule, production of timber and fiber products is to be emphasized.

Table 2
Estimated enrollment and annual property tax benefit associated with state property tax programs promoting ecosystem services from private forestland in the United States, by region. 2014.

Region	Number of participants	Area enrolled	Average annual tax benefit	Total annual benefit
		Acres[a]	$ per acre	$ for region
North	831,214	32,517,096	$15.14	$492,328,789
South	1,817,730	112,010,500	$7.76	$869,453,436
Rocky Mountain	285,830	12,228,447	$7.94	$97,062,230
Pacific Coast	919,304	53,087,856	$2.89	$153,605,485
National Total	3,854,078	209,843,899	$7.68	$1,612,449,940

[a] In certain regions, states were excluded because information was not available.

4.2. Participants and benefits

Property tax programs that promote ecosystem services on private forest lands nationwide enrolled nearly 210 million acres (85 million ha) of forest land and involved over 3.8 million participants in 2014 (Table 2). The area enrolled ranged from 33,000 acres (13,000 ha) in Delaware to nearly 36 million acres (15 million ha) in Alaska, with an average state-wide enrollment of almost 420,000 acres (170,000 ha). Property tax programs in six states, all but one of which is in the South, accounted for nearly 10 million acres (4 million ha) of forest land. State participation in property tax programs that promote ecosystem services ranged from 400 enrollees in Delaware to over 413,000 in Arkansas. Averaged nationwide, the participation rate was over 77,000 per state. An estimated 44% of all eligible private forestland area in the United States was enrolled in special property tax relief programs.

Participants in preferential property tax programs focused on private forests in 2014 collectively received over $1.61 billion in property tax reductions (Table 2). Nationwide, the acre-weighted average annual reduction was $7.68 per acre, although in some cases it exceeded $60 per acre. Sixteen programs provided more than $10 per acre in average reduced annual taxes (for example, Indiana, Mississippi, California), while 18 programs provided less than $3 per acre in tax reduction (for example, Maine, Louisiana, Wyoming). These large state-by-state disparities occur for various reasons, including differences in land value, taxable value, and the mill rates applied (Butler et al., 2012).

4.3. Regional conditions

4.3.1. North region

Twenty-five property tax programs promoted ecosystem services from private forests in the North during 2014 (Table 3), with five states offering two programs each (Massachusetts, Michigan, Minnesota, Ohio, and Wisconsin). Regionwide, over 32.5 million acres (13.2 million ha) were enrolled (an estimated 25% of eligible forestland), with enrolled area per state ranging from 33,000 acres (13,000 ha) in Delaware to slightly less than seven million acres (3 million ha) in Ohio. Four states (Ohio, Maine, Wisconsin, Vermont) accounted for nearly half the total area enrolled in the region. At one extreme, a modest 400 participants were enrolled in Delaware's preferential tax program, while Ohio's two tax programs combined engaged over 405,700 participants. Annual property tax reduction provided by the region's preferential tax programs averaged slightly more than $15 per acre per year ($37 per ha per year), with Ohio's Current Agricultural Use Valuation Program and Forest Tax Law Program combined providing a reduction of nearly $36 per acre per year ($89 per ha per year). Close behind were average annual benefits offered by Wisconsin's Forest Crop Law and Managed Forest Law, namely $28 per acre ($69 per ha per year).

4.3.2. South region

Fourteen tax programs promoted ecosystem services from private forests in the South, with Georgia the only state offering two programs for such purposes (Forest Land Protection Program, Conservation Use Valuation Program) (Table 4). Slightly more than 112 million acres (45.3 million ha) were enrolled regionwide, with individual program enrollment extending from a low of 700,000 acres (283,000 ha) in Virginia to 17 million acres (7 million ha) in Alabama. Of the region's total eligible private forestland, an estimated 48% was enrolled in a special property tax program – just over half of which was in four states, namely Georgia, Alabama, Mississippi, and Arkansas. As for participants, such ranged from a low of 9310 in Virginia to over 413,000 in Arkansas, with seven of the region's states positioned above the regionwide average number of participants per state (140,000). Annual property tax reductions averaged $7.76 per acre ($19.17 per ha per year) across the region, although the smallest reduction, namely less than one dollar per acre ($2.47 per ha per year) occurs in South Carolina with Oklahoma not far behind at $1.34 per acre ($3.31 per ha per year). At the other extreme, tax reductions were highest in Kentucky and Mississippi, just over $30 per acre ($74 per ha per year) in the former and just under $30 per acre $74 per ha per year in Mississippi. Less than $3 per acre per year ($7 per ha per year) in tax reduction is provided by nearly half the region's programs.

4.3.3. Rocky mountain region

An estimated 12.2 million acres (4.9 million ha) were enrolled in preferential property tax programs in the Rocky Mountain region in 2014 (Table 5), an estimated 28% of the forest area so eligible. Rocky Mountain is the only region in which all states have but a single preferential property tax program. Enrollment in programs reducing property taxes ranged from a low of 106,000 acres (43,000 ha) in Nevada to a high of more than 2.2 million acres (890,000 ha) in Idaho, with an average enrollment per state of just over one million acres (405,000 ha). Half the enrolled acres in the region occur in two states, namely Montana and Idaho combined. Colorado has the fewest number of participants in a program reducing property taxes, namely 1050, while Kansas and Nebraska have the largest number, namely over 50,000 each. Regionwide, annual property tax reductions in 2014 averaged $8 per acre per year ($20 per ha per year), with Kansas the only state providing an annual benefit greater than $7 per acre per year ($17 per ha per year), namely over $60 per acre ($148 per ha per year). Colorado provides the smallest tax reduction, namely less than one dollar per acre per year ($2.47 per ha per year).

4.3.4. Pacific coast region

States in the Pacific Coast Region collectively offer seven property tax incentive programs, with Oregon and Washington offering two each (Table 6). Program enrollment regionwide in 2014 approached 54 million acres (21.8 million ha), namely an estimated 76% of forest land eligible for such programs. Enrollment per program ranged from nearly 36 million acres (14.5 million ha) in Alaska to fewer than 600,000 acres (243,000 ha) in Hawaii (based on Hawaii County records). Nearly 920,000 participants benefit from the region's property tax programs, with participation ranging from nearly 196,400 participants in Oregon's two property tax incentive programs to 356,450 participants in

Table 3
Estimated annual financial benefits provided by state property tax programs promoting ecosystem services on private forest lands in the United States, North Region, 2014.

State	Number of participants (or parcels, plans, contracts)	Total area enrolled	Average annual net tax benefit [a]	Total annual tax benefit (savings)	Comment
		Acres	$ per acre	$ for state	
Connecticut	6,675[a]	480,000	$2.61	$1,252,800	–
Delaware	400 (parcels)	33,000	N.D.	N.D.	–
Illinois	7500 (plans)	162,700	$1.54	$250,558	Forest Development Act
Indiana	13,000 (parcels)	599,700	$23.02	$13,805,094	–
Iowa	48,000 (parcels)	692,934	$12.19	$8,446,865	–
Maine	63,210[a]	3,691,633	$1.42	$5,242,118	Excludes 7.5 million acres in Unorganized Territory
Maryland	1300	84,000	$3.35	$281,400	–
Massachusetts	7,150[a]	306,000	$1.97	$602,820	Chapter 61 and 61A Programs
Michigan	2,680[a]	2295,00	$1.26	$3,81,250	Commercial Forest Program Qualified Forest Property Tax Program
Minnesota	7000	995,700	$6.68[a]	$6,652,520	Sustainable Forest Incentive Act Class 2c Managed Forest Land Program
Missouri	4800	34,900	$6.61	$230,689	–
New Hampshire	48,730[a]	2612.366[a]	$3.42	$9,210,275	With and without documented stewardship
New Jersey	10,875[a]	238,166	$5.81	$1,383,744	–
New York	2849 (parcels)	1,103,700	$9.46	$10,441,002	–
Ohio	405,730[a]	6972,900[a]	$35.72	$246,039,131	Current Agricultural Use Valuation Program, Forest Tax Law
Pennsylvania	92,540[a]	4,238,197	$13.23	$56,071,346	–
Rhode Island	2,530[a]	139,000	$9.54	$1,326,060	–
Vermont	17,000 (parcels)	2,300,000	$5.74	$13,202,000	One mile or less from road
West Virginia	41,445[a]	2,242,200	$8.20	$18,386,040	–
Wisconsin	47,800[a]	3,295,000	$28.46[a]	$95,671,700	Forest Crop Law, Managed Forest Law

N.D. = not determined.
– = no applicable comment.
[a] Estimate.

Table 4
Estimated annual financial benefits provided by state property tax programs promoting ecosystem services on private forest lands in the United States, South Region, 2014.

State	Number of participants (or parcels, plans, contracts)	Total area enrolled	Average annual net tax benefit [a]	Total annual tax benefit (savings)	Comment
		Acres	$ per acre	$ for state	
Alabama	192,100[a]	17,000,000	$2.13	$36,210,000	–
Arkansas	413,260[a]	11,323,400	$3.41	$38,612,794	–
Florida	26,700	2,101,100	$14.96	$31,432,456	Ten counties only
Georgia	198,700	8,610,000	$1.43	$25,891,008	Conservation Use Program and Forest Land Protection Program
Kentucky	212,590[a]	18,105,600	$30.18	$259,849,800	–
Louisiana	159, 840[a]	11,860,400	$1.17	$13,876,668	–
Mississippi	125,000	12,000,000	$29.36	$352,320,000	–
North Carolina	110,000	8,000,000	$6.15	$49,200,000	–
Oklahoma	85,470[a]	7,000,000	$1.34	$9,380,000	–
South Carolina	177,920[a]	7,615,000	$0.69	$5,254,350	–
Tennessee	17,100	1,539,000	$19.24	$29,610,360	–
Texas	89,740[a]	6,156,000	$1.50	$9,234,000	–
Virginia	9310[a]	700,000	$12.26	$8,582,000	–

– = no applicable comment.
[a] Estimate.

California's program. The region's seven property tax programs reduced taxes an average of up to $2.90 per acre per year ($7.16 per ha per year) in 2014 (excludes Alaska and Washington's Open Space Timberland Program). Within the region, California's program provided an average tax reduction of $22.35 per acre per year ($55.22 per ha per year) – the region's highest amount. Such was followed by Hawaii at nearly $18 per acre per year ($44.5 per ha per year). Statewide information for Washington was only available for the state's Designated Forestland Program, which had a net tax benefit of $1.22 per acre; ($3 per ha per year).

5. Conclusions

State property tax programs and the fiscal incentives embodied therein are among the many methods that can be used to promote the availability of ecosystem services from private forestland in the United States. The intent of this nationwide 50-state review was to determine the legally established types and importance of ecosystem services promoted by such programs, estimate the number of participants (persons, owners, parcels) and area of forest land enrolled in them, and the amount by which property taxes are reduced as an incentive to promote the availability of desired ecosystem services.

Table 5
Estimated annual financial benefits provided by state property tax programs promoting ecosystem services on private forest lands in the United States, Rocky Mountain Region, 2014.

State	Number of participants (or parcels, plans, contracts)	Total area enrolled	Average annual net tax benefit [a]	Total annual tax benefit (savings)	Comment
		Acres	$ per acre	$ for state	
Arizona	24,520[a]	760,000[a]	N.D.	N.D.	–
Colorado	1050[a]	250,077	$0.59	$147,545	–
Idaho	12200[a]	2200,000[a]	$2.92	$6,424,000	–
Kansas	50,420[a]	953,000[a]	$60.28	$57,446,840	–
Montana	34,430[a]	3,946,170	$4.38	$17,284,225	–
Nebraska	50,420[a]	527000[a]	$5.06	$2,666,620	–
Nevada	18,280[a]	106,000[a]	$4.49	$475,940	–
New Mexico	27,490[a]	827,400[a]	$4.55	$3,764,670	–
North Dakota	11,000	368,800	$6.55	$2,415,640	Excludes Tribal Landowners
South Dakota	12,000	492,000	$4.83	$2,376,360	–
Utah	32,030[a]	970,500[a]	$3.28	$3,183,240	–
Wyoming	11,990[a]	827500[a]	$1.06	$877,150	–

N.D. = not determined.
– = no applicable comment.
[a] Estimate.

Table 6
Estimated annual financial benefits provided by state property tax programs promoting ecosystem services on private forest lands in the United States, Pacific Coast Region, 2014.

State	Number of participants (or parcels, plans, contracts)	Total area enrolled	Average annual net tax benefit[a]	Total annual tax benefit (savings)	Comment
		Acres	Dollars per acre	Dollars total	
Alaska	82,000	35,875,000	N.D.	N.D.	Private Forestland Exempt from Taxation
California	356,450[a]	5,418,000	$22.35	$121,092,300	–
Hawaii	113,235[a]	577500[a]	$17.95	$10,366,125	–
Oregon	196,369[a]	8,065,134	$2.29	$18,448,997	Forestland Program and Small Tract Forestland Program
Washington	171,250	3,031,199	$1.22	$3,698,063	Designated Forestland Program and Open Space Timberland Program

N.D. = not determined.
– = no applicable comment.
[a] Estimate.

The ecosystem services determined to be most consistent as a focus for property tax programs directed at private forest land were the: integrity and sustainability of forests, open space and scenic resources, conservation of soils and wetlands, production of timber and fiber products, protection and supply of fish and wildlife, protection and supply of water, and recreational uses and resource preservation. Among these services, the production of timber and fiber products was most frequently cited in state property tax laws and rules (47 states), followed by maintaining the integrity and sustainability of forests (25 states), open space and scenic resources (21 states) and protection and supply of fish and wildlife (20 states). Property tax laws and rules in relatively few states directed property tax reductions toward promoting the conservation of soil and wetlands and the protection and supply of water.

Enrollment in property tax programs focused on ecosystem services in 2014 totaled nearly 210 million acres (85 million ha) nationwide –44% of private forestland so eligible. Fifty-eight different state property tax programs were offered to over 3.85 million participants, with total enrollment in any one program ranging from 400 to more than 413,000 participants. These participants collectively received an estimated $1.61 billion in reduced annual property taxes. The acre-weighted average annual value of the annual property tax reduction was $7.68 per acre ($19 per ha), with some programs providing tax reductions as high as $60 per acre ($148 per ha). Sixteen state programs provided more than $10 per acre ($25 per ha) annually in tax reductions, while 18 programs provided annual reductions of no more than $3 per acre ($7 per ha).

6. Policy and management implication

Forest resource managers and policymakers can benefit from reliable evidence regarding property tax incentives as a way of promoting forest-based ecosystem services. The information provided by this research can be used to advance a better understanding of and appreciation for the broad array of ecosystem services that can be addressed by such programs and the level of tax reductions that might be required to promote these services. Participant rates and financial incentive rates can also be useful as guides for the design of property tax programs focused on private forests generally. Future research may also be stimulated by the study's results, especially regarding connections between property tax reductions and the types, amounts and diversity of forest-based ecosystem services promoted.

Acknowledgments

Research was supported by the University of Minnesota's Department of Forest Resources; Minnesota Agricultural Experiment Station Projects MIN-42-54 and MIN-42-65; and the USDA Forest Service, Southern Research Station, through Joint Venture Agreements 11-JV-11330143- 129 and 14-JV-11330143-082.

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