The Value of Cooperative Extension’s Public Benefit Explored through Enhancements to Forest Ecosystem Services Provision

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ABSTRACT

Cooperative Extension produces public value through educational programming that benefits the greater community. Forests provide numerous valuable benefits to society through the provision of ecosystem services. Cooperative Extension educational programming positively impacts forest owners, who in turn conduct actions that enhance ecosystem services. A heretofore unrecognized relationship exists between Cooperative Extension and ecosystem services that provides opportunity for mutual benefit. Applying ecosystem services values to Extension natural resources-related programmatic outcomes through benefit transfer provides an avenue for Extension to make significant advancements in monetizing public value. Beyond serving simply as a source of financial justification, however, linkages with ecosystem services also provide Cooperative Extension with opportunities to improve the design and delivery of educational programs, do a better job articulating an array of public benefits resulting from agency accomplishments, and optimize allocation of sparse resources and Extension efforts. This dissertation thoroughly explores these concepts by providing an overview of: Cooperative Extension in general and Extension forestry more specifically; public value in an Extension context; ecosystem services; ecosystem services valuation; benefit transfer, and; connections between these diverse topics. In addition, benefit transfer principles are applied to an existing Extension evaluation data set in attempt to monetize Cooperative Extension’s impact, lessons learned are explored, and the Cooperative Extension public value discussion is reframed as one aspect of overall continuous organizational improvement.
Cooperative Extension produces public value through educational programming that benefits the greater community. Forests provide numerous valuable benefits to society through the provision of ecosystem services such as clean air, aesthetic beauty, and clean water. Cooperative Extension educational programming positively impacts forest owners, who in turn conduct actions that enhance ecosystem services. A heretofore unrecognized relationship exists between Cooperative Extension and ecosystem services that provides opportunity for mutual benefit. Applying ecosystem services values to Extension natural resources-related programmatic outcomes through benefit transfer—a process by which monetary values from primary studies are applied to similar sites where original studies are not possible due to high costs or time constraints—provides an avenue for Extension to apply monetary values to the public benefits it provides. Beyond serving simply as a source of financial justification, however, linkages with ecosystem services also provide Cooperative Extension with opportunities to improve the design and delivery of educational programs, do a better job articulating an array of public benefits resulting from agency accomplishments, and optimize allocation of sparse resources and Extension efforts. This dissertation thoroughly explores these concepts by providing an overview of: Cooperative Extension in general and Extension forestry more specifically; public value in an Extension context; ecosystem services; ecosystem services valuation; benefit transfer, and; connections between these diverse topics. In addition, benefit transfer principles are applied to an existing Extension evaluation data set in attempt to monetize Cooperative Extension’s impact, lessons learned are explored, and the Cooperative Extension public value discussion is reframed as one aspect of overall continuous organizational improvement.
Dedicated to my father
Acknowledgements

I began this pursuit in 2009. I graduated in 2017. During the eight years that intervened I benefited from the generosity, advice, and counsel of many individuals, accumulating debts that are inadequately repaid through expressions of gratitude. I recognize and thank the following individuals for their kindness, generosity, and contributions, without whom completing this dissertation would not have been possible.

The Virginia Tech Department of Forest Resources and Environmental Conservation admitted me as a graduate student. In the process, the Department accepted coursework completed 11 to 13 years prior as part of my Master’s program and applied those hours toward the Ph.D. requirements. Without transferring those hours pursuing a Ph.D. program would not have been an option for me. That act of generosity, along with the observation that the window would not remain open indefinitely, was the impetus I needed to get started. Thank you for that.

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Introduction

Hoag (2005) observed that the Cooperative Extension Service is an outstanding success story for education, but a model whose value is now in question. The appropriateness of the original public Extension model is weakened because citizens are more educated and information is easy to gather. The author proposed a solution to this dilemma which emphasized Extension’s reputation for providing unbiased research-based information, and encouraged increased focus on natural resources and social issues. In essence, Hoag (2005) and Barden et. al. (1996) recognized a societal need for implementing sustainable forestry on all non-industrial private forestland and proposed natural resources as an increased area of emphasis for Cooperative Extension.

A potential contributing factor to Hoag’s assertion regarding the value of the Cooperative Extension model is that institutionalized Cooperative Extension evaluation and reporting structures encourage numbers-based results such as program participation, number of programs conducted, number of educational materials produced, knowledge gained by program participants, and so on. Although impact reporting advancements have been made in recent years, reporting structures and accompanying organizational culture that encourages participation and numbers-based reporting does not generally encourage higher level impact reporting, making it very difficult to monetize Extension public value in a methodical, transparent, and credible manner.

Kalambokidis (2014) articulated three main ways Extension programs create public value: by addressing concerns about fairness, closing an information gap, and/or encouraging actions that benefit the greater community (or equivalently, discourage actions that impose
Although each of these can be thought of as a criterion to justify public sector involvement, Kalambokidis (2014) observed that most Extension programs focus on the third type of value creation, benefiting the greater community, and that is where this project focuses. More specifically, the ecosystem services that forests provide to benefit society. And, although existing literature would suggest that Extension is not maximizing opportunities to capture and report upon improved provision of ecosystem services resulting from educational programming, nevertheless the implication is there that Cooperative Extension educational programming can positively impact forests in a manner that benefits society. This story can be told through intentional evaluation, data collection, and analysis of educational program offerings, supplemented by benefit transfer of existing values where appropriate and necessary due to lack of financial resources and/or time constraints.

There is an undeniable, heretofore unrecognized, symbiotic relationship between Cooperative Extension and ecosystem services that provides opportunity for mutual benefit. With Extension’s nation-wide coverage, community relationships, research-based educational programming model, and subject matter expertise, the organization is well-positioned to enhance and optimize ecosystem services by reaching forest landowners. And, through application of benefit transfer principles, it may be possible for Cooperative Extension to articulate societal value through enhanced provision of ecosystem services.

The following chapters delve into a thorough exploration of this thought process. Chapter 1 provides an overview of: Cooperative Extension in general and Extension forestry more specifically; public value in an Extension context; ecosystem services; ecosystem services valuation; benefit transfer, and; potential connections between these diverse topics. In
Chapter 2 we apply benefit transfer principles to an existing Extension evaluation data set in attempt to monetize Cooperative Extension’s impact on ecosystem services provided to society through enhanced management actions conducted on private forest landholdings, and explore lessons learned. In Chapter 3 we discuss the potential organizational culture change implications for incorporating ecosystem services valuation into Cooperative Extension programming, and reframe public value as one aspect of continuous organizational improvement.

Beyond serving simply as a source of financial justification, linkages with ecosystem services also provide Cooperative Extension with opportunities to: improve the design and delivery of educational programs; do a better job articulating an array of public benefits resulting from agency accomplishments; optimize allocation of sparse resources and Extension efforts, and; address the existential question facing Cooperative Extension in an era of readily available information: Why should Extension exist?
Chapter 1: Literature Review and Conceptual Case

Introduction

The purpose of this chapter is to: describe the history and structure of Cooperative Extension in general and Extension forestry more specifically; describe how Cooperative Extension approaches accountability; explain the idea of “public value” in an Extension context; define and explain ecosystem services and ecosystem services valuation via benefit transfer; examine connections between these diverse topics, and; argue that Cooperative Extension has the potential to capture and report public value from ecosystem services provided by forests...but isn’t.

Cooperative Extension Overview

The Smith Lever Act formalized Cooperative Extension in 1914, establishing the United States Department of Agriculture’s partnership with land-grant universities to apply research and provide education in agriculture (USDA NIFA 2017). Originally focused on rural agricultural issues, Extension systems today typically address four broad disciplines: Agriculture and Natural Resources, Family and Consumer Sciences, 4-H Youth Development, and Community Viability. Cooperative Extension’s presence in communities is significant, with offices in or near most of the nation's approximately 3,000 counties (USDA NIFA 2017) in addition to numerous cities. Cooperative Extension has a common mission of supplying research-based information and education to help people make positive life change (Franz and Townson 2008).

Kells (1995) stated that higher education organizations, and particularly universities, are among the most complex known. The Cooperative Extension System has a complex funding
and staffing structure (Franz and Townson 2008) that is traditionally represented by a local/state/federal partnership (Figure 1). County and city governments provide funding and other support for local offices, including partial salary and fringe benefit contributions for local Extension agents, in-kind office space, and support services. State government supplies salary and fringe benefit support and operating dollars for faculty and staff in local units, on land-grant campuses, and at agricultural research and extension stations. The federal government also contributes funds for salaries and operating expenses. These funding sources are supplemented by grants, contracts, fiscal gifts, and user fees (Franz and Townson 2008). Field Extension office staffing varies widely from location to location according to local needs and available funding (Franz and Townson 2008).

Figure 1: The Cooperative Extension System partnership illustrating the connections between county, state, federal, and grants/contracts/gifts/user fees (Franz and Townson 2008). Used with permission; e-mail attached.
County, multicounty, and state-level Extension faculty and staff plan, implement, and evaluate educational experiences for clientele according to the Extension programming model. The programming model’s basic elements include: (1) situation analysis, (2) program design and implementation, and (3) program evaluation and reporting (Figure 2) (Virginia Cooperative Extension 2017a). Extension faculty commonly build extensive partnerships and collaborations with government, nongovernmental organizations (NGOs), and other groups to carry out and expand the impact of their efforts (Franz and Townson 2008). And, Extension recruits, trains, and uses hundreds of thousands of volunteers to help plan, deliver, and evaluate extension educational programs (Seevers et. al. 2007). In Virginia alone, volunteers contributed an estimated 936,039 hours to Extension programming efforts valued at $24,421,258 in calendar year 2016 (Jones 2017). This value is based on $26.09/hr from Independent Sector (2017). Independent Sector’s national value of volunteer time is derived from the average hourly earnings of all production and non-supervisory workers on private non-farm payrolls based on yearly earnings provided by the Bureau of Labor Statistics. Independent Sector then indexes...
this figure to determine individual state values, which are increased by 12 percent to account for fringe benefits (Independent Sector 2017).

Extension program evaluation efforts serve multiple purposes, to include incorporating feedback to improve educational programming, communicating impacts to program collaborators and stakeholders, and internal accountability. However, the main driver for program evaluation in Cooperative Extension is public accountability to maintain and increase funding. With its reliance on multiple, and often declining, funding streams from local, state, federal, and nongovernmental sources, Extension attempts to capture and communicate the impact of educational programming activities to a variety of external audiences (Franz and Townson 2008).

**Cooperative Extension Expectations and Accountability**

This section briefly describes Cooperative Extension evaluation, reporting and accountability mechanisms. Although traditional accountability reporting approaches are one way to assess value, we subsequently argue that it is insufficient for this purpose.

Cooperative Extension has an elaborate reporting structure due to its reliance on multiple funding streams and compliance with local, state, federal, university, and agency expectations, policies, and guidelines. Program expectations—often referred to as indicators of quality—established for Extension faculty provide a basic set of standards. For example, the Virginia Cooperative Extension (VCE) indicators of quality articulate in part that effective Extension programs: should address citizen’s problems and contribute directly to the improvement of life within the state; utilize planned educational programming to connect research, science, and technology to the people’s needs; are consistent with the Cooperative
Extension mission; result from using the Extension programming model as a guide, and; rely on public input to guide programming efforts (Virginia Cooperative Extension 2017b). Effective Extension programs are also expected to: demonstrate an awareness of social, economic, and/or environmental considerations; reflect the critical needs and problems of residents within local communities while keeping in mind state and national priorities, and; reach numbers of clientele that are consistent with the committed resources. The VCE indicators of quality also identify effective Extension programs as fostering collaborative relationships with public and private partners, including teamwork that promotes local, regional, state, national, and international Extension priorities, and attracting funding and support from local and state governments--among other sources--to enhance programming efforts (Virginia Cooperative Extension 2017b). Indicators of quality exist for each of the Cooperative Extension program areas.

Cooperative Extension faculty report accomplishments through a variety of mechanisms, including capturing daily direct and indirect contacts with clientele, submitting annual individual and Unit plans of work, completing annual accomplishment reports, and submitting activity reports to local funding partners, among others. Extension faculty annual accomplishments are used for performance evaluation purposes and summarized for state and federal level reports. District and/or Unit Directors evaluate Extension agent performance against a variety of metrics that vary slightly from state to state. For example, the Kentucky Cooperative Extension agent evaluation rubric covers the following categories: Councils, Leadership Development, Educational Programming, Accountability and Public Relations, Facilitation/Collaboration/Teamwork, and Service. Within each topic area agents are rated on
various indicators. For example, to obtain a “consistently exceeds expectations” rating within the Accountability & Public Relations topic area the faculty member must evaluate and discuss most programs with the assistance of leaders, and share program outcomes with people outside of Extension to help them understand the importance of programming to the whole community (Kentucky Cooperative Extension 2014).

Virginia Cooperative Extension utilizes an evaluation matrix containing 30 indicators organized by the following themes: Extension, Citizenship, Management and Leadership, and External Funding. To achieve an “Exemplary” rating for the Evaluation/Impact indicator, for example, an agent must achieve a level of work whereby “Evaluation results are used to develop strategies for programs that will result in significant practice and/or behavioral change in clientele regionally (Virginia Cooperative Extension 2017c). Another example evaluation instrument, obtained from the University of Tennessee Extension, organizes indicators into categories of Program Development, Program Accountability, and Professionalism, with an additional section specific to County Directors that have additional administrative responsibilities. In the Tennessee system defining expectations for “Outcomes and Impacts,” an agent has achieved expectations if his/her program outcomes are clearly stated, measurable, and at the knowledge, skills, and attributes level or higher. In addition, this level of performance requires that agents: use existing state-wide outcome indicators when available, achieve desired impacts, and; include long-term outcomes at program maturity for multi-year educational programs (Tennessee Cooperative Extension 2007).

Each state’s Cooperative Extension system submits a federal Plan of Work to the National Institute of Food and Agriculture (NIFA), and reports annually against this plan. The
Plan of Work includes an overview, summary of the state’s merit review process, strategies for addressing critical issues and needs of under-served audiences, and methods used for obtaining stakeholder input. In addition, each Planned Program—whereby a Planned Program consists of overarching subject matter themes—selected by the state is summarized as follows: A) Program Summary, B) Program Knowledge Areas, C) Situation and Scope, D) Assumptions and Goals, E) Program Inputs, F) Program Activity, G) Program Outputs, H) State Defined Outputs, I) State Defined Outcomes, J) External Factors, and K) Planned Evaluation Studies (Virginia Cooperative Extension 2016).

The Natural Resources, Environment, and Climate Change Planned Program is one of seven planned programs featured in the 2017 Virginia State University and VPI&SU Combined Research and Extension Plan of Work. The ultimate goals of this outcome are “To impact climate change through educational and research efforts that directly foster greater forest stewardship, environmentally sound land management activities and improved water quality” and “To provide for improved environmental quality, while also providing for economic vitality of families and communities (Virginia Cooperative Extension 2016).” State defined outcomes for this planned program include private forest landowners demonstrating the application of tools to improve forest health and sustainability, and management practices of forest, land, and water for conservation and protection of native and endangered aquatic fishes and land animals, among others (Table 1) (Virginia Cooperative Extension 2016).
Table 1: State defined planned program outcomes in the 2017 Virginia State University and Virginia Polytechnic Institute and State University Combined Research and Extension Plan of Work (Virginia Cooperative Extension 2016). Used with permission; e-mail attached.

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<th>O. No</th>
<th>Outcome Name</th>
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<tr>
<td>1</td>
<td>Private water supply users who participate in drinking water clinics more effectively manage their systems</td>
</tr>
<tr>
<td>2</td>
<td>Private forest landowners demonstrate application of tools to improve forest health and sustainability</td>
</tr>
<tr>
<td>3</td>
<td>Researchers are calibrating the performance of a common watershed model for estimating water quality to allow the prediction of water quality at the watershed scale</td>
</tr>
<tr>
<td>4</td>
<td>Research climate change adaptation techniques for crop producers that will result in recommendations for the use of land management as a climate change adaptation strategy in the US and abroad</td>
</tr>
<tr>
<td>5</td>
<td>Increase in the amount of cropland (acres) managed with conservation tillage production techniques</td>
</tr>
<tr>
<td>6</td>
<td>Increase in the amount of cropland (acres) subject to improved nutrient management technologies</td>
</tr>
<tr>
<td>7</td>
<td>Increase the number of residential landscapes who have adopted best management practices</td>
</tr>
<tr>
<td>8</td>
<td>Increase by municipalities and private industries in adoption of composting as a waste treatment technique</td>
</tr>
<tr>
<td>9</td>
<td>Adoption and implementation of renewable energy production of farms and local municipalities and businesses</td>
</tr>
<tr>
<td>10</td>
<td>Youth increase agricultural literacy</td>
</tr>
<tr>
<td>11</td>
<td>Management practices of forest, land, and water for conservation and protection of native and endangered aquatic fishes and land animals</td>
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Planned program output measures required by NIFA in the annual accomplishments report include: the number of direct and indirect adult and youth contacts made, number of patents submitted, and number of peer-reviewed publications. State defined outputs are measured in terms of the number of educational programs offered, number of educational materials developed, number of program participants, and “identifiable impacts” reported. Outcomes types are typically categorized as change in action or change in knowledge (Virginia Cooperative Extension 2016). Approaches to evaluation planning outlined for Planned Programs throughout the report are somewhat vague, generally stating essentially that evaluations will be conducted, but with few details regarding how evaluations will be constructed to capture information in a manner that goes beyond knowledge gain to support high quality impact reporting and assertions regarding Cooperative Extension’s value to society.
Each Plan of Work is reviewed for consistency with the federal Extension funding lines by a National Program Leader assigned to the state. This insures that funds are used as intended by the legislation that authorized them (Hewitt 2017). Assessment criteria generally speak to whether each section of the report addresses the requirements. For example, the approved 2016 *Virginia State University and Virginia Polytechnic Institute and State University Combined Research and Extension Annual Report of Accomplishments and Results* illustrates that the reviewer noted the existence of: an executive summary, the inclusion of total FTE’s, inclusion of the merit/program review process, and inclusion of the stakeholder input process with appropriate actions and methods. With specific regard to Planned Programs, the reviewer looked for acceptability in logic model elements, dollars expended, appropriateness of knowledge areas, appropriate outputs for each program, and appropriate outcomes for each program (Virginia Cooperative Extension 2017d). It appears that, while providing base-level accountability, Federal reporting formats and accompanying review criteria generally support a numbers based reporting philosophy that does not encourage states to capture and pursue higher-level impacts and accomplishments from Extension programming efforts.

**Cooperative Extension Public Value**

This section reviews public value in an Extension context, and argues that a better job is needed. Public value is defined by Moore (1995) as creating a service that benefits society as a whole. Kalambokidis (2003) theorized that, when a service is recognized as having significant public value, even citizens who do not directly benefit from the service will endorse its public funding. According to Kalambokidis and Bipes (2007), private benefits accrue to program participants from Extension programming while public benefits accumulate for society. Using
the principles of public economics, the authors observe that it is possible to exclude “non-payers” from participating in most outreach programs and thus receiving private benefits, but it is not possible to exclude non-payers from receiving the public benefits of those programs. (Forest ecosystem services, described later in this chapter, represent one example of a service produced by private forest landowners that benefits the public both directly and indirectly.) In addition, Kalambokidis (2014) articulates three main ways Extension programs create public value: by addressing concerns about fairness, closing an information gap, and/or encouraging actions that benefit the greater community (or equivalently, discouraging actions that impose costs on the community). Although each of these can be thought of as a criterion to justify public sector involvement, Kalambokidis (2014) observes that most Extension programs focus on the third type of value creation (benefiting the greater community).

Kalambokidis (2013a) explained that there is an increasing need for Cooperative Extension to make the case for public funding, and to a wider audience. Declining financial support from public sources is cited as rationale behind the need for improved justification for public funding support for Cooperative Extension (Kalambokidis 2011) (Franz 2011). There are numerous recent examples of funding cuts to Cooperative Extension across the United States that illustrate this concern. For example, the biennial 2015-2017 Wisconsin state budget included a $3.6 million reduction to Cooperative Extension, which represented 8.3 percent of the on-going state funding (Zoellner 2016). The North Dakota State University Extension Service received a 14.5% budget reduction in the 2015-2017 budget (Pates 2017), amounting to 1/8 of Extension’s budget (ND Farmers Union 2017). Coon (2017) observed that the Oklahoma Cooperative Extension Service was downsizing and reorganizing after consecutive years of
unprecedented budget cuts nearing 19% over the previous two fiscal years. According to Herrold (2017), University of Missouri Extension received a five percent budget cut for fiscal year 2017, and was looking at further budget reductions for FY’18 as the university attempted to cut 12 percent from all schools, colleges, and divisions on campus.

Cooperative Extension can typically provide evidence of private value through evaluation, reporting, and testimonials but often struggles with making public value statements (Kalambokidis 2004) (Kalambokidis 2011). And, Extension has struggled to find ways to help decision-makers understand the public value of its work (Franz 2011), perhaps due in part to a culture of numbers-based reporting approaches illustrated by the federal plans and reports discussed in the previous section. Although difficult to quantify and communicate to funding partners, as long as the public sector remains an important source of Extension’s funding, demonstrating public value will play an important role in the organization’s future success (Kalambokidis 2004).

Kalambokidis (2013a) observed that resource constraints dictate that Extension cannot provide direct benefits to everyone in a state. However, Extension programs appear to be creating value for almost everyone in the state. To capitalize on this, the author recommends that Cooperative Extension capture, measure, and communicate about this value. Kalambokidis (2010) provides a prescription for doing this that incorporates consideration of stakeholder’s concerns, awareness of an educational program’s public benefits, impact and outcome data, and a plan for using the message. Kalambokidis and Bipes (2007) recommended that Cooperative Extension identify changes that participants make from program attendance, the outcomes that result from those changes, and articulate the public value that arises from
those outcomes; particularly from a program’s long-term outcomes (Kalambokidis 2009a). The authors emphasize the importance of substantiating claims with evaluation data and research to provide credibility. They emphasize that the public value approach is not just about the message, but also about doing the work that justifies the message. When it comes to monetizing Extension public value, however, Kalambokidis (2009b) recommended proceeding with caution, acknowledging at that time that Cooperative Extension did not yet have all the resources and tools necessary to estimate the financial benefits of agency programs. To do a credible job, Kalambokidis (2009b) asserts, applied economists, program evaluators and others would need to devote many more hours to this effort.

**Extension Forestry**

This section provides a general description of Extension forestry programming and associated outcomes, and in conjunction with subsequent sections on ecosystem services and benefit transfer, argues that Extension natural resources educational programming efforts provide an avenue for strengthening public value claims.

The Clark-McNary Act of 1924 directed the Secretary of Agriculture to work with states to strengthen Extension forestry efforts, and the Norris-Doxey Cooperative Farm Forestry Act of 1937 established on-farm demonstrations of forestry practices (Barden et. al. 1996). Yet, despite the fact that family forest owners account for 92 percent of the private forest owners and 62 percent of the private forest land (35 percent of all forest land) ownership in the in the United States (Butler 2008), Barden et. al. (1996) observed that only 1.7 percent of the nearly 16,000 FTEs in all Extension programs were dedicated to forestry. Germain and Ghosh (2013) observed that less than 5% of Extension employees in the northeastern United States were
forestry and natural resources educators. Barden et. al. (1996) concluded that a redirected Extension system would be a critical element in a successful educational effort to achieve sustainable forests and viable communities. Demchik et. al. (2009) observed that Extension would be in a better position to help family forest owners with forest management by increasing their expertise in forestry and natural resources management. This could be accomplished by increasing staffing levels in these disciplines or expanding the responsibilities of current educators in closely related fields of agriculture and horticulture (Germain and Ghosh 2013).

Where Extension forestry programs exist, they often have positive outcomes for private family forest owners. For example, timber management programs regularly lead to higher yields and more product availability given the same producer input (Marcouiller et. al. 1992), and educational program attendance has resulted in increased landowner adoption of conservation-oriented forest management practices and plans (Straka and Franklin 2008) as well as increases in acreage on which landowners have thinned, reforested following harvest, carried out invasive species control, and implemented forest practices that improved wildlife and watershed resources (Fisher 2011). More specifically, Straka and Franklin (2008) conducted 14 conservation forestry workshops that were attended by 385 forest owners who controlled over 225,000 acres in the South Carolina lowcountry. The authors evaluated three of these workshops, discovering that participants estimated future savings--due to more cost-effective practices learned at the workshops--of about $62,000 and future increased earnings of approximately $250,000 per workshop. Research by Munsell and Germain (2004) in the New York City watershed region identified that respondents with a written forest management plan
participated in Cooperative Extension forestry educational programs with greater frequency. More specifically, 55% of survey respondents that had attended an Extension workshop or technical service program in the previous year indicated they had a written forest management plan; 79% of respondents that attended two to four educational programs in the previous year had written forest management plans, and 100% of respondents that participated more than four times had a written forest management plan (Munsell and Germain 2004). Germain et. al. (2014) concluded that family forest owners who are more engaged with educational programming demonstrated better implementation of silviculture and BMPs than their less engaged counterparts. Fisher (2011) observed that 135 forest landowners responding to a five-year follow-up survey regarding attendance at one or more Extension forest landowner education programs between 2006 and 2011 in the Virginia Southern Piedmont region conducted one or more positive management actions impacting 36,628 acres of land. Actions taken included thinning a stand of trees to improve forest health, enrolling property in a conservation easement, and controlling invasive exotic species, among many others. In addition, landowners attending Fisher’s educational programs reported receiving over $580,000 in income from timber harvests. A study by Jones and Finley (1993) discovered that 99% of the general public and 98% of forest landowners felt education was an effective forest management promotion strategy. And, the authors concluded that the need for--and rationale behind--a forest resources Extension program was evident.

These studies serve as examples of private value--as discussed by Kalambokidis and Bipes (2007)--from Extension forestry programs and typify the types of outcomes captured and reported in peer-reviewed literature by Extension forestry professionals. Given the potential
for forests to provide public benefits such as climate regulation, aesthetic beauty, enhanced water and air quality, and others described in the following section, however, these results imply that Extension forestry programs could play a significant role in articulating overall Cooperative Extension public benefit as encouraged by the writings of Kalambokidis...but do they? This question will be explored later in this chapter.

**Forest Ecosystem Services: Definition**

Return on investment is a widely acknowledged goal of forest management. However, Hull et. al. (2004) illustrate that private forest landowners have many reasons for owning woodland and that income is often a secondary consideration. In fact, forests tend to be undervalued when priced for timber only (Raunikar and Buongiorno 2006). Beyond timber, Wilson and Howarth (2002) observed that ecosystem goods and services provide benefits to society as a whole, over and above the benefits they provide to individuals. Pearse and Holmes (1993) proposed that the objective of forest management is to ensure that forests make their maximum contribution to human welfare, implying that forest policy has a social purpose and is intended to advance human values. Walsh et. al. (1990) designated the public’s willingness to pay for various benefits that forests provide to the general public as public preservation benefits. Pearce (2001) contended that assigning economic values to nonmarket benefits provided by forests would provide financial incentives for forest conservation and sustainable use that would potentially make retaining land in a natural state a desirable economic alternative to conversion to other uses.

Although publicly owned forests are managed to provide public benefits, Haskell et. al. (2010) observed that society often enjoys environmental amenities as a consequence of
management actions taken by private landowners in pursuit of their own objectives. Examples from the literature include scenery, carbon sequestration, contributions to public health through filtered air and water, watershed protection, biodiversity, enhanced national security, family values, and reinforced faith (Boyd & Banzhaf 2007, Moore et. al. 2011, Hull 2011, Liu et. al. 2010, Raunikar & Buongiorno 2006, Ma et. al. 2012, Haskell et. al. 2010, Paul 2011). These studies document that, while private forest landowners own and manage land for a variety of personal objectives, their efforts also provide multiple benefits to society.

The components of nature, including forests, that are actively or passively enjoyed, consumed, or otherwise used to produce human well-being are referred to as “ecosystem services” (Boyd & Banzhaf 2007, Fisher et. al. 2009, Moore et. al. 2011, Fisher and Turner 2008). The Millenium Ecosystem Assessment (2005) observed that “the human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services. Braat and de Groot (2012) attribute Paul and Anne Ehrlich with coining the term “ecosystem services” in 1981.

A key point espoused by Fisher et. al. (2009) and Fisher and Turner (2008) is that services must be ecological phenomena and they do not have to be directly utilized. Unlike authors that see ecosystem services as directly consumable end points (Boyd & Banzhaf 2007), Fisher et. al. (2009) reason that ecosystem functions or processes become services if there are humans that benefit from them either directly or indirectly.

Pearce (2001) identified four classifications of goods and services produced by forests that benefit humankind:
1) Direct use values: values arising from consumptive and nonconsumptive uses of the forest such as timber and fuel, extraction of genetic material, recreation, and tourism;

2) Indirect use values: values arising from various forest services, such as the protection of watersheds and carbon storage;

3) Option values: values reflecting a willingness to pay to conserve the option of making use of the forest in the future even though no current use is made of it;

4) Nonuse values (also known as existence or passive use values): values that reflect a willingness to pay for the forest in a conserved or sustainable use state, but the willingness to pay is unrelated to current or planned use of the forest.

Wainger and Mazzotta (2011) considered option values to be part of nonuse values, identifying nonuse values as preferences for preserving the existence of ecosystems, retaining the option to use them in the future, or holding them in trust for future generations. Pearse and Holmes (1993) opined that nonuse values are an important component of the total value of forest resources, and may exceed the use value. Kramer et. al. (2003) expressed the opinion that existence value has emerged as the most important non-use or passive use value associated with environmental resources.

Sagoff (1997) expressed concern that placing a monetary value on ecosystem services as defined in Costanza et. al. (1997) would potentially defeat attempts to protect the natural environment. However, Ervin et. al. (2012) concluded that the lack of ecosystem services values led to degradation and unsustainable use of ecological assets, and advocated for credible values for nonmarket ecosystem services that can inform the management of natural assets. Kramer et. al. (2003) reason that estimating the economic values for forest ecosystems can improve the formation and implementation of policies to manage those ecosystems. The majority focus of ecosystem services valuation literature appears to agree.
Forest Ecosystem Services: Valuation

Pearse and Holmes (1993) observed that resource and environmental economists have developed methods for estimating the economic value of environmental amenities based on two types of evidence: stated and revealed preference. Stated preference methods are quantitative techniques for determining an individual’s preferences by asking the person to choose from different alternatives (Binder et. al. 2017). Stated preference approaches elicit individual valuations through surveys and generally allow for measuring nonconsumptive uses such as existence or option values (Pearce 2002). Stated preference methods included contingent valuation, which involves using surveys to ask people how much they would be willing to pay for specific environmental services (Kaufman 2012).

Revealed preference methods estimate individual preferences based on observable decisions in actual markets for a good whose value depends on the non-market ecosystem service (Binder et. al. 2017). Revealed preference methods include hedonic price and travel cost methods (Pearce 2002). The travel cost method measures the time and expense incurred while traveling to visit a site. Individuals’ willingness to pay to visit the site can be estimated based on the number of trips made at different travel costs (Kaufman 2012). Hedonic methods are based in how environmental quality is reflected in market prices for housing (Pearce 2002). For example, hedonic methods have been used to estimate the value of aesthetic amenities in urban and rural forests such as tree cover, open space, and proximity to parks based on home sales prices in different housing markets (Binder et. al. 2017) (Kaufman 2012). DEFRA (2007) provide a summary table to facilitate choosing an economic valuation method for valuing different ecosystem services. And, TEEB (2012) provide additional summary information.
regarding valuation methods and associated considerations. Combining and summarizing information from Pearce (2002), DEFRA (2007), and TEEB (2012) provides a synopsis of valuation methods, element(s) of total economic value captured, ecosystem services valued, benefits, limitations, and accompanying notes for direct market, revealed preference, and stated preference valuation methods (Table 2).

Numerous studies endeavor to place a value on the non-use and non-market services that ecosystem services provide. Kramer et. al. (2003) observed that studies showed consistent support for protection and restoration of forest ecosystems as an economic good that people are willing to pay for. Binder et. al. (2017) provide a template for organizing one’s thoughts around identifying and valuing ecosystem services from forests (Table 3). There is an extensive and growing body of research that explores how economic approaches are applied to ecosystem services to elicit values. Selected examples that relate specifically to forests ecosystem services valuation are briefly introduced in the following paragraphs.

Walsh et. al. (1990) determined that recreation use and preservation benefits of forest quality per resident household in the state of Colorado averaged $47, with public preservation values representing nearly three-quarters of the total benefits. In addition to recreational use, people valued the option of future access to forest quality, knowledge of its existence, and availability to future generations (Walsh et. al 1990).

Banzhaf et. al. (2011) observed that residents’ willingness to pay for potential improvements in acid rain reduction in the southern Appalachian Mountains was $32 per year per household, with a confidence interval of $22 to $43. Multiplying this figure by the
Table 2: Summary of valuation methods, element of total economic value captured, ecosystem services valued, benefits, limitations, and accompanying notes for direct market, revealed preference, and stated preference valuation methods. Table content is combined and summarized from Pearce (2002), DEFRA (2007), and TEEB (2012).

<table>
<thead>
<tr>
<th>Valuation Method</th>
<th>Element of Total Economic Value (TEV) Captured</th>
<th>Basis for Method / Ecosystem Service(s) Valued</th>
<th>Benefits</th>
<th>Limitations</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Market Methods</td>
<td>Direct and indirect use.</td>
<td>Marked products such as timber, fish, and genetic information.</td>
<td>Market data readily available and robust. Reflects private willingness to pay.</td>
<td>Limited to ecosystem services with a market. Markets can be distorted due to subsidies or lack of competition.</td>
<td></td>
</tr>
<tr>
<td>Cost-based Approaches</td>
<td>Direct and indirect use.</td>
<td>Depends on the existence of markets for the ecosystem service in question. An example is the expenditure on water filtration as a proxy for the value of water pollution damages.</td>
<td>Market data readily available and robust.</td>
<td>Can potentially overestimate actual value. Value is based on cost of alternative rather than the value of the benefit provided.</td>
<td>Examples of cost-based approaches include: avoided cost method, replacement cost method, mitigation or restoration cost.</td>
</tr>
<tr>
<td>Production Function</td>
<td>Indirect use.</td>
<td>Change in environmental good valued by change in value of output. Environmental services that serve as inputs to market products such as the effects of air or water quality on agriculture and forestry production.</td>
<td>Market data readily available and robust. Links ecosystem functions to market values.</td>
<td>Data-intensive. Data on changes in services and production impact often missing. Complex for multi-use systems.</td>
<td>Requires good understanding of production technology and strong knowledge of behavioral response. Valuation may be biased if applied without accounting for changes (e.g., different crops, production technology) in use of good.</td>
</tr>
<tr>
<td>Revealed Preference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hedonic Pricing</td>
<td>Direct and indirect use.</td>
<td>Ecosystem services that contribute to air quality, aesthetics, landscape, quiet, etc. Attributes that can be appreciated by potential buyers. Environmental quality reflected in market prices.</td>
<td>Based on market data, so relatively robust figures.</td>
<td>Very data-intensive and limited primarily to services related to property.</td>
<td>Requires market data and attributes (e.g., housing or land) and environmental metrics. Cannot assess impacts that do not vary across regions and implicitly assume that people actually respond to environmental quality of interest. Theoretically accounts for different land-use decisions.</td>
</tr>
<tr>
<td>Travel Cost</td>
<td>Direct and indirect use.</td>
<td>Price of accessing good equal to opportunity cost of time and travel cost. All ecosystem services that contribute to recreational activities.</td>
<td>Based on observed behavior.</td>
<td>Generally limited to recreational benefits. Difficulties arise when trips are made to multiple destinations.</td>
<td>Requires observing the number of trips to an environmental amenity from a number of regions; also needs regional population and estimates of opportunity cost of time and travel. May be biased by base assumption of equal opportunity and travel costs across individuals; may be biased by assumption of equal WTP across individuals and regions.</td>
</tr>
<tr>
<td>Random Utility</td>
<td>Direct and indirect use.</td>
<td>All ecosystem services that contribute to recreational activities.</td>
<td>Based on observed behavior. Limited to use values.</td>
<td></td>
<td>Models preferences by scoring and ranking the alternatives.</td>
</tr>
<tr>
<td>Stated Preference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contingent Valuation</td>
<td>Use and non-use.</td>
<td>All ecosystem services.</td>
<td>Able to capture use and non-use values.</td>
<td>Bias in responses, resource-intensive method, hypothetical nature of market.</td>
<td>Requires survey based data collection. Measure appears sensitive to framing and is not incentive compatible, leading to problems with protest responses. Moreover, people are not calibrated to value non-market goods.</td>
</tr>
<tr>
<td>Choice Modeling</td>
<td>Use and non-use.</td>
<td>All ecosystem services.</td>
<td>Able to capture use and non-use values.</td>
<td></td>
<td>Survey respondents make choices across environmental goods with varying bundles of attributes. Trade-offs between attributes reveals values.</td>
</tr>
</tbody>
</table>
Table 3: Template for identifying and valuing ecosystem services from forests (Binder et. al. 2017). Fair Use determination attached.

<table>
<thead>
<tr>
<th>Forest use</th>
<th>Benefit</th>
<th>Beneficiary</th>
<th>Ecosystem service (valued end product of the forest ecosystem)</th>
<th>Ecological production function</th>
<th>Economic benefits function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timber production</td>
<td>Timber for wood products</td>
<td>Industrial wood producers</td>
<td>Merchantable timber (stumpage)</td>
<td>Stand simulation models (e.g., Forest Vegetation Simulator)</td>
<td>Market price of timber (stumpage price)</td>
</tr>
<tr>
<td>Carbon storage</td>
<td>Climate regulation</td>
<td>Everyone</td>
<td>Sequestered carbon</td>
<td>Carbon budget simulation models (e.g., FORCARB2)</td>
<td>Social cost of carbon</td>
</tr>
<tr>
<td>Water regulation</td>
<td>Irrigation water</td>
<td>Farmers</td>
<td>Flow of water downstream</td>
<td>Paired watershed studies Forest hydrological models (e.g., Distributed Hydrology Soil Vegetation Model)</td>
<td>Market price for water Shadow price of water Hedonic price model for farmland</td>
</tr>
<tr>
<td></td>
<td>Flood control</td>
<td>Homeowners</td>
<td>Peak flow downstream</td>
<td>Paired watershed studies Forest hydrological models</td>
<td>Avoided damage</td>
</tr>
<tr>
<td></td>
<td>Coldwater fishing</td>
<td>Anglers</td>
<td>Trout abundance</td>
<td>Energy transfer models for stream temperature coupled with trout population models</td>
<td>Hedonic travel cost model Discrete choice RUM</td>
</tr>
<tr>
<td>Clean drinking water</td>
<td>Local water consumers</td>
<td>Amount of sediment in water</td>
<td>Erosion prediction models (e.g., Water Erosion Prediction Project model)</td>
<td>Household demand model for water, avoided costs of treatment, replacement cost</td>
<td></td>
</tr>
<tr>
<td>Safe navigation</td>
<td>Commercial navigators</td>
<td>Amount of sediment in water</td>
<td>Erosion prediction models</td>
<td>Avoided costs of dredging</td>
<td></td>
</tr>
<tr>
<td>Clean drinking water</td>
<td>Local water consumers</td>
<td>Amounts nitrate and phosphorus in water</td>
<td>Nutrient and chemical movement models (e.g., Soil and Water Assessment Tool)</td>
<td>Household demand model for water, avoided costs of treatment, replacement cost</td>
<td></td>
</tr>
<tr>
<td>Aesthetic amenity</td>
<td>Aesthetic amenity near forest</td>
<td>Forest cover in viewedshed</td>
<td>Stand simulation models Forest landscape simulation models</td>
<td>Hedonic property price model</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aesthetic amenity</td>
<td>Forest cover in viewedshed</td>
<td>Stand simulation models Forest landscape simulation models</td>
<td>Recreational demand model</td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td>Recreational hiking, camping, and biking</td>
<td>Old growth area, forest density, burned area</td>
<td>Stand simulation models Forest landscape simulation models</td>
<td>Recreational demand model Discrete choice RUM</td>
<td></td>
</tr>
<tr>
<td>Wildlife</td>
<td>Recreational hunting</td>
<td>Hunters</td>
<td>Game abundance</td>
<td>Demographic models of wildlife abundance and viability (e.g., RAMAS)</td>
<td>Recreational demand model Discrete choice RUM</td>
</tr>
<tr>
<td></td>
<td>Protecting rare and endangered species</td>
<td>Species survival probability</td>
<td>Demographic models of wildlife abundance and viability</td>
<td>Contingent valuation method</td>
<td></td>
</tr>
</tbody>
</table>
approximate number of households in the five state area encompassing this region would produce benefits of approximately $430 million (Banzhaf et. al. 2011).

Liu et. al. (2010) estimated the total value of ecosystem services in New Jersey as $11.6 to $19.6 billion per year using spatially explicit benefit transfer. By applying a 3% discount rate to the lower bound of this range (i.e., $11.6 billion) the authors estimated the present value of New Jersey’s ecosystem services at $387 billion. With specific regard to forest ecosystem services, Liu et. al. (2010) placed a value of $1.88 billion based on peer-reviewed studies that use conventional environmental economic techniques such as travel cost, hedonic pricing, and contingent valuation. This value increased to $2.16 billion if non peer-reviewed studies and secondary studies summarizing primary valuation literature were included. Again, based on peer-reviewed studies, Liu et. al. (2010) provided a value of $1,283/ac for forests attributable to the following components: gas exchange ($60/ac), water ($9/ac), pollination ($164/ac), habitat ($923/ac), and aesthetics ($130/ac).

Garber-Yonts (2004) determined that Oregon residents had the highest willingness to pay for increasing the amount of forest devoted to achieving old-growth characteristics. On average, survey respondents indicated an annual willingness to pay of $380 per household per year to increase old growth forests from 5% to 35% of the age-class distribution.

Ervin et. al. (2012) valued recreation, water supply, and energy production on the Mt. Hood National Forest at $55.8 million, $45 million, and $32.9 million respectively. Supporting the assertion by Pearse and Holmes (1993) about use and nonuse values, Ervin et. al. (2012) estimated the valued of harvestable timber at $15.2 million, a distant fourth in terms of economic value. Although the authors felt that their value estimates represented a
conservative first attempt at quantifying and monetizing ecosystem services on the Mt. Hood National Forest, they viewed their efforts as having unanticipated impacts. They concluded that sustaining ecosystem services requires management of natural, manmade, social, and human capital (Ervin et. al. 2012).

Moore et. al. (2011) sought to quantify the benefits that Georgia’s private forests provide to non-forest owners. Drawing on Liu et. al. (2010) and other authors, they adopted a four step process for estimating the public ecosystem service benefits of private forests in Georgia, as follows: 1) Identify the geographic, ecological, and economic scope of the study; 2) Create a landscape classification system based on forest characteristics which predict significant differences in flow and value of ecosystem services; 3) Use the best available data to estimate average per-acre values for each unique combination of forest characteristics and each ecosystem service identified, and; 4) Calculate total ecosystem service value.

Moore et. al. (2011) concluded that annual per-acre values ranged from $264 to $13,442 depending on the characteristics of the forest. Higher per-acre values were obtained for forested wetlands or riparian forests in and near urban areas. Lower per-acre values were obtained for non-wetland forests in rural areas. The authors estimate that the value of ecosystem services provided by Georgia private forest landowners to the public is over $37.6 billion per year (Moore et. al. 2011).

A report by the Berks Nature Conservancy cites studies that demonstrated the more forest cover a watershed had, the fewer dollars must be spent in water treatment costs. Average annual treatment costs were cited as $297,110 for a watershed 60% covered by forest, while costs rose to $923,450 for a watershed with only 10% forest cover. The same report
states that every cubic foot of stormwater dealt with naturally by riparian buffers reduces stormwater costs by $2.00.

Campbell and Tilley (2014) proposed methods for developing an Ecological Investment Corporation (EIC) as a potential solution for valuing ecosystem services and incorporating them into the economy. Their study attributed the difference in performance between a typical Maryland forest and the most likely alternative land-use (suburban development), to the ecosystem service provided by the forest measured in emergy. Whereby emergy synthesis is defined as a “method of environmental accounting where the cumulative energy necessary to produce the observed components of the studied system is accounted for (Campbell and Tilley 2014). As part of this process the authors determined that each acre of forest in Maryland provided $270/ha/yr in ecosystem services benefit based on commodity eco-price, and $736/ha/yr based on specific eco-price. Campbell and Tilley (2014) concluded that the forests of Maryland provide a public value of $5 billion. They suggest that a good starting point for payments for ecosystem services programs in Maryland would be “an entity that facilitates monetary exchange between owners of properties that provide ecosystem services (forest landowners) and consumers of ecosystem services (all members of society) to fund preservation and restoration of forest land (Campbell and Tilley 2014).”

Paul (2011) relied on meta-analyses of pre-existing academic and policy studies to quantify the nine benefits of natural resources and land cover types in Virginia on public lands and on lands under easement. These benefits included: water quality, water supply, pollination, recreation, forest products, farm products, disturbance prevention, habitat, and carbon sequestration. Valuing these items individually via various methodologies, Paul (2011)
concluded that natural services contribute $21.8 billion to Virginia’s economy annually. Of the benefits from natural services, $5.1 billion is provided by public lands and $520 million from private lands under easement (Paul 2011). Paul provided per acre values by land cover type (Table 4). Per acre values for deciduous forest, mixed forest, and evergreen forest are listed as $698/ac, $729/ac, and $765/ac, respectively.

Table 4: Ecosystem services values per-acre by land cover type (Paul 2011). Fair Use determination attached.

<table>
<thead>
<tr>
<th>Land Cover Type</th>
<th>Acreage in VA</th>
<th>Value Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaches (Sand and Clay)</td>
<td>2,746</td>
<td>$507,768</td>
</tr>
<tr>
<td>Emergent Herbaceous Wetlands</td>
<td>190,164</td>
<td>$4,827</td>
</tr>
<tr>
<td>Woody Wetlands</td>
<td>706,409</td>
<td>$4,815</td>
</tr>
<tr>
<td>Open water</td>
<td>492,275</td>
<td>$1,805</td>
</tr>
<tr>
<td>Evergreen Forest</td>
<td>2,147,214</td>
<td>$765</td>
</tr>
<tr>
<td>Mixed Forest</td>
<td>3,630,432</td>
<td>$729</td>
</tr>
<tr>
<td>Deciduous Forest</td>
<td>10,904,427</td>
<td>$698</td>
</tr>
<tr>
<td>Pasture/Hay</td>
<td>4,837,562</td>
<td>$207</td>
</tr>
<tr>
<td>Row Crops</td>
<td>37,032</td>
<td>$88</td>
</tr>
<tr>
<td>Urban/Recreational Grasses</td>
<td>1,284,127</td>
<td>$58</td>
</tr>
<tr>
<td>Transitional</td>
<td>317,973</td>
<td>$46</td>
</tr>
<tr>
<td>Quarries/Strip Mines/Gravel</td>
<td>42,991</td>
<td>$0</td>
</tr>
<tr>
<td>Low Intensity Residential</td>
<td>570,750</td>
<td>$0</td>
</tr>
<tr>
<td>High Intensity Residential</td>
<td>32,546</td>
<td>$0</td>
</tr>
<tr>
<td>Commercial/Industrial/Transportation</td>
<td>270,425</td>
<td>$0</td>
</tr>
</tbody>
</table>

Krieger (2001) summarized numerous studies addressing the economic value of forest ecosystem services. For example, the author summarized the range of estimated forest ecosystem service values by geographic region in the United States (Table 5). In their paper entitled *Assessment and Valuation of Forest Ecosystem Services: State of the Science Review,*
Table 5: Range of estimated forest ecosystem service values in the United States by region (Krieger 2001). Fair Use determination attached.

<table>
<thead>
<tr>
<th>Ecosystem Service</th>
<th>Entire United States</th>
<th>Rocky Mountains</th>
<th>Southeast</th>
<th>Region</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pacific Northwest</td>
</tr>
<tr>
<td><strong>Watershed services</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quantity</td>
<td>$0.26 to $0.50/acre-foot</td>
<td>$4.07 to $9.40/acre-foot</td>
<td>$57/household/year</td>
<td>$920,000 to $3.2 million/year</td>
</tr>
<tr>
<td>Quality</td>
<td>$64.16/household/year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil stabilization</td>
<td>$1.94/ton</td>
<td>$5.5 million/year</td>
<td></td>
<td>$90,000</td>
</tr>
<tr>
<td>Air quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Climate regulation</td>
<td>$1 to $6 billion/year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biological diversity</td>
<td>$4 to $54 billion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Recreation</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic impact</td>
<td>$1.3 to $110 billion (national forests)</td>
<td>$736 million (wilderness)</td>
<td>$6 billion (all) to $407 million (hunting)</td>
<td>$1 billion (fishing)</td>
</tr>
<tr>
<td>Wilderness recreation</td>
<td>$600 million/year</td>
<td>$14/visitor day</td>
<td>$12/visitor day</td>
<td>$29 million/year</td>
</tr>
<tr>
<td>Hunting and fishing</td>
<td>$2.07 to $12.3 million</td>
<td>$237 to $637 million</td>
<td></td>
<td>$13 to $25/deer</td>
</tr>
<tr>
<td>Non-timber products</td>
<td>$300 million/year</td>
<td></td>
<td></td>
<td>$910,000/ year</td>
</tr>
<tr>
<td><strong>Cultural values</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aesthetic and passive use</td>
<td>$280 million/year</td>
<td>$14 to $92/household/year</td>
<td>$12 to $99/household/year</td>
<td>$48 to $144/household/year</td>
</tr>
<tr>
<td>Endangered species</td>
<td>$2 to $3.7 billion/year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cultural heritage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Binder et. al. (2017) provide an updated and comprehensive review on the status of non-urban forest ecosystem services valuation research, albeit not in tabular form. In addition to summarizing ecosystem services by geographic region, Krieger (2001) included additional tables illustrating water quantity, water quality, carbon sequestration, recreation and tourism, and
cultural values of forests by study, geographic scope of values, basis for valuation, value estimate, and region. An example of this format is provided for cultural values (Table 6).

Wainger and Ervin (2017) identified a number of websites that catalog research, analytic resources, and case studies relating to ecosystem services and accompanying valuation. These include:

- National Ecosystem Services Partnership:  [https://nicholasinstitute.duke.edu/focal-areas/national-ecosystem-services-partnership](https://nicholasinstitute.duke.edu/focal-areas/national-ecosystem-services-partnership)
- Ecosystem Services Partnership:  [https://www.es-partnership.org/](https://www.es-partnership.org/)
- The United States Environmental Protection Agency EnviroAtlas:  [https://www.epa.gov/enviroatlas](https://www.epa.gov/enviroatlas)
- The Natural Capital Project:  [https://www.naturalcapitalproject.org/](https://www.naturalcapitalproject.org/)
- The OpenNESS Project:  [http://www.openness-project.eu/](http://www.openness-project.eu/)

In addition, a variety of web-based tools are available to assist with valuing ecosystem services. Selected examples are briefly described in the following paragraphs.

**InFOREST.** Developed in partnership by the Virginia Department of Forestry, Virginia Tech, Virginia Department of Game and Inland Fisheries, and the USDA Forest Service, InFOREST [www.http://inforest.frec.vt.edu/](http://inforest.frec.vt.edu/) enables users to calculate forest ecosystem service benefits related to air quality, biodiversity, carbon sequestration, nutrient and sediment runoff, and open lands for sites in Virginia based on user input of stand information (VDOF 2014). Users can select either a county-level analysis or customize a defined area of interest, entering
Table 6: Summary of forest cultural values, basis for valuation, and geographic scope of values in the United States by region (Krieger 2001). Fair Use determination attached.

<table>
<thead>
<tr>
<th>Study</th>
<th>Geographic scope of values</th>
<th>Basis for valuation</th>
<th>Value estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>** Entire United States</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loomis and Richardson (2000)</td>
<td>National forest roadless areas</td>
<td>Passive use values of roadless areas</td>
<td>$280 million annually (nationwide)</td>
</tr>
<tr>
<td>** Southeast region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barnhill (1999)</td>
<td>Blue Ridge Parkway, North Carolina and Virginia</td>
<td>Economic impact of forest scenery</td>
<td>$1.3 billion in tourism expenditures, $98 million in annual tax revenues, 26,500 jobs</td>
</tr>
<tr>
<td>Haird et al. (1992) Aldy et al. (1999)</td>
<td>North Carolina</td>
<td>Use and passive use values of healthy forest (contingent valuation) (contingent valuation)</td>
<td>$15 to $90/ household/year total value (use and passive use)</td>
</tr>
<tr>
<td>** Walsh and Loomis (1989)</td>
<td>Virginia</td>
<td>Use and passive use values for wilderness (contingent valuation)</td>
<td>$12/day use value, $12/day passive use value</td>
</tr>
<tr>
<td>** Rocky Mountain region</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walsh et al. (1990)</td>
<td>Colorado</td>
<td>Use and passive use values of healthy forest (contingent valuation)</td>
<td>$47/household/year: $13 (recreation), $10 (option), $10 (existence), $14 (bequest)</td>
</tr>
<tr>
<td>Walsh and Loomis (1989)</td>
<td>Colorado</td>
<td>Use and passive use value of wilderness — 1.4 to 10 million acres (contingent valuation)</td>
<td>$14 to $32/household/year</td>
</tr>
<tr>
<td>Walsh and Loomis (1989)</td>
<td>Utah</td>
<td>Use and passive use value of wilderness — 2.7 to 16.2 million acres (contingent valuation)</td>
<td>$53 to $92/household/year</td>
</tr>
<tr>
<td>Walsh and Loomis (1989)</td>
<td>Colorado</td>
<td>Use and passive use value of wilderness (contingent valuation)</td>
<td>$25.30/household/year to protect 5 million acres; total preservation value of $28 million</td>
</tr>
<tr>
<td>** Pacific Northwest region and California region</td>
<td>Western states</td>
<td>Existence value for old-growth forest (contingent valuation)</td>
<td>$48 to $144/household/year</td>
</tr>
<tr>
<td>Moskovitz and Talberth (1998)</td>
<td>Oregon, Washington, California and United States</td>
<td>Value of habitat for endangered species protection (contingent valuation)</td>
<td>Total value of $1.5 billion/year: $34.84/household/year (Washington), $36.91 (Oregon), $20.88 (California), $15.21 (United States)</td>
</tr>
<tr>
<td>Rubin et al. (1991)</td>
<td>Oregon</td>
<td>Value of protecting old-growth forest habitat for northern spotted owl (contingent valuation)</td>
<td>$90/household/year</td>
</tr>
<tr>
<td>Loomis et al. (1994)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
scenarios regarding acreage gained or lost in different forest types to determine the corresponding impact on ecosystem services. InFOREST then produces values per acre. For example, using the Carbon Sequestration calculator, we can estimate that a 100-acre hardwood stand in Montgomery County, Virginia with 80 square feet of basal area per acre sequesters approximately 9261 MT CO$_2$e, or 9.2 MT/ac (VDOF 2014).

INFOREST draws upon other existing web-based models for support. For example, in the Carbon Sequestration calculator, the Virginia Tech Forest Modeling Cooperative FASTLOB http://frec.vt.edu/ForestModelingResearchCooperative/fastlob.htm growth and yield model is used for carbon estimates for pine stands if age, trees per acre, and either dominant height or

Table 6, continued: Summary of forest cultural values, basis for valuation, and geographic scope of values in the United States by region (Krieger 2001). Fair Use determination attached.

<table>
<thead>
<tr>
<th>Study</th>
<th>Geographic scope of values</th>
<th>Basis for valuation</th>
<th>Value estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hagen et al. (1992)</td>
<td>Oregon</td>
<td>Value of protecting old-growth forest habitat for northern spotted owl (contingent valuation)</td>
<td>$95/household/year</td>
</tr>
<tr>
<td><strong>Northeast Region</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gilbert et al. (1992)</td>
<td>Vermont and eastern states</td>
<td>Passive use value of eastern wilderness (contingent valuation)</td>
<td>$3.7 and $16.7 million for Vermont residents and all residents of the east, respectively</td>
</tr>
<tr>
<td>Fassold (1999)</td>
<td>Massachusetts</td>
<td>Replacement cost of public forest area</td>
<td>$4.5 million for 36 acres</td>
</tr>
<tr>
<td><strong>Upper Midwest region</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chang et al. (1977)</td>
<td>Wisconsin</td>
<td>Total passive use value of wilderness (contingent valuation)</td>
<td>$7 million (residents of Wisconsin)</td>
</tr>
<tr>
<td><strong>Southwest region</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loomis and Ekstrand (1997)</td>
<td>Arizona, Colorado, New Mexico, Utah</td>
<td>Value of protecting old-growth forest habitat for Mexican Spotted Owl (contingent valuation)</td>
<td>$40.49/household/year</td>
</tr>
<tr>
<td>Moskowitz and Talberth (1998)</td>
<td>Southwest</td>
<td>Existence value of threatened species (contingent valuation)</td>
<td>$2.0 and $3.7 billion (nationwide)</td>
</tr>
</tbody>
</table>
site index are available. The impact of management options such as fertilization and thinning are also available from FASTLOB. InFOREST uses the USDA Forest Service Forest Vegetation Simulator (FVS) https://www.fs.fed.us/fvs/index.shtml model for all hardwood and mixed pine/hardwood stands (USDA Forest Service 2017a).

The National Tree Benefit Calculator. Developed by Casey Trees and Davey Tree Expert Company, the National Tree Benefit Calculator http://treebenefits.com/calculator/ enables users to estimate the environmental and economic benefits that individual street trees provide on an annual basis. Like the InFOREST Air Pollution Benefits Calculator, the National Tree Benefit Calculator incorporates i-Tree tools. Users begin by selecting a climatic zone, and then enter a tree species, diameter, and land-use type to estimate an annual benefit. For example, a 36-inch northern red oak tree located on a single family residential lot is estimated to intercept 3,030 gallons of water, conserve 258 kilowatt hours of electricity, make contributions to absorbing, intercepting, or lessening the need for creation of pollutants, and sequester 431 pounds of carbon dioxide per year, ultimately providing an estimated $151 in overall benefits per year.

i-Tree Tools. i-Tree http://www.itreetools.org/index.php is a peer-reviewed software suite from the USDA Forest Service that provides urban and rural forestry analysis and benefits assessment tools to assist with quantifying the structure, risk, and environmental services provided by trees (USDA Forest Service 2017b). Tools assist with regional analyses of tree benefits for municipalities; parcel level analyses to assist with design considerations; structure, environmental, and value effects of tree canopy on water quantity and quality, and; tree canopy benefits. Initially released in 2006, i-Tree Tools provides managers and advocates with
tools to quantify ecosystem services and benefit values of community trees and forests at multiple scales.

**InVEST.** Developed by the Natural Capital Project and released in May 2016, InVEST https://www.naturalcapitalproject.org/invest/ is a suite of free, open-source software models used to map and value ecosystem goods and services. The software provides information about how changes in ecosystems are likely to lead to changes in the flows of benefits to people (Sharp et. al. 2016) and is designed to inform decisions about natural resource management. The toolset currently includes 18 distinct ecosystem service models designed for terrestrial, freshwater, marine, and coastal ecosystems. InVEST models are grouped into three primary categories: 1) supporting services, 2) final services, and 3) tools to facilitate ecosystem service analyses (Sharp et. al. 2016). InVEST returns results in either biophysical terms (i.e., tons of carbon sequestered) or economic terms (i.e., net present value of that sequestered carbon).

Many authors presenting estimates of ecosystem services values are careful to note the applicability of the data and associated values to very specific ecosystem and individual preference characteristics. In particular, Moore et. al. (2011) notes that: “The preferred (valuation) approach depends on the type of resource being valued and whose values are being considered. Because values are resource, location, and population specific, it is always preferred to estimate values from data specific to the resource, location, and population.” However, authors note that time and budget constraints often limit the ability to collect original data (Liu et. al. 2010, Moore et. al. 2011). As a result, the practice of benefit transfer is an
accepted alternative, albeit an inferior one, to original data collection (Liu et. al. 2010, Johnston et. al. 2015).

**Benefit Transfer**

A literature review indicates that the practice of benefit transfer is a critical link for successfully communicating societal value of forest ecosystem services in different policy contexts. The benefit transfer process takes primary study results from one area and applies them to a similar situation in another location, but one where primary studies are not available due to high costs, lack of time, or other constraints (Liu et. al. 2010, Johnston et. al. 2015). In addition, benefit transfer is useful when monetary values are needed to inform decisions but highly precise estimates are not required (Johnston and Wainger 2015). According to Johnston and Wainger (2015), “Given the increasing demand for information on ecosystem services values and the shortage of resources necessary to conduct primary research, benefit transfers are a common component of ecosystem service valuation.” DEFRA (2007) states that benefit transfer use is essential to the more practical application of environmental values in policy-making.

Most recent works identify two primary approaches to benefit transfer: unit value and benefit function transfers (Johnston et. al. 2015). Unit value transfers involve transferring a single number—or set of numbers—from pre-existing primary studies to the policy site. Function transfers rely upon meta-analysis that combines results from multiple prior studies, modeling two or more previous studies, or parametric functions derived from original research (Johnston et. al. 2015). Although function transfers are typically more accurate than unit value
transfers (Splash and Vatn 2006), the latter can perform satisfactorily if the study and policy sites are very similar (Johnston et. al. 2015).

The least complex—and often most inaccurate—method of transfer uses a single unadjusted value that is applied from a study site to a policy site without consideration of context (Johnston et. al. 2015). Any errors in the original economic value estimate are also transferred, resulting in an invalid estimate for the policy site (Johnston and Wainger 2015). As a result, similarity between study and policy site environmental characteristics, valuation contexts, and populations are important considerations for increasing the accuracy of transfer estimates (Johnston et. al. 2015, Johnston and Wainger 2015), as are guidelines for evaluating the quality of primary valuation studies (Brouwer and Navrud 2015), and valid and reliable willingness to pay estimates (Whitehead et. al. 2015). All monetary value transfers require primary original studies upon which values are based and justified (Splash and Vatn 2006).

Given that the accuracy of benefit transfer depends on the procedures and data that are applied, Johnston and Wainger (2015) propose that 13 factors be described to increase the likelihood of accurate and credible transfers. The authors suggest outlining the transfer steps and articulating the conceptual model establishing linkages among ecosystem services, human values, and related goods. They recommend describing the affected policy site along with the reasons for assumed correspondence among the site, populations and goods/services within the study and policy contexts. The quantities or qualities of goods/services whose values are being estimated should be reviewed, including the units of measure. Data sources utilized, the specific type of value that is transferred, the methods used to collect and screen data, transfer methods, and statistical methods and assumptions should be described. As should the scaling
and implied assumptions, the final transferred unit and aggregated estimates of value or other outcomes, and the results of any sensitivity analyses, robustness tests and accuracy evaluations (Johnston and Wainger 2015).

Similarly, Splash and Vatn (2006) found lower transfer errors when a series of conditions were matched at the study and policy sites, to include: the environmental good/service, its quantity/quality and the change in quantity/quality; the population, their use of the good/service, and their characteristics; constructed market characteristics; the institutional setting; time between primary collection and transfer, and; geographical location.

Brouwer (2000) is cited as advocating the following set of value transfer steps: 1) define the environmental goods and services; 2) identify stakeholders; 3) identify values held by different stakeholder groups; 4) involve stakeholders in determining monetary environmental value validity; 5) select primary study data, taking into account internal and external validity; 6) account for primary study design impacts on value outcomes, and; 7) involve stakeholders in the validation of values being transferred.

Wainger and Mazzotta (2011) identified two keys to using benefit transfer successfully. First, the authors recommend finding robust values that can be appropriately transferred to the ecological and sociodemographic conditions present at a site. Then, they suggest Identifying how those values change as the quality or quantity of the service changes.

A sample benefit transfer tool is the Benefit Transfer and Use Estimating Model Toolkit http://dare.agsci.colostate.edu/outreach/tools/#BTT produced by Loomis and Richardson (2008). The authors provide benefit transfer values and estimated meta-analysis equations for benefit function transfer covering the following topics: use values per day of hunting, fishing,
and viewing; use and passive use values per acres of habitat, and; use and passive use values per household of threatened and endangered species. Applying the terrestrial habitat value per acre metafunction, which is available to download in spreadsheet form via the website, returns dollars per acre and total annual dollar value (2006 figures) after selecting options for acreage, wildlife viewing, open space, and whether the site provides an opportunity for viewing multiple species. For example, a 100-acre site that provides wildlife viewing, open space, and habitat for multiple species was valued at $48,060/acre or $4.8 million total annual value for the 100 acres in recreational use and existence value (Loomis and Richardson 2008).

**Cooperative Extension has the Potential to Capture and Report Public Value from Ecosystem Services Provided by Forests**

Given that Cooperative Extension educational programming positively impacts forest landowners, and forests provide ecosystem services, one could theorize that Extension programs enhance ecosystem services. If this thought process holds true, positive Extension impacts on family forest owners would thus generate benefits for society as a whole. Unfortunately, there are very limited examples in the literature that make legitimate connections between Extension forestry outcomes and forest ecosystem services provision. And, none were located that provide willingness to pay estimates or dollar values resulting from Extension program participation. Several peripherally related articles that have addressed this area are described in the following paragraphs.

**Renewable energy.** Respondents to a survey administered by Germain and Ghosh (2013) agreed that using a renewable source of energy will help the environment and that managing for woody biomass was a means to promote energy independence. Renewable
energy sources provide public benefits to society in terms of improved national security and environmental sustainability. The authors identified woody biomass for energy production as an important product for family forest owners. They also identified the opportunity for landowners, local government officials, and county and state Extension personal to collaborate on developing and promoting emerging markets for woody biomass-based bioenergy (Grebner et. al. 2009). In addition, increased focus on woody biomass for energy production could serve as a catalyst to improve forest stewardship on family forests (Germain and Ghosh 2013). Grebner et. al. (2009) concluded that Extension was poised to seize the opportunity to create new and potentially innovative programs at a pivotal time in energy development that can result in the betterment of local economies and create new opportunities for county and state level Extension personnel to serve their clients.

**Water quality.** There are numerous examples of how Extension positively impacts water quality through programming that reduces pesticide use, encourages cattle exclusion from water bodies, by encouraging landscaping practices that promote water conservation, etc. With specific regard to Extension forestry impacts on water quality, however, there are fewer studies available. One example is the work by Munsell and Germain (2004) linking Extension program participation with management planning and improved stewardship and sustainable forest management in the New York City watershed region. The authors observed that Extension programs transfer stewardship values and sustainable forest management information, and in turn, written management plans increase the frequency and likelihood of implementation. They discovered a correlation between the participation rates in Extension
forestry educational programs and written forest management plan use among New York City nonindustrial private forestland owners.

**Carbon sequestration.** Cason et. al. (2006) articulate that Extension can play an important role in carbon sequestration by effectively communicating knowledge to nonindustrial private forest (NIPF) landowners. Extension personnel can help to increase landowner awareness of carbon sequestration in forest ecosystems by making landowners aware of the potential of their lands to sequester carbon (Cason et. al. 2006). The authors argued that, as carbon credit programs become more common, university Extension personnel will be requested to address the basics of carbon sequestration and the specifics of carbon credit programs. Cason et. al. (2006) opined that any Extension program dealing with plant productivity can be adapted to include carbon storage.

**Biodiversity.** According to Straka and Franklin (2008), conservation forestry involves the use of low-cost forest management practices to enhance biodiversity. The authors conducted educational programming to encourage conservation forestry efforts on South Carolina’s coastal plain by developing three major conservation forestry strategies to encourage longleaf pine conversion, prescribed fire usage, and better bottomland hardwood management (Straka and Franklin 2008). As a result of their workshops, Straka and Franklin (2008) reported that 79 forest owners were implementing conservation forestry management plans on approximately 135,000 acres of forestland at the time their article was published.

**Payments for ecosystem services.** Gwin and Pomeroy (2015) conducted interviews with Extension personnel in Oregon, Washington, and Montana. The results revealed limited involvement by Extension personnel with helping clients capitalize on payments for ecosystem
services (PES), both conceptually and as specific programs. Interviews with Extension personnel revealed a significant information gap around payments for ecosystem services (Gwin and Pomeroy 2015).

Gwin and Pomeroy (2015) provided several recommendations for Cooperative Extension with regard to payments for ecosystem services. They encourage Extension personnel whose clientele include private rangeland and forest owners to educate themselves about payments for ecosystem services due to the potential to pair natural resource conservation with increased landowner income. The authors observe that Extension can be an effective intermediary regarding payments for ecosystem services because of its ongoing relationships with landowners, and the preference of landowners for working with known, local entities. They indicate that research-based Extension materials can provide Extension with reliable and credible information to assist landowners with payments for ecosystem services. Furthermore, the authors suggest that Extension can incorporate payments for ecosystem services into ongoing educational formats, particularly forest and range stewardship workshops.

Summary: The (Untapped) Potential for Ecosystem Services to Justify the Cooperative Extension System

Hoag (2005) observed that the Cooperative Extension Service is an outstanding success story for education, but a model whose value is now in question. The appropriateness of the original public Extension model is weakened because citizens are more educated and information is easy to gather. The author proposed a solution to this dilemma which emphasized Extension’s reputation for providing unbiased research-based information, and encouraged increased focus on natural resources and social issues:

“The private sector will provide some information but will generally undersupply it, and in some cases may have the incentive to provide misinformation. This leaves gaps or niches for Extension, but not an excuse to become a monopoly provider. Publicly provided Extension is more likely than a private system to address externalities such as those associated with the use of natural resources, make information availability more equitable, address risk, take advantage of pooling resources for large problems, or have regard for nonmarket concerns such as community health and social issues such as environmental justice. It is in these areas where Extension leaders should focus their attention (Hoag 2005).”
In essence, Hoag (2005) and Barden et. al. (1996) recognized a societal need for implementing sustainable forestry on all non-industrial private forestland and proposed natural resources as a focus area for Cooperative Extension.

A potential contributing factor to Hoag’s assertion regarding the value of the Cooperative Extension model is that institutionalized Cooperative Extension evaluation and reporting structures encourage numbers-based results such as program participation, number of programs conducted, number of educational materials produced, knowledge gained by program participants, and so on. Although impact reporting advancements have been made in recent years, reporting structures and accompanying organizational culture that encourages participation and numbers based reporting does not generally encourage higher level impact reporting, making it very difficult to monetize Extension public value in a methodical, transparent, and credible manner.

Kalambokidis (2014) observed that most Extension programs focus on creating public value through benefiting the greater community. Consistent with this thinking, forests provide numerous valuable benefits to society through the provision of ecosystem services. And, although existing literature would suggest that Extension is not maximizing opportunities to capture and report upon improved provision of ecosystem services resulting from educational programming, nevertheless the implication is there that Cooperative Extension educational programming can positively impact forests in a manner that benefits society. This story can be told through intentional evaluation, data collection, and analysis of educational program offerings, supplemented by the transfer of existing values where appropriate and necessary due to lack of financial resources and/or time constraints.
The application of models such as InFOREST, along with benefit transfer of applicable values from similar primary studies, in assessing Cooperative Extension’s potential to enhance the public value of forest ecosystem services provides a desirable alternative to participation numbers and knowledge gain for articulating Extension’s impact. For example, if a forest landowner attends an Extension educational program, and that landowner then makes a decision to retain a forest rather than convert to another use that he/she attributes specifically to program attendance, then InFOREST can be used to project the CO$_2$ removal by that stand, which in turn provides a public benefit that can be monetized. Likewise, modeling benefits of forest management can encourage the civically minded landowner to consider broader societal benefit when taking management actions.

There is an undeniable, heretofore unrecognized, symbiotic relationship between Cooperative Extension and ecosystem services that provides opportunity for mutual benefit. With Extension’s nation-wide coverage, community relationships, research-based educational programming model, and subject matter expertise, the organization is well-positioned to enhance and optimize ecosystem services by reaching forest landowners. And, through application of benefit transfer principles, it may be possible for Cooperative Extension to articulate societal value through enhanced provision of ecosystem services. Chapter 2 will explore methods for operationalizing this thought-process.
Chapter 2: Applied Case and Lessons Learned

Introduction

This chapter explores the application of benefit transfer principles to a pre-existing Extension evaluation data set in an effort to monetize Cooperative Extension’s impact on ecosystem services provided to society through enhanced management actions conducted on private forest landholdings by Extension program participants. We also explore the potential for Extension forestry to connect across desired outcomes, private value, and public value goals to demonstrate broader economic impact to society resulting from agency actions.

The thought process is conceptualized as follows. We begin with an anticipated learning outcome, such as forest landowners taking at least one positive management action. Then, proceed to capturing and articulating the private value of this management action, such as income received from thinning to improve overall forest health. Benefit transfer is then applied to estimate the associated public benefit that improved forest health provides to society through enhanced carbon dioxide removal, improved aesthetic beauty, and/or other benefits (Figure 3).

Figure 3: Connecting across anticipated educational learning outcomes, private actions, and implied public benefits to demonstrate enhanced economic impact for Cooperative Extension forest landowner education programming.
In the process, we demonstrate that, although considered less costly and time consuming than conducting original studies, benefit transfer still requires investing thought to match appropriate primary studies with policy site characteristics using research-based transfer principles; time that is well spent in the interest of making credible claims. Kalambokidis (2009c) emphasizes the importance of not publicly using a public value message until it is defensible. In our case application, we uncover two underlying important considerations for making such defensible claims. First, we identify causation and correlation in original Extension evaluation data sets as an important consideration impacting the accuracy of value transfers and accompanying public value claims, along with broader implications for Cooperative Extension evaluation efforts. Furthermore, we identify and discuss challenges presented by the marginal and interconnected nature of improvements resulting from forest landowner actions as complicating valuation efforts.

Kalambokidis (2009b) identified that some Extension programs lend themselves more readily to monetization than others, citing the example of educational efforts resulting in waste reduction as more easily monetized than those leading to social capital improvements. Our opinion is that Extension forestry programming contain elements of both. That is, some aspects of forest management improvements are more easily monetized than others.

**Extension Programming Process**

Within Cooperative Extension educational programming efforts, county, multicounty, and state-level Extension faculty and staff plan, implement, and evaluate educational experiences for their clientele according to the Extension programming model. As previously mentioned, the programming model's basic elements include (1) situation analysis, (2) program
design and implementation, and (3) program evaluation and reporting (Virginia Cooperative Extension 2017a).

Extension program development often involves logic modeling. Logic models are used by staff to help conceptualize Extension educational program inputs, outputs, and desired short, medium, and long-term outcomes. Logic models also enable the consideration of resources required to support the effort, assumptions made, and external factors that could influence results (Figure 4) (UWEX 2017).

Within the programming process, Extension evaluation efforts serve multiple purposes, such as incorporating feedback to improve educational programming, communicating impacts to program collaborators and stakeholders, and internal accountability. However, the main driver for program evaluation in Cooperative Extension is public accountability to maintain and increase funding (Franz and Townson 2008). With its reliance on multiple, and often declining, funding streams from local, state, federal, and nongovernmental sources, Extension attempts to capture and communicate the impact of educational programming activities to a variety of external audiences (Franz and Townson 2008). This process becomes increasingly critical as competition for public funding rises and as economic, environmental, and social issues become more complex (Franz and Townson 2008).
Figure 4: Sample logic model template used for Extension educational program conceptualization (UWEX 2017). Copyright © by the Board of Regents of the University of Wisconsin System doing business as the division of Cooperative Extension of the University of Wisconsin-Extension. Fair Use determination attached.

Regretfully, Workman and Scheer (2012) concluded that, despite quality programming experiences, Extension is rarely documenting and demonstrating evidence of true, higher-level outcomes that provide sufficient basis for public value claims. For example, a recent Virginia Cooperative Extension white paper identified that over 70 percent of the impact statements written by VCE agents in 2015 were being reported at the level of “Knowledge Gained” or lower (Clark et. al. 2016). Additionally, only 27% of all impact statements reported an economic benefit. Workman and Scheer (2012) articulate that, although it is likely that Extension
programs make positive differences in the lives of individuals and communities, and that Extension greatly benefits society as a whole, more program evaluation with evidence of higher-level impact showing public value is needed.

**Case Study**

To test our theory, we explore the monetization potential of forest landowner actions identified during a five-year impact study conducted by a VCE Forestry and Natural Resources Extension agent. An impact statement resulting from this data set received the 2011 state-level VCE Programming Award in the program evaluation category. As part of the data collection process, forest landowner education program participants were surveyed to learn about changes and impacts realized since gaining knowledge at one or more landowner education programs between 2006 and 2011 (Fisher 2011). Mail surveys—see Appendix A for the survey template—were distributed to 285 participants and 135 (47%) were returned. The survey intended to capture intermediate practice change, acres impacted, and in some cases associated economic private value. More specifically, results showed that respondents took actions with implications for conservation of forestland (22,879 acres), production of timber and non-timber forest products (8,624 acres), wildlife habitat improvement (2,646 acres), recreational value and aesthetics enhancement (2,046 acres), and protecting land adjacent to waterways (434 acres) (Table 7).
Table 7: Acres impacted as reported by VCE Central District forest landowner education program participants responding to a 2011 survey (Fisher 2011).

<table>
<thead>
<tr>
<th>Management Action Taken</th>
<th>Acres Impacted</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conservation of Forestland</strong></td>
<td></td>
</tr>
<tr>
<td>Enrolled in the Virginia Tree Farm System</td>
<td>11,678</td>
</tr>
<tr>
<td>Thinned a stand of timber for forest health</td>
<td>3,567</td>
</tr>
<tr>
<td>Enrolled in conservation easement</td>
<td>3,097</td>
</tr>
<tr>
<td>Reforested harvested timberland</td>
<td>1,495</td>
</tr>
<tr>
<td>Controlled invasive species</td>
<td>1,445</td>
</tr>
<tr>
<td>Started a Limited Liability Corporation (LLC)</td>
<td>1,097</td>
</tr>
<tr>
<td>Reforested open fields</td>
<td>499</td>
</tr>
<tr>
<td><strong>Forest Products</strong></td>
<td></td>
</tr>
<tr>
<td>Began a small forest products enterprise</td>
<td>4,704</td>
</tr>
<tr>
<td>Harvested timber</td>
<td>3,920</td>
</tr>
<tr>
<td><strong>Wildlife Management</strong></td>
<td></td>
</tr>
<tr>
<td>Created snags for cavity dwelling species</td>
<td>1,799</td>
</tr>
<tr>
<td>Planted trees for wildlife habitat improvement</td>
<td>245</td>
</tr>
<tr>
<td>Created supplemental food plots for wildlife</td>
<td>307</td>
</tr>
<tr>
<td>Planted native warm season grasses for cover</td>
<td>133</td>
</tr>
<tr>
<td>Softened edges of field openings</td>
<td>161</td>
</tr>
<tr>
<td>Water Resources</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Seeding logging roads and decks following a harvest</td>
<td>312</td>
</tr>
<tr>
<td>Created or enhanced a riparian streamside buffer</td>
<td>87</td>
</tr>
<tr>
<td>Planted trees to control erosion on stream bank</td>
<td>35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recreation and Aesthetics</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Created a recreational trail</td>
<td>798</td>
</tr>
<tr>
<td>Built a road for access to the farm</td>
<td>486</td>
</tr>
<tr>
<td>Created a place for nature study</td>
<td>463</td>
</tr>
<tr>
<td>Maintained a fire trail</td>
<td>300</td>
</tr>
</tbody>
</table>

It is interesting to note that, of 36,628 acres potentially impacted, only 8,624 acres (24%) directly related to product (i.e., income-oriented) objectives. This is similar to the findings regarding landowner objectives discussed in Hull et. al. (2004). In addition to acreage impacted by one or more positive management actions, survey respondents estimated earning $580,000 in timber income from timber sales due to forest harvesting activities. Income received in this manner is an example of private value. However, Raunikar and Buongiorno (2006) observed that forests tend to be undervalued when priced for timber only. Although it captured landowner observations regarding acres impacted through actions taken as a result of attending Extension forestry educational programs, and income from timber sales earned since attending those programs, the study stopped short of assigning public value.
Benefit Transfer Considerations

Many of the forest landowners in the case study took actions such as improving forest health (thinning, invasive species control), protecting water quality (planting grass seed and trees to prevent erosion), and protecting open space (enrolling land in conservation easements) that produce benefits to individuals beyond the private landowner. Implied ecosystem services in the data set include: improved water quality via landowner actions that reduced erosion potential (i.e., seeding log landings, establishing riparian buffers); carbon dioxide and climate regulation through activities that improved forest health (i.e., thinning, reforestation, afforestation); increased aesthetic beauty or improved access for viewing nature (i.e., tree planting, recreational trail construction, creating a place for nature study), and; enhanced biodiversity (i.e., controlling invasive exotic species, planting warm season grasses, creating snags for cavity trees).

As discussed in Chapter 1, the benefits that ecosystems provide to society can be estimated through a process called benefit transfer. Benefit transfer is defined as using research results from existing primary studies at one or more sites to extrapolate value estimates for another similar situation where primary studies are not available, considered infeasible, or are too expensive (Johnston et. al. 2015). In the traditional function transfer approach, values that are intended to be applied to the policy context are directly obtained from a single source study by combining parameter estimates from that source study with variable settings for the target, or policy context (Moeltner et. al. 2007). Referred to as unit value or point transfer, applying values from individual source studies remains the oldest and most common form of benefit transfer. Unit value transfers are simple to use, and are often
the only approach available when source studies are limited (Rolfe et. al. 2015a). When conducting benefit transfers appropriate protocols must be followed to select source studies, transfer values, and improve accuracy. In addition, particular attention must be given to the quality and appropriateness of sources studies and to similarities between study and policy sites (Rolfe et. al. 2015a).

While unit value transfer involves a single value estimate, meta-analysis entails using statistical methods to combine, analyze, and synthesize results from multiple, related studies with the objective of drawing general conclusions (Nelson 2015). In the words of Nelson (2015), “meta-analysis allows generalizations about the underlying population of effects and increases the power of statistical tests.” Availability of primary studies is often an issue with meta-analysis, however, and identifying a sufficient number of suitable source studies is the first challenge to address (Rolfe et. al. 2015b). The statistical analysis required for successful meta-analysis requires substantial data (Rolfe et. al. 2015b). For example, Nelson and Kennedy (2009) summarized 140 meta-analyses, and in doing so identified that the mean number of primary studies and accompanying observations included were 42 and 191, respectively. According to Rolfe et. al. (2015b), the field of primary valuation studies is often limited and results in tradeoffs between quality of studies selected and the number of studies available.

In searching for studies that offered potential as a legitimate source of transfer values for application to the case study data, we specifically searched for peer-reviewed, primary studies focusing on benefits provided by private forests in the United States mid-Atlantic and southeastern regions. Three studies that seemed to fit our criteria as a source of benefit transfer values include Moore et. al. (2011), Liu et. al. (2010), and Campbell and Tilley (2014). A
summary of the forest per-acre values provided by these studies is included in Table 8. A sample containing three studies is insufficient for conducting meta-analysis, however, and as a result our efforts focused on identifying which of the studies is best suited for unit value transfer.

Among the considerations for accurate benefit transfer are similarity between the site characteristics, valuation context, and populations at the study site and the policy site (Loomis and Rosenberger 2006). Many authors presenting estimates of ecosystem services values are careful to note the applicability of the data and associated values to very specific ecosystem services.

Table 8: Summary of forest per-acre values from three potential sources of benefit transfer values considered for application to the case study data set.

<table>
<thead>
<tr>
<th>Service</th>
<th>Campbell and Tilley (2014)* $/ac</th>
<th>Liu et. al. (2010)** $/ac</th>
<th>Moore et. al. (2011) $/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Storage</td>
<td>10</td>
<td>60</td>
<td>34</td>
</tr>
<tr>
<td>Stormwater mitigation</td>
<td>588</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Groundwater Recharge</td>
<td>351</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Nutrient Uptake</td>
<td>69</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Soil Building</td>
<td>17</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Erosion Prevention</td>
<td>173</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Air Pollutant Removal</td>
<td>413</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Biodiversity protection</td>
<td>215</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pollination</td>
<td>0.75</td>
<td>162</td>
<td>154</td>
</tr>
<tr>
<td>Aesthetics/Recreation</td>
<td>-</td>
<td>130</td>
<td>506</td>
</tr>
<tr>
<td>Habitat/Refugia</td>
<td>-</td>
<td>923</td>
<td>92</td>
</tr>
<tr>
<td>Water Regulation and Supply</td>
<td>-</td>
<td>9</td>
<td>918</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1837</td>
<td>1284</td>
<td>1704</td>
</tr>
</tbody>
</table>

*Using the authors' values for specific eco-price and converted from $/ha to $/ac.

**The author's reference Type A studies (peer-reviewed) only.
and individual preference characteristics. In particular, Moore et. al. (2011) notes that: “The preferred (valuation) approach depends on the type of resource being valued and whose values are being considered. Because values are resource, location, and population specific, it is always preferred to estimate values from data specific to the resource, location, and population.”

Similarly, Splash and Vatn (2006) found lower transfer errors when the following conditions were matched at the study and policy sites: the environmental good/service, its quantity/quality and the change in quantity/quality; the population, their use of the good/service, and their characteristics; constructed market characteristics; institutional setting; time between primary collection and transfer, and; geographical location.

Richardson et. al. (2015) identify three possible approaches to unit value transfer: 1) selecting an individual study that best matches the characteristics of the policy site; 2) applying an average value from multiple studies, and; 3) applying administratively approved values. To comply with recommended practice for improving transfer accuracy, we applied the Splash and Vatn (2006) considerations to the Campbell and Tilley (2014), Moore et. al. (2011), and Liu et. al. (2010) papers in order to determine if one was most suitable for application to the case data.

**Environmental good/service being valued.** Carbon storage / gas exchange valuation was a common element across all three papers, as was pollination. Campbell and Tilley (2014) developed separate values for groundwater recharge and stormwater, while Moore et. al. (2011) and Liu et. al. (2010) referred to this area as water quantity and quality. Moore et. al. (2011) and Liu et. al. (2010) developed values for aesthetics and habitat, but Campbell and
Tilley (2014) did not. Campbell and Tilley (2014) assigned values to nutrient uptake, soil building, erosion prevention, air pollutant removal, and biodiversity protection, while the other authors did not.

**Population characteristics.** As all three studies under transfer consideration represented state-wide efforts, we referred to US Census Bureau (2010) data to compare the population characteristics between Virginia, Maryland, New Jersey, and Georgia (Table 9). The ethnicity, gender, and racial demographics are fairly consistent across states, with New Jersey having a higher percentage of Hispanic or Latino residents (ethnicity), and Georgia and Maryland having higher percentages of African American residents (race).

Table 9: US Census Bureau (2010) statistics for Georgia, Maryland, New Jersey, and Virginia summarizing population characteristics in terms of ethnicity, gender, and race.

<table>
<thead>
<tr>
<th>State</th>
<th>Ethnicity</th>
<th>Gender</th>
<th>Race</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hispanic or Latino</td>
<td>Non Hispanic or Latino</td>
<td>Male</td>
</tr>
<tr>
<td>Georgia</td>
<td>9%</td>
<td>91%</td>
<td>49%</td>
</tr>
<tr>
<td>Maryland</td>
<td>8%</td>
<td>92%</td>
<td>48%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>18%</td>
<td>82%</td>
<td>49%</td>
</tr>
<tr>
<td>Virginia</td>
<td>8%</td>
<td>92%</td>
<td>49%</td>
</tr>
</tbody>
</table>

**Constructed market characteristics.** Constructed market characteristics illustrate the hypothetical market that an economist defines in a survey enabling respondents to assign value to the ecosystem service. Moore et. al. (2011) and Liu et. al. (2010) conducted primary studies whole or in part, with neither constructing a hypothetical market. Campbell and Tilley (2014) proposed methods for developing an Ecological Investment Corporation as a potential solution for valuing ecosystem services and incorporating them into the economy. The authors developed an “environmental accounting (emergy synthesis) approach in order to provide valuation external to the economy and adherent to the fundamental laws of thermodynamics.”
Institutional setting. With regard to institutional setting, we considered that all three studies represented a state-wide perspective, and elicit values for private property.

The time between primary collection and transfer was similar. Two of the studies under consideration were published in 2010, and one in 2014, while the case data was collected in 2011. Dollar values presented in the primary studies were adjusted for inflation using the Bureau of Labor Statistics Consumer Price index inflation calculator and presented in July 2017 values (Table 10).

Table 10: Summary of forest per-acre values from three potential sources of benefit transfer values considered for application to the case study data set, adjusted to July 2017 dollars using the Bureau of Labor Statistics Consumer Price inflation calculator.

<table>
<thead>
<tr>
<th></th>
<th>Campbell and Tilley (2014)*</th>
<th>Liu et. al. (2010)**</th>
<th>Moore et. al. (2011)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/ac</td>
<td>$/ac</td>
<td>$/ac</td>
</tr>
<tr>
<td></td>
<td>1887</td>
<td>1441</td>
<td>1846</td>
</tr>
</tbody>
</table>

*Using the authors' values for specific eco-price and converted from $/ha to $/ac.  
**The author's reference Type A studies (peer-reviewed) only.

Geographic location. The geographic location and related characteristics for each site were also considered. Virginia, Maryland, and Georgia each have five physiographic regions in common: Atlantic Coastal Plain, Piedmont, Blue Ridge, Appalachian Ridge and Valley, and the Appalachian Plateau. New Jersey has four physiographic regions, to include the Ridge and Valley, Highlands, Piedmont, and Atlantic Coastal Plain.
With specific regard to forest coverage, the percent urban and rural forestland area, percentage of forest in private ownership, population per square mile, and percentage of population in urban and rural settings were summarized combining census data and state-specific FIA reports from the USDA Forest Service (Brandeis and Hartsell 2016, Crocker 2016, Lister and Widman 2014, Rose 2014) (Table 11). Virginia and Georgia showed striking similarities in terms of percent urban and rural land area, percent forest cover, percent forest in private ownership, population per square mile, and percent urban and rural population. Maryland and New Jersey had higher percentages of urban land area, significantly less acreage in forest, approximately 20% less forest cover, less forest in private landownership, and much higher populations per square mile.

Table 11: Percent urban and rural forestland area, percentage of forest in private ownership, population per square mile, and percentage of population in urban and rural settings. (Sourced from USDA Forest Service Forest Inventory and Analysis and US Census Bureau statistics).

<table>
<thead>
<tr>
<th>State</th>
<th>Region</th>
<th>Land Area (square miles)</th>
<th>Percent Urban</th>
<th>Percent Rural</th>
<th>Forested Acres (million acres)</th>
<th>Percent Forest Cover</th>
<th>Percent Forest in Private Ownership</th>
<th>Population</th>
<th>Population per Sq. Mile</th>
<th>Percent Pop. Urban</th>
<th>Percent Pop. Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Georgia</td>
<td>Southeast</td>
<td>57,513</td>
<td>8%</td>
<td>92%</td>
<td>24.7</td>
<td>63%</td>
<td>85%</td>
<td>9,687,653</td>
<td>168.4</td>
<td>75%</td>
<td>25%</td>
</tr>
<tr>
<td>Maryland</td>
<td>Mid-Atlantic</td>
<td>9,707</td>
<td>21%</td>
<td>79%</td>
<td>2.5</td>
<td>40%</td>
<td>73%</td>
<td>5,773,552</td>
<td>594.8</td>
<td>87%</td>
<td>13%</td>
</tr>
<tr>
<td>New Jersey</td>
<td>Mid-Atlantic</td>
<td>7,354</td>
<td>40%</td>
<td>60%</td>
<td>2.0</td>
<td>42%</td>
<td>48%</td>
<td>8,791,894</td>
<td>1195.5</td>
<td>96%</td>
<td>4%</td>
</tr>
<tr>
<td>Virginia</td>
<td>Southeast</td>
<td>39,490</td>
<td>7%</td>
<td>93%</td>
<td>16.0</td>
<td>63%</td>
<td>82%</td>
<td>8,001,024</td>
<td>202.6</td>
<td>75%</td>
<td>25%</td>
</tr>
</tbody>
</table>

By applying the thought process proposed by Splash and Vatn (2006) to insure more accurate benefit transfers, and based on striking similarities in forest and population characteristics, similarities in demographics, matching physiographic regions, consideration of private forests, and state-wide data applications, we conclude that Moore et. al. (2011) provides the best match for potentially transferring values to the case study data.

Recall that Moore et. al. (2011) identified public values of forests ranging from $264 to $13,442/acre annually with higher per acre values generally coming from forested wetlands or
riparian forests in urban areas and lower values from non-wetland forests in rural areas.

Applying the low end of this range to the case due to the predominance of non-wetland, rural forests in the policy site could conceivably result in a claim that 135 forest landowners attending Virginia Cooperative Extension educational programs in the Virginia Southern Piedmont Region between 2006 and 2011 took one or more positive management actions that improved the health of forests valued at approximately $7,393,056 by the general public.

(Based on 28,004 acres impacted for non-product actions). Adding $580,000 in timber income reportedly received by survey respondents would result in a combined public and private value of $7,973,056. However, would making this claim be accurate?

Recall that Moore et. al. (2011) considered the values of: gas and climate regulation, water quality and quantity, soil formation and stability, pollination, habitat, and aesthetic/cultural/non-use values. The case data includes actions that fit several of these categories (gas and climate regulation, water quality, habitat, and aesthetic value), while others are not directly addressed (i.e., soil formation and stability, pollination, and cultural values). In addition, before a transfer and corresponding claim can be made, we need to again consider the nature of the case study data—and others like it--and honestly assess whether the information gleaned from participant surveys—a common characteristic of Cooperative Extension evaluation efforts--can realistically be valued.

Causation/Correlation and Marginality

Causation and correlation. Although the case study asked forest landowners to indicate “changes and impacts realized since your knowledge gained from these (Extension) events” it does not ascertain the degree to which program attendance influenced the outcome. In other
words, there is the possibility that people who attend workshops are more motivated in general and would likely have taken some kind of management action regardless of whether they attended an Extension program (i.e., the case data is correlational and therefore does not lend itself to causative conclusions). As a result, we cannot necessarily infer that workshop attendance caused these actions, as motivated landowners may have chosen to conduct management activities anyway. This uncertainty is consistent with the findings of Silver et. al. (2015), who assert that the link between intention and behavior is poorly understood for private woodland owners.

The difference—i.e., forest landowner actions taken as a direct result of attending the Extension program above and beyond what they planned to do on their own—is something that must be addressed in order to make credible claims. Kalambokidis et. al. (2015) likewise agree that, without controlling for all other influence on program participants’ behavior, we cannot claim the extent to which programs caused changes in behavior. Knowing this information is necessary in order to calculate accurate public values attributable to actions taken, and improved ecosystem services resulting from, Extension program attendance. In the words of Jenal and Liesner (2017), “To achieve confidence that our interventions indeed played a role in achieving the change, we need to attribute the change to the intervention.”

Jenal and Liesner (2017) define “attribution” as the establishment of a causal link between an observed change and a specific intervention. The authors identify three types of approaches for measuring attribution: comparative, prospective, and retrospective. Comparative approaches measure two or more cases that are similar with the exception of a few key traits. The prospective approach starts with a theory (i.e., logic model) regarding how a
program intends to create short, medium, or long term practice change and then measures results along the way. Retrospective attribution involves measuring changes that occurred, and then tracing back to the causal factors in attempt to determine which contributed to the change.

Games (1990) observed that correlational studies are worthwhile as sources of hypotheses about causation, but should be verified by proper experimentation before social policy is made. Richardson et. al. (2015) cautioned against making careless benefit transfers and the potential impact on the field of study. The authors cautioned that frequent use of highly flawed welfare estimates in the policy process may affect the policy relevance of the whole field, potentially jeopardizing the continued opportunity for ecologists and economists to make progress on integrating natural resource values into decision-making. This in turn could undermine improved natural resource policy making, ultimately causing adverse consequences for society’s wellbeing. Richardson et. al. (2015) suggest that this risk can be avoided if appropriate guidelines and recommendations for benefit transfer for ecosystem service valuation are followed. Silver et. al. (2015) recommend that state-level policy makers orient outreach and incentive programs using actual behavioral studies. With these thoughts in mind, it benefits not only an agency—such as Cooperative Extension--seeking to demonstrate public value, but also the benefit transfer field of study, if benefit transfer is not applied to correlational studies.

While not necessarily allowing for causative conclusions, the case data may be sufficient to support a hypothesis that Extension forestry programs result in landowner practice changes that positively impact ecosystem services valued by society. Time and resources permitting, a
properly designed causal study would be necessary as a next step to fully answer the question of Cooperative Extension forestry programming implications for ecosystem services public value. That said, however, if we assume that perhaps even 10% ($797,306) of the case data set relates to causation, it still provides an opportunity to focus the public value conversation.

**Marginality.** In addition to causal considerations, there is the complex nature of changes in value attributable to landowner management actions that changed as a result of attending an Extension program. For example, demonstrating the public value increases that result from thinning improvements (forest health, CO₂ removal), in conjunction with potential public value increase from planting warm season grass (aesthetics, biodiversity) or other management activities, is a complex undertaking. Pendleton and Shonkwiler (2001) describe the interconnected nature of attributes as implying that one attribute cannot be managed without having potentially significant impacts on the levels of remaining attributes. The authors caution against considering single attributes without considering the impacts of other activities on the overall bundle of attributes. To deal with the complexity of ecosystem services dynamics in social-ecological systems, Mouchet et. al. (2014) recommend a methodological approach that considers a diverse range of methods to analyze ecosystem services associations; one that uncovers the ecological and economic factors driving ecosystem services bundles.

It is much easier to conceptualize a linear function whereby ecosystem services attributes are considered consistent across acreage, as opposed to one that changes based on the attribute being discussed. As a result, whereby benefit transfer provides us with a starting point for focusing discussion and claims on a narrower range of values, a primary study that creates causal linkages while simultaneously exploring public perceptions of improvements in
forest attributes would provide important insight for advancing the science in this area. More specifically, a proposed method for 1) attributing forest landowner management actions taken to attendance at Extension education events, as well as gaining insight into whether 2) the general public assigns more value to individual forestland management activities carried out by Extension program participants, and how this value changes as the combination of attributes changes, is described in the following section. To address each of these considerations we explored additional literature regarding causal studies conducted with forest landowners and investigations into public preferences concerning different types of forests and the attributes that characterize them.

**Evidence-Based Studies Regarding Forest Landowner Actions and Assessing Public Preferences for Forest Attributes: A Proposed Method for Extension**

Silver et. al. (2015) conducted an evidenced-based review of timber harvesting behavior among private forest woodland owners. The authors assigned their highest evidence rating to articles that measured actual timber harvesting behaviors rather than self-reported past harvests or intention to harvest in the future. Similar to struggles earlier in this dissertation with identifying Extension forestry published papers that articulated actual practice change, Silver et. al. (2015) identified only a “handful” of evidence-based reviews in forestry research that verify landowner behaviors by using actual harvest data, field visits, or interviews. Using timber harvesting as their platform for exploration, the authors reviewed 87 published articles for landowner timber harvesting behaviors, determining that only five used actual harvesting data to “ground-truth” stated or intended attitudes toward timber harvesting. Of these, studies by Egan and Jones (1993) and Munsell et. al. (2009) were among those receiving the
highest rating for work addressing the link between landowner stated intentions and actual behaviors.

Silver et. al. (2015) recommend mixed-methods approaches to understand private woodland owner timber harvesting behavior in a manner that measures actual harvesting behavior instead of stated intentions or decisions to harvest timber. This thought process can be extrapolated beyond timber harvesting to other management actions that landowners may have taken as a result of some stimulus; a stimulus such as attending an Extension educational program. The authors recommend an approach that involves measuring actual behavior through field visits or spatially explicit data. Thought processes expressed by Silver et. al. (2015), along with methodologies employed by Egan and Jones (1993), Munsell et. al. (2009), and Fajvan et. al. (1998), provide helpful insights into mixed method study designs that ultimately lead to causative conclusions. The methodologies employed by these authors served as the basis for the following general study outline to determine if private forest landowners are taking management actions as a direct result of Extension program participation.

The proposed study begins with a telephone survey of private forest landowners that agree to speak with the researcher and whom attended Extension forestry programs in Virginia over a five-year period from January 1, 2012 to December 31, 2016. Following a brief introduction, the survey would ask the landowner for insights into six questions (Appendix B) related to their level of engagement with their forestland, type of engagement, Extension educational program attendance, management actions attributable to Extension program attendance, and management actions that they would have conducted regardless of Extension
program attendance. Management action choices provided in the survey are borrowed from Hull et. al. (2004) and Fisher (2011).

At the conclusion of the survey, each landowner participant would be asked for permission to visit his/her property for the purpose of viewing management actions. Follow-up field visits would then be conducted on those properties, or a random sample of landowners if the level of agreement was high, to ground-truth statements from the surveys. Researchers would walk transects across the property making observations of management activities (Appendix C). These observations could be accompanied by landowner insights into when management activities took place in order to cross reference with the timeline for Extension program participation. Researchers would then verify the number and type of Extension programs attended by consulting Extension program participant registration records.

To provide a basis for comparison, non-Extension program participants could likewise be consulted regarding their management activities. Landowners could be randomly selected from a GIS data set that identifies forested Virginia land parcels greater than or equal to 10 acres in size, and then cross referenced with locality tax records to obtain landowner contact information. After a brief introduction, phone calls to these landowners would first identify whether the individual had attended Extension forestry programs in the past. If so, the interview would conclude. If not, level and type of engagement would be queried, followed by a request for permission to visit the landowner’s property to view management activities. Ground-truthing interviewee statements about their management activities would proceed in a similar manner to that outlined for Extension program participants.
These observations will allow for a variety of insights, to include a comparison of the level of engagement and types of management activities conducted by Extension program participants and non-participants alike, and causal conclusions about what management activities have actually been implemented by Extension program participants.

The next phase of the proposed study would be to assess the value that members of the general public assign to forests managed by Extension program participants vs. those forests managed by non-Extension program participants in attempt to make public value claims. This can be designed as a choice experiment. This approach involves collecting preference data from subjects comparing a number of alternatives, each described in terms of some number of attributes (Adamowicz et. al. 1998). Though commonly presented in words and numbers, attribute levels may be communicated via pictures, computer graphics, charts, or other means (Adamowicz et. al. 1998). A recent study by Caselegno et. al. (2013) even used data derived from social media to capture variation in the value that people place on different parts of the landscape. A study by Giergiczny et. al. (2015) claims to represent the first effort at quantifying forest structural attributes with respect to both the social and relative contribution of each attribute to recreational value expressed in monetary terms, thereby combining approaches used in landscape research with non-market valuation techniques. Although our interest goes beyond recreational value, Giergiczny et. al. (2015) does provide useful insight into potential methods.

To provide the basis for our choice experiment, photos would be taken while visiting the (engaged) Extension program participant and non-Extension program participant tracts mentioned above. While conducting transects, photographs would be taken of different
management activities encountered. Or, lacking management activities, representative photographs would be taken of forestland conditions. Following the field visit photo collages would be prepared for each site. Once collections of images were completed for all sites, they would be presented to members of the general public in a series of side-by-side slide comparisons. Participants would be asked to assume the role of a local government official, and assign a finite number of tax dollars to support the results pictured in each scenario. This will provide insight into public value placed on engaged Extension program participant actions vs. those actions taken by non-Extension program participants. Although we hypothesize that the forested tracts managed by Extension program participants would attract higher dollar investment than those owned by non-Extension program participants, the outcome remains to be seen. Cataloging the suite of management activities reflected in each photo collage as independent variables, with dollar values assigned as the dependent variable, may begin to provide insight into the marginal nature of forest management actions and corresponding perceptions regarding public value.

Summary

Kalambokidis (2009b) observed that Cooperative Extension did not yet have all the resources and tools necessary to estimate the financial and fiscal benefits of the organization’s programmatic offerings, and we have endeavored to contribute insights and processes to advance organizational thinking in this area. To do a credible job articulating public value, Kalambokidis (2009b) asserts, applied economists, program evaluators and others would need to devote many more hours to data collection and analysis, building and testing models, and writing and testing reports. According to Kalambokidis (2009b), the “likely result of pressuring
Extension program teams to estimate financial impacts while providing them with inadequate resources is a collection of poor quality analyses that erode Extension’s credibility.” We agree, with particular emphasis on Extension organizational approaches to properly designed causal evaluations as a foundation.

We have attempted to avoid the pitfalls identified by Kalambokidis (2009b) by taking an optimistic yet objective look at applying benefit transfer principles to an existing Cooperative Extension evaluation data set as a method for assigning value to Extension forestry’s impact on ecosystem services provided to society through enhanced management actions conducted on private forest landholdings by program participants. In the process we determined that, in addition to honoring research-based benefit transfer best practice procedures, the integrity of the data set to which benefit transfer is being applied is an important consideration for making accurate monetary claims. And, we demonstrate causation, correlation, and marginal changes in attributes as important considerations impacting the accuracy of value transfers and accompanying Extension public value claims, introducing a theoretical draft primary study design to advance understanding of practice changes and societal values attributable to Cooperative Extension forestry educational program participation.

Chapter three will further investigate a model of organizational change that illustrates how intentionally planned evaluation efforts, that take into consideration existing ecosystem services valuation literature, best practices in value transfer, and other considerations, can enhance Cooperative Extension public value claims.
Chapter 3: Continuous Improvement: A Future for Extension

Introduction

Since 2004 a small segment of the Cooperative Extension literature has been focused on public value (Kalambokidis 2004, Kalambokidis 2011, Franz 2011, Franz 2014, Kalambokidis et. al. 2015). Existing literature generally focuses on the importance of articulating public value (Kalambokidis 2004), processes for incorporating public value thinking into organizational culture (Kalambokidis 2011, Franz and Van Ginkel 2011), and a few examples of aggregating private value across a spectrum of participants in attempt to arrive at public value (but primarily accomplishing aggregated private value) (DeBord 2005). Kalambokidis et. al. (2015) assert that “the public sector has a role in encouraging, teaching, and even subsidizing actions by individuals that benefit the greater community.” By providing these public benefits, the authors observe, the public sector creates public value.

Authors that espouse the importance of public value in justifying Cooperative Extension generally stop short of providing concrete examples for how to assign a credible monetary value to Extension’s public impact. As illustrated in Chapter 2, there are reasons for this: doing so can be difficult, complicated, and expensive. Even so, decision-makers and Extension employees alike are understandably skeptical about the veracity of significant public value claims when Extension cannot articulate clear justification for how the numbers were achieved. A credible process, along with organizational culture change, that provides legitimacy to public value financial impact claims is still needed to achieve the goals that public value advocates propose. Yet, a conundrum exists. Cooperative Extension, in pursuit of making claims of generating public value to maintain and improve funding, 1) is rarely documenting and
demonstrating evidence of true, higher-level outcomes that provide sufficient basis for public value claims (Workman and Scheer 2012), and 2) often does not have the funding to conduct sufficient research to support public value claims with facts.

Ultimately, Cooperative Extension must be willing to reallocate limited resources to support the generation of both private and public value statements. While adjusting Extension culture to capture enhanced provision of ecosystem services through evaluation approaches that incorporate research methods--and generating associated public value statements supported by research-based ecosystem services valuation literature--provides one avenue for improving the credibility of Extension public value claims, review of organizational change literature indicates that modifying culture to increase emphasis on ecosystem services provision and accompanying valuation strategies is best approached in a continuous, evolutionary manner rather than through wholesale changes.

Toward this end, Chapter 3 explores the following topics: Cooperative Extension organizational culture; organizational change theory; Extension evaluation as a key element in organizational efficacy, and; recommendations for shifting Extension organizational culture to improve emphasis on ecosystem services provision and enhance overall organizational effectiveness. We conclude by presenting a new model for viewing Cooperative Extension public value as an overall result of efforts to continually improve, rather than simply an economic process.

Cooperative Extension Organizational Culture

Chapter 1 provided a general overview of Cooperative Extension funding and organizational structure. The following paragraphs illustrate Cooperative Extension
organizational culture through the missions and values of three Cooperative Extension systems: Georgia, Maine, and Virginia.

Organizational culture is characterized by values and behaviors that contribute to an organization’s social and psychological environment (WebFinance Inc. 2017). In addition to values and behaviors, organizational culture includes: the dominant leadership style, language and symbols, the procedures and routines, and the definitions of success that characterizes an organization. Organizational culture also represents the underlying assumptions, expectations, collective memories, and definitions present in an organization (Berrio 2003).

Cooperative Extension systems articulate organizational culture through statements that capture the organization’s mission, values, and beliefs. For example, the University of Georgia Cooperative Extension document entitled *Extension Organization Principles* defines the organization’s mission as:

> “University of Georgia Cooperative Extension responds to the people’s needs and interests in agriculture, the environment, families and 4-H/youth in Georgia with unbiased, research-based education (University of Georgia 2017).”

Similarly, the University of Maine Cooperative Extension mission is to:

> “...help Maine people improve their lives through an educational process that uses research-based knowledge focused on issues and needs (University of Maine 2017).”

And, Virginia Cooperative Extension’s mission is defined as:

> “Virginia Cooperative Extension helps lead the engagement mission of Virginia Tech and Virginia State University, the commonwealth’s land-grant universities. Building local relationships and collaborative partnerships, we help people put scientific knowledge to work through learning experiences that improve economic, environmental, and social well-being (Virginia Cooperative Extension 2017e).”

Beyond mission statements, however, values and beliefs articulated by Cooperative Extension systems provide deep insights into Extension organizational culture. For example,
values espoused by the University of Georgia Cooperative Extension (UGACE) include work ethic, honesty, the land-grant concept, agency heritage for change and problem-solving, extension of knowledge to citizens, and programming excellence with continuous improvement through technology, communication, and training (University of Georgia Cooperative Extension 2017). And, UGACE goes on to express a variety of beliefs, including belief in its people, and sincerely working to help Georgians become healthier, more productive, financially independent, and environmentally responsible (University of Georgia Cooperative Extension 2017).

Similarly, the Virginia Cooperative Extension Core Values contain references to: inclusion of all stakeholders and partners, integrity of information, science-based knowledge, engagement, partnerships, individual relationships, and good stewardship of the public trust (Virginia Cooperative Extension 2017e).

The University of Maine Cooperative Extension (UMCE) organizational values include respect for individuals as whole persons, trust, appreciation of diversity, cooperation, integrity, creativity and innovation, participatory management, and respect for wisdom inherent in all levels of the organization and for the contributions of volunteers (University of Maine Cooperative Extension 2017). The UMCE organizational philosophy includes the statement that provides significant insight into the development and maintenance of organizational culture: “More important than a particular organizational structure, staff attitudes and interactions with one another will create a spirit that either revitalizes or debilitates the organization.” One difference in the three cultures is that UMCE formally acknowledges in their organizational philosophy the importance of work/life balance in contributing to personal and organizational
sustainability. UMCE expresses belief in supporting staff to do excellent work in an organizational climate that encourages work/life balance and personal sustainability for employees, acknowledging that this in turn contributes to the ability of the organization to better fulfill the mission and better serve the people of Maine (University of Maine Cooperative Extension 2017).

Although comprised of 76 unique land-grant universities across the country and with offices in or near most of the nation’s 3,142 counties and county equivalents, Cooperative Extension has a common mission of supplying research-based information and education to help people make positive life change (Franz and Townson 2008). Rennekamp and Engle (2008) summarize Extension culture as placing great value on service to people.

In a study of Ohio State University Extension culture, Berrio (2003) determined that Extension personnel exhibited a Clan culture type. The Clan culture is characterized as a family type of organization that represents: a friendly place to work where people share a lot of themselves; leaders have the role of mentors or facilitators; loyalty and tradition are important; employees have a high level of commitment, and; there is emphasis on individual development, morale, teamwork, participation, and consensus (Berrio 2003).

The Clan culture portrays OSU Extension as an organization that concentrates on internal maintenance with flexibility, concern for people, and sensitivity for customers. When stratified by program area, employees identifying with Agriculture & Natural Resources, Family & Consumer Sciences, and 4-H Youth Development, all had a dominant Clan culture characteristics. Community Viability professionals had a Hierarchical culture type, which is defined as focusing on internal maintenance with a need for stability and control. A nationwide
Organizational Change Theory

With public value measurement and articulation via enhanced ecosystem services provision not yet an organizational norm, culture change surrounding evaluation in general, and public value efforts more specifically, will likely be necessary if Cooperative Extension in to normalize efforts to articulate societal value through this medium. How this change could occur requires a basic understanding of organizational change theory. Kezar (2001) identified five types of organizational change: Teleological, Life Cycle, Dialectical, Social Cognition, and Cultural.

**Teleological.** Teleological organizational change models see change agents and leaders as the focus of the change process (Kezar 2001). More recent teleological models involve individuals throughout the organization through the use of teams and collaboration. However, in this approach, individuals within the organization receive little attention and are mostly unimportant (Kezar 2001). This is a key flaw in applying teleological models to Cooperative Extension. Although the organizational leader plays an important role in communicating vision, employees are primarily self-directed with minimal supervision, operate with a wide degree of latitude and autonomy, and are more likely to see clients/citizens as directing efforts. As a result, employees in Cooperative Extension are a key determinant regarding whether organizational change is adopted, to what extent, and how it is communicated to stakeholders.

**Life Cycle.** Life Cycle models envision change as progressive and rational. Organizations are born, grow, mature, go through stages of revival, and eventually decline. The process is a
natural progression that cannot be stopped or altered (Kezar 2001). Change in this model occurs as individuals adapt to the organization’s life cycle and management assists employees with adapting through training and motivational techniques until the organization reaches maturity (Kezar 2001).

Dialectical. In the dialectical approach, the focus is on identifying key people in the organization who will facilitate change—referred to as “evaluation champions” later in this chapter—as well as individuals who will resist change. Networking is used to develop relationships with key people who can be used to influence others and overcome resistance to change. In the words of Kezar (2001), “Once the change agent has an agenda, a network, coalitions, and a power base, then he or she is ready to bargain and negotiate in order to create change.” While commonplace, dialectical methods are less appropriate for organizations that claim to place significant value on people.

Social cognition. Social cognition change models examine how leaders shape the change process through framing and interpretation, and how individuals within the organization interpret and make sense of change. A focus is on identifying the views and belief of organizational participants, and then providing leaders with training on how to lead people to envision a different organizational reality (Kezar 2001). Social cognition ignores values, feelings, and emotions, making this approach unlikely to be successful in a values driven organization like Cooperative Extension.

Cultural. According to Kezar (2001), cultural change theories emphasize the collective process of change and the accompanying role of each individual. Key components of change
include: modifying the vision and mission statements; developing enthusiasm; communicating values and beliefs, and; leaders performing symbolic actions, among others.

Although some change theory models are more applicable to changing Cooperative Extension organizational evaluation culture, it is likely that approaches to change will necessarily incorporate components from several theories.

Bryce (1991a) observed that the approach of many managers in the current era is to focus on output numbers and to narrowly define the function of workers. As discussed earlier in this dissertation, despite occasional efforts to the contrary Cooperative Extension’s reporting focus is likewise primarily on output numbers, with field faculty roles defined by programmatic focus, within which the scope is very broad. Bryce (1991a) reviewed two groups of management theorists: Deming and the Japanese school, who theorize that competitiveness requires a complete change of management’s fundamental philosophy and approach, and; Juran and Crosby, who encourage refocusing management’s attention on quality issues to maintain the competitive edge. Examples of each school of thought will be explored further in the following paragraphs.

**Deming.** Dr. W. Edwards Deming presented 14 Points for Management, as summarized from the W. Edwards Deming Institute (2017): 1) Create constancy of purpose toward improvement of product and service; 2) Adopt the new philosophy; 3) Cease dependence on mass inspection to achieve quality; 4) End the practice of awarding business on the basis of price tag; 5) Improve constantly and forever the system of production and service; 6) Institute modern methods of training on the job; 7) Institute leadership: give all employees the proper tools to do the job right; 8) Drive out fear, so that everyone can work effectively; 9) Break down
barriers between departments and encourage different departments to work together on problem solving; 10) Eliminate numerical goals, posters, and slogans that ask for new levels of productivity without providing specific improvement methods; 11) Remove barriers that rob the hourly worker of his right to pride in workmanship; 12) Remove all barriers to pride in workmanship for people in management and engineering, and eliminate the annual merit rating and management by objective; 13) Institute a vigorous program of self-improvement, and 14) The transformation is everyone’s job. Dr. Deming also introduced the PDSA Cycle (Plan-Do-Study-Act), also known as the Deming Wheel or Deming Cycle. This cycle is a systematic process for gaining valuable learning and knowledge for the continual improvement of a product, process, or service (W. Edwards Deming Institute 2017).

Many of Deming’s points can be applied to the Cooperative Extension system, to include: constancy of purpose toward improving product and service; giving employees the tools required to do their jobs right (i.e., training, technology, financial resources); driving out fear to improve effectiveness (avoid management by intimidation, introduce change incrementally); breaking down barriers between departments, encouraging different departments to work together on problem solving (address academic and programmatic silos by developing cross programmatic teams); eliminating numerical quotas (develop a reporting system that emphasizes client practice change rather than numbers of participants, publications, and presentations); removing all barriers to pride in workmanship (provide sufficient resources for employees to maximize effort, reduce counter-productive administrative directives and bureaucracy, appropriately compensate employees, eliminate burdensome reporting systems); provide vigorous and ongoing education and retraining
(encourage employee professional development and provide adequate financial resources to support these efforts), and; encourage system-wide participation in improvement efforts (i.e., organizational buy-in at all levels).

Ishikawa. Kaoru Ishikawa’s organizational change theory included total quality management, team-based contributions, and customer focus (Ishikawa 1985). Ishikawa believe that practicing quality control involved developing, designing, producing, and servicing a quality product that was always satisfactory to the consumer. Consumers could be the ultimate end-user of the product, or the next internal step in a process. Ishikawa introduced the concept of quality circles, where volunteers from the organization met to discuss improvements to organizational performance. Ishikawa insisted that total quality meant everyone contributed, and believed that quality enhancements were facilitated by providing extensive education in quality improvement tools to all job levels (Ishikawa 1985). Ishikawa believed that building a quality culture was a slow process easily destroyed by too rapid an implementation process (Torroella 2005). Like Deming, Ishikawa’s theory can be applied to Cooperative Extension as an organization. Extension should always strive to design and deliver the highest quality educational products possible to address client needs. In addition, personal observations indicate that customer service delivered internally, such as training sessions at professional development conferences or Extension specialist responses to field faculty and vice versa, do not always achieve the same level as those delivered externally. Extension faculty and staff should always strive to serve both internal and external customers. In addition, Ishikawa’s observations about implementing cultural changes slowly have direct application in Cooperative Extension cultures that do not readily accept change.
Juran. Joseph M. Juran espoused the philosophy that quality-related activities must be conducted by all organizations/departments in a company (Juran 2017). Juran’s theory states that the role of upper management is to lead a company through three major breaks with tradition: 1) annual improvement in quality, year after year, forever; 2) hands-on leadership by upper management to establish new policies, goals, plans, and organizational measures and controls throughout the company, and; 3) massive training in quality for the entire management team, not just the quality department. Juran believed that upper management is responsible for producing breakthroughs in quality improvement, feeling that “There is no possibility for the workforce to make a major contribution to solving the company’s problems” (Bryce 1991a). Juran (2017) notes that these efforts served as the basis for creating a process known today as Six Sigma (2017), where Six Sigma is defined as a “disciplined, data-driven approach and methodology for eliminating defects, driving toward six standard deviations between the mean and the nearest specification limit, in any process” (iSixSigma 2017).

While Juran’s overall emphasis on quality is applicable to Cooperative Extension, the point regarding workforce contributions is problematic. As illustrated later in this chapter, numerous authors emphasize the importance of workforce contribution to, and active participation in, organizational change for those efforts to be successful. Personal observations support that close collaboration between management and Extension field faculty and staff results in greater diversity of thought, collaborative problem-solving, and the generation of many new ideas and practices that lead to organization improvement. In turn, employees are more likely to implement changes in which they have had an active decision-making role.
Crosby. Another thought leader in organizational improvement, Philip B. Crosby (2005) presents his absolutes of quality management as follows: the definition of quality is conformance to requirements; there is no such thing as a quality problem; there is no such thing as the economics of quality - it is always cheaper to do the job right the first time; the performance standard is zero defects, and; the only performance measurement is the cost of quality. Consistent with this theory, personal observations indicate that Cooperative Extension does not have funding issues at the local level where high quality programming is taking place. By contrast, poor quality customer service and educational programming leads to client complaints, dissatisfaction by local government partners, and proposals for funding and/or staffing reductions.

Crosby (2005) asserts that people are slow to change because they reject newness. As a result, he advocates that a company quality improvement plan must be well thought out, and it “must be implemented according to a plan, over a long period of time.” It requires cultural change, becomes part of one’s lifestyle, and must be continually implemented. Crosby’s approach may as well be written with Cooperative Extension in mind. As observed by Kalambokidis et. al. (2015), telling personnel that they need to make a change in how they state their case, or make a case at all, can feel challenging and threatening to Extension employees. Yet, numerous examples exist where Cooperative Extension systems have implemented rapid, drastic, and far-reaching restructuring efforts, with varying degrees of success (Morse 2009) (LeCompte 2011).

Crosby presents his own 14 point plan for organizational improvement: 1) Management commitment; 2) Create quality improvement teams; 3) Quality measurement; 4) Cost of quality
evaluation; 5) Quality awareness; 6) Corrective action; 7) Establish an ad hoc committee for the zero defects program; 8) Supervisor training; 9) Zero defects day; 10) Goal setting; 11) Error cause removal; 12) Recognition; 13) Quality controls, and; 14) Do it over again.

Continuous improvement. Over time, organizational change theories espoused by early thought leaders like Deming, Ishikawa, Juran, Crosby, and others have led to concepts such as Total Quality Improvement (TQM) and continuous improvement. According to Temponi (2005) continuous improvement is one of the core values of quality management. Continuous improvement is a people-focused system that aims to continually increase performance by stressing learning and adaptation as keys to an organization’s success.

Temponi (2005) observed that a continuous improvement focus in academics would result in several positive outcomes, to include: the development of graduates that are more involved, engaged, and motivated in their education; the formation of strong relationships between community employers and institutions of higher learning, and; improved reputations. Extrapolating these observations to Cooperative Extension implies that adopting a continuous improvement mindset would benefit educational programs by increasing client levels of engagement and involvement, improving relationships and partnerships with stakeholders and community partners, and improving Cooperative Extension’s reputation for providing quality products, and therefore perceived public value. We opine that the necessity for wholesale and reactionary Extension reorganization efforts responding to financial resource issues could be reduced or eliminated by organizational commitment to continuous improvement at all levels, to include emphasis on public value articulation through ecosystem services as one component.
Fryer et. al. (2007) provides a comprehensive review of continuous improvement literature applied in the public sector. The authors begin by observing that the public sector has followed the private sector, taking tools developed in the manufacturing sector and adapting and implementing them with varying degrees of success. The authors observe that the public sector is distinct from private sector in several key areas. First, the primary goal of public agencies is not maximizing profit. Cooperative Extension is an example of this, typically offering educational programs for free or at very low cost. Next, most public services have three distinct domains: policy, managerial, and professional. People in public organizations switch between these different domains as well as have multiple reporting structures. This description applies to Cooperative Extension as well, with the most prevalent involving staff reporting results to local partners, program teams, state administration, local boards and committees, and so forth. For example, in addition to annual accomplishment reports submitted through state reporting software, VCE Unit Coordinators submit monthly, quarterly, or yearly summaries of accomplishments to local funding partners. Extension employees are also beholden to local, state, federal, and university policies and procedures.

Fryer et. al. (2007) point out that a third difference between public and private sector entities is that public organizations suffer from a lack of clarity about who their customers are. And, they have a diverse range of stakeholders to serve, many of whom are customers as well. This is true for Extension. As illustrated earlier in this chapter, Extension mission statements commonly cite all citizens in the state as constituents, served through broadly interpreted programmatic areas, which in turn contributes to a sense that Extension must be all things to all people. Fryer et. al. (2007) also expressed that public sector service quality often suffers from
intangibility, heterogeneity, and inseparability. For example, services cannot be precisely
defined and measured, services are inconsistent as they depend on the interaction between the
individual service provider and the customer, and the delivery and consumption of the service
occur simultaneously and the customer may influence the outcome of the service provided.

One need look no further than the public value as an Extension-related concept that is
difficult—but not impossible—to precisely define and measure, while educational programs
inherently present the challenge of simultaneous delivery and consumption. And finally,
infinite demand, variability of service provided, high expectations, and limited resources also
differentiate the public from the private sector (Fryer et. al. 2007).

Fryer et. al. (2007) observed that public agencies are also subject to “whims and fancies”
of government. The authors indicate that a new administration often results in reorganization
of the agency with new boundaries. They also observe that reorganization results in
uncertainty, the organization takes time to settle down after changes are implemented, and
such actions are not conducive to providing first class service.

According to Fryer et. al. (2007), the public sector motivation for improvement is not
increased profit but rather being faced with ever greater demands on increasingly limited
resources. This is similar to observations made earlier in this chapter by Extension public value
advocates (Kalambokidis 2004, 2011). Fryer et. al. (2007) cite numerous benefits of applying
continuous improvement as a strategy to achieve organizational culture change, to include:
low capital investment, ideas and suggestions come from those that are actually doing the job,
increased employee commitment, improved performance/equality, reduction of waste,
reduced costs, and improved customer satisfaction. Very few public organizations have the
resources to rely on a few large changes but instead need to continually make smaller improvements. Martichenko (2004) observed that “organizations that do not embrace continuous improvement will follow destructive patterns of re-organization, re-structuring, layoffs, and other reactionary management techniques.”

While there appears to be no published literature on applying continuous improvement principles in Cooperative Extension, there are numerous examples of Cooperative Extension systems responding to limited resources with wide-scale restructuring (Morse 2009, Shaver 2009, Greiner 2010, Kirwan 2016). ASTD (2006) states that it typically takes some pain point to be the motivator for steering away from the status quo. This implies that organizations implement change in a reactionary manner, such as an Extension system restructuring when budget cuts move an organization past the tipping point. These restructuring plans typically involve regionalizing an agency that has historically been locally based, resulting in the strong likelihood of decreased programming presence at the local level, with corresponding reduction in relationships and advocacy, which in turn leads to further reductions in funding, and further agency retraction: a process of continuous decline (Figure 5).
Continuous improvement results in organizations becoming more responsive/flexible and therefore more able to adapt to future change (Fraser 1995). In the longer term, generating a culture focused
on continuous improvement will also deliver a culture focused on participation, partnerships, and empowerment, leading to enhanced fundamental skills of all staff and superior operational performance. And, in the words of Fraser (1995), quality can be an effective marketing strength.

Fryer et al. (2007) cite public organizations constantly facing the challenge of doing more with less as rationale for continuous improvement. We theorize that continuous improvement strategies applied incrementally in Cooperative Extension would lead to improved educational program quality, agency function, and funding. More specifically, we theorize that implementing continuous improvement approaches and methodology would have the opposite effect to that presented in Figure 5. That is, increased programming presence at the local level, leading to higher quality programming, stronger impacts, improved relationships and advocacy, and more resources, which in turn leads to additional programming and the cycle repeats, reversing the downward spiral that has engulfed many Extension systems nationwide (Figure 6).

Figure 6: Anticipated result of continuous improvement efforts in Cooperative Extension systems, to include concentrating limited resources at the local level, resulting in increased programming presence, impact, relationships, advocacy, and ultimately, financial resources.
Extension Evaluation: A Key Component of Continuous Improvement and Cultural Change

One key aspect of informing an organizational improvement process is assimilating and acting upon information gained through program evaluation. A major underlying principle is the establishment of constant self-assessment techniques (Temponi 2005). Kalambokidis (2009a) states that “the public value approach must work hand in hand with program evaluation: it is through good program evaluation that we are able to make credible statements about our programs’ public value.” Kalamabokidis et. al. (2015) assert that “insistence on monetizing program benefits without devoting significant resources to program evaluation runs the risk of releasing poorly done, indefensible estimates of financial impact, thus endangering Extension’s most prominent asset – its credibility.” Silliman et. al. (2016) espouse that “…incorporating evaluation can cultivate a spirit of continuous learning, improvement, and accountability, and create awareness and support for program evaluation and self-evaluation as a performance improvement strategy.” Evaluation, its application in Cooperative Extension, and potential contributions to organizational improvement are explored in the following paragraphs.

The Extension programming process is a cultural feature that is unique to the Cooperative Extension organization. As described earlier in this dissertation, Extension faculty and staff plan, implement, and evaluate educational experiences for clientele according to the Extension programming model. Extension faculty should be evaluating educational programs to determine how educational programs were received, opportunities for program improvement, knowledge gained, and short, medium, and long-term practice change. Baughman et. al. (2012) observed that Extension educators are encouraged to conduct evaluations to meet reporting
requirements while also learning more about the impacts of their programs. And, the authors’ study identified that Extension educators use evaluation results to persuade others about the value of their programs; to learn more about their programs; to change how others think about their program, and to a lesser extent; to transform or end a program.

Despite being a formal part of the programming process, however, and the subject of frequent organizational discussions and training, Extension evaluation infrequently articulates practice change and societal value. For example, a recent Virginia Cooperative Extension (VCE) white paper identified that over 70 percent of the impact statements written by VCE agents in 2015 were are being reported at the level of “knowledge gained” or a lower level of programming (Clark et. al. 2016). In addition, only 27% of all impact statements reported an economic benefit. These results were returned despite frequent communications and training/individualized coaching sessions with Extension agents regarding the importance of evaluation and impact writing. Lamm and Israel (2011) found that the majority of Extension faculty in their study were just reporting the number of clients attending their programs (82.4%), and 13.6% did not engage in the practice of evaluation at all. Thus, despite being an integral part of the Extension programming process, it would appear that evaluation is not necessarily an ingrained aspect of Cooperative Extension culture.

Workman and Scheer (2012) articulate that, although it is likely that Extension programs make positive differences in the lives of individuals and communities, and that Extension greatly benefits society as a whole, more program evaluation with evidence of higher-level impact showing public value is needed. Franz et. al. (2014) expressed the opinion that, although a strong evaluation culture developed across Extension in the 15 years prior to their
article, most Extension program evaluation falls short by measuring only the private value of programs. The authors express concern that evaluation efforts document only learning or behavior changes of direct participants in Extension programs, look at problems in a linear way, and through isolated efforts. Lamm and Israel (2011) observed that the ability to provide credible information depends primarily on the evaluation activities of Extension professionals. Franz et. al. (2014) observed that public value measurement and articulation is not an organizational norm. The authors recommend that Extension programming and evaluation models change from a linear orientation to an approach better suited to today’s more complex programming and political environment.

Guion et. al. (2007) observed that Cooperative Extension is working to build evaluation capacity of faculty and staff, driven by change influences in the form of increased accountability, reporting program outcome and impacts, and evidence-based policies. The authors observed that it is becoming increasingly common for states to hire Extension evaluation specialists with programming emphasis who are located within departments or program units. Via survey-based research, they discovered that 37% of evaluation specialists were located within a program development and evaluation unit, followed by 24% being located in administration, 22% located in an academic department, and 17% in a program area or programming group. The authors also noted that the majority of Extension evaluators work Extension-wide. That is, they do not serve a single program area. They also tend to be housed in a separate program evaluation or administrative unit, although a small number of Extension evaluators serve a single program area and are housed with specialists from that program area. Even so, Lamm and Israel (2011) observed that, even with the assistance of Extension
evaluation specialists, “supportive evaluation cultures within state Extension systems are limited despite research showing evaluation is an essential Extension employee competency.”

Boyd (2009) observed that many Extension evaluators report to administrators such as deans and directors, and work for the organization, at least in part, through administrators who are "champions" for evaluation. Evaluation champions are leaders who have influence in the organization and who value and support evaluative thinking. Champions are key to the success of evaluation capacity building efforts in Extension (Silliman et. al. 2016). Boyd (2009) observed that evaluators and administrators together can: 1) involve stakeholders consisting of field faculty and specialists in what is realistic and possible; 2) set a positive tone for what can be done, and; 3) communicate that both program improvement and program results are important findings in evaluation processes.

Volkov and King (2007) provide numerous insights for building an organization’s evaluation capacity via their four page checklist. The authors recommend awareness of the internal and external organizational context, including power hierarchies, administrative culture, and decision-making processes. Then, cultivate a positive, internal organizational context that is receptive to evaluation capacity building. They recommend consideration of the external environment and its influence on an organization. The authors encourage purposefully creating mechanisms within the organization that enable the development of evaluation capacity such as implementing long term evaluation capacity building plans, building and reinforcing infrastructure to support evaluation processes, socializing the organization’s evaluation process, and building peer learning structures. With regard to resources, recommendations include providing and continuously expanding access to evaluation
resources, and securing support for program evaluation in the organization (Volkov and King 2007).

Rennekamp and Engle (2008) observed that increased Cooperative Extension commitment to evaluation has been driven by external pressure to demonstrate results or ensure program quality. Cooperative Extension systems are faced with the necessity of evolving to keep pace with client needs, evolving issues, competing educational content delivery streams, and fluctuating funding streams. Part of the reality for Cooperative Extension in demonstrating societal value is to develop an organizational culture that values and encourages advanced and technically sound evaluation approaches that capture results capable of being valued at a higher level.

Fernandez and Rainey (2006) list several recommendations for successfully managing change in the public sector. First, organizations should ensure that the need exists. Once the need is confirmed, leaders should verify and persuasively communicate the need for change, and then develop a course of action and/or strategy for implementing it. Organizations must build internal support for change, including top management support and commitment. Building external support from political “overseers” and key external stakeholders is also necessary. And finally, the authors recommend providing sufficient resources. In addition, as people are generally reluctant to change, organizations are not likely to embrace change for reasons they do not find convincing (ASTD 2006).

Smith and Torppa (2010) ask the question: What can Extension organizations do to flourish during continuous change? They theorize that the most important action Extension organizations can take to help personnel adapt to current changes, while at the same time
growing the capacity to thrive during ongoing and future changes, is to encourage personnel to take an active role in organizational planning processes. The authors concluded that—for personnel at all levels in the organization—greater participation in change processes led to more receptivity to change, less pessimism about the plan's likelihood of success, and more motivation to help insure the plan’s success. Listening to internal and external concerns is important, because organizational change is personal (ASTD 2006).

With regard to cultural change in higher education organizations, Kells (1995) correlates the success of change efforts with: positive attitude toward change by leadership; the development of adequate levels of internal motivation; a proper infrastructure of information, and; a careful and appropriate selection of a design or approach for the evaluation process. The author cautions that proposed change should be similar in substance or style form the norms of the organization, and should be something which can be a powerful persuader, such as demonstrating the willingness of the organization to redistribute limited resources as an incentive for participation and/or for significant levels of results.

**Summary: Recommendations for Shifting Cooperative Extension Culture**

With these views in mind, along with insights from thought leaders in management and organizational effectiveness, we synthesize the following considerations to assist with articulating our organizational change theory for Cooperative Extension. That is, implementing change that enhances Extension’s ability to make credible public value claims through enhanced ecosystem services provision underlain by a continuous improvement mindset in all facets of the organization.
Micro Level

- Provide in-service training opportunities to educate faculty on ecosystem services, benefits provided by ecosystem services, how Extension programming positively impacts ecosystem services, and benefit transfer of ecosystem services values to articulate public benefit outcomes. (Germain and Ghosh (2013) observe that “The most effective and efficient manner to promote an innovation...is to first engage the change agents who have contact with family forest owners”).

- Consider shifting faculty full-time equivalents (FTE’s) to refocus on areas such as forestry and natural resources subject matter where opportunities await to demonstrate improved value through enhanced ecosystem services.

- Reallocate FTE’s for existing agricultural economists to assist with public value articulation and making ecosystem services benefit transfers.

- Hire economists and statisticians to provide analytical expertise to determine the economic impact of Extension programs and develop more quantitative approaches for assessing impact (Franz et. al. 2014).

- Fully engage environmental and resource economists as members of interdisciplinary teams from the outset, and over extended periods of time Ervin et. al. (2012).

- As part of the overall organizational approach, managers may need to place increased emphasis on the strength of a faculty member’s impacts. This while recognizing, however, that the highest performing Extension employees typically receive personal satisfaction from assisting clients and are motivated more by intrinsic mechanisms than administration cajoling, performance evaluation, or financial incentives.

Meso Level

- Increase administrative support for evaluation in general to elevate the importance of evaluation and increase visibility and importance within the organization (Lambur 2008).

- Identify ways for evaluators to become engaged with programmers earlier in the program development process (Guion et. al. 2007).

- Incentivize evaluation efforts that demonstrate collaboration with an Extension specialist that leads to credible ecosystem services public value claims.

- Promote evaluation as a tool for improving programs rather than helping Extension meet demands for accountability (Lambur 2008).
• Provide recognition to Extension agents whose evaluation efforts truly demonstrate environmental practice change.

• Adopt a culture where program staff view themselves as primary stakeholders for evaluation results, thus increasing the likelihood that they become engaged in the process of conducting high-quality evaluations (Lambur 2008).

• Incorporate research methods into program evaluation and design (Diem 2002) to assist with quantifying changes in ecosystem services and estimating to what extent the Extension program is responsible.

Macro Level

• Insure top management commitment, a clear mission statement, clear goals, and a clear commitment towards internal and external customer satisfaction (Fryer et. al. 2007), where external customers include an emphasis on consumers of ecosystem services.

• Continuous learning is vital; emphasize education (Fryer et. al. 2007). Provide faculty with continued organizational support and coaching on an individual basis following initial training opportunities (Kells 1995), to include ecosystem services.

• Commit to quality management as a long-term process (Crosby 2005) (Fryer et. al. 2007).

• Involve employees in organizational improvement and decision-making (Fryer et. al. 2007) (Smith and Torppa 2010) (W. Edwards Deming Institute 2017) while recognizing that democratic participation in decision-making and effectiveness (deciding on feasible actions to achieve goals) often conflict (Alexander 2015).

• Encourage managers to challenge process, inspire a shared vision, enable others to act, model the way, and encourage the heart (Bryce 1991b). Remove barriers, roadblocks, and silos that interfere with superior performance (W. Edwards Deming Institute 2017).

Conclusion

Hoag (2005) observed that the Cooperative Extension Service is an outstanding success story for education, but a model whose value is now in question. The appropriateness of the original public Extension model is weakened because citizens are more educated and information is easy to gather. The author proposed a solution to this dilemma which
emphasized Extension’s reputation for providing unbiased research-based information, and encouraged increased focus on natural resources and social issues. In essence, Hoag (2005) and Barden et. al. (1996) recognized a societal need for implementing sustainable forestry on all non-industrial private forestland and proposed natural resources as an increased area of emphasis for Cooperative Extension.

Since 2004 a segment of the Cooperative Extension literature has been focused on public value (Kalambokidis 2004, Kalambokidis 2011, Franz 2011, Franz 2014, Kalambokidis et. al. 2015). Existing literature generally focuses on the importance of articulating public value (Kalambokidis 2004), processes for incorporating public value thinking into organizational culture (Kalambokidis 2011, Franz and Van Ginkel 2011), and a few examples of aggregating private value across a spectrum of participants in attempt to arrive at public value (but primarily accomplishing aggregated private value) (DeBord 2005). Kalambokidis et. al. (2015) assert that “the public sector has a role in encouraging, teaching, and even subsidizing actions by individuals that benefit the greater community. By providing these public benefits, the authors observe, the public sector creates public value.

Lamm and Israel (2011) state that Extension continues to exist with little data showing programmatic worth. This appears to be an accurate assessment, but does not need to remain that way. As has been discussed throughout this dissertation, applying ecosystem services values to Extension natural resources-related programmatic outcomes provides a vehicle for Extension to make significant advancements in addressing the value question. This requires a different way of thinking that challenges an often siloed organizational culture (even though ecosystem services have positive implications for all four traditional Extension programming
areas). This story can be told through intentional evaluation, data collection, and analysis of educational program offerings, supplemented by the transfer of existing values where appropriate and necessary due to lack of financial resources and/or time constraints in order to monetize public value. There is an undeniable, heretofore unrecognized, symbiotic relationship between Cooperative Extension and ecosystem services that provides opportunity for mutual benefit. With Extension’s nation-wide coverage, community relationships, research-based educational programming model, and subject matter expertise, the organization is well-positioned to enhance and optimize ecosystem services through expanded efforts to reach forest landowners and practitioners.

The extent that existing research-based public valuation models can be applied to support Extension public value claims depends on a number of factors. These include the existence and level of sophistication of those models, whether the resulting values can be reasonably applied across cases, whether data is obtained from Extension evaluation approaches that can be plugged into these models, and whether Extension culture adapts to incorporate these approaches, to name a few. It behooves Extension practitioners to be aware of the public valuation models in their respective disciplines so that we can further explore and expand the application of these models in articulating Extension public value. Adopting this mindset will require a shift in organizational thinking, one that views public value as both monetized impact and a continuous improvement process that emphasizes the overall value that Extension provides to citizens (Figure 7). And in the process, provides an opportunity to extend Cooperative Extension’s life cycle, improve the design and delivery of educational programs, do a better job articulating an array of public benefits resulting from agency
accomplishments, optimize allocation of sparse resources, and make substantive contributions
to facilitating positive life change in Extension clientele. The latter of which, after all, provides
the answer to the existential question.

Figure 7: A thought-process for bolstering Extension public value claims.
Literature Cited


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Appendix A:

Case Study Forest Landowner Survey
Forest Landowner Survey
Virginia Cooperative Extension, Central District

You are receiving this survey based on your participation - since 2006 - in one or more Virginia Cooperative Extension Forest Landowner Education Programs. These would have included field tours, bus tours, classroom sessions, workshops, and retreats. Please indicate changes and impacts realized since your knowledge gained from these events. Your responses will be kept confidential and will only be used to indicate total impact of the Central District Extension Forest Landowner Education Program. Please help us maintain this important program by sharing what you have accomplished. A self-addressed stamped envelope has been provided in hopes of obtaining a greater response rate. Thank you for taking the time to complete this vital information that will continue to provide direction for our programs.

I. Forest Improvement:
I/we have secured professional assistance on my/our property yes no
I have obtained/updated a forest management plan for my property yes no

Our family has more specifically performed the following conservation management on our forestland:

<table>
<thead>
<tr>
<th>Check all that apply</th>
<th>Acres</th>
<th>Income Realized per acre</th>
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<tbody>
<tr>
<td>___ Conservation Easement</td>
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<tr>
<td>___ Virginia Tree Farm System</td>
<td></td>
<td></td>
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<tr>
<td>___ Family Farm Limited Liability Corporation (LLC)</td>
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<td></td>
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<tr>
<td>___ Reforested open fields</td>
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<tr>
<td>___ Reforested harvested timberland</td>
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<tr>
<td>___ Thinned a stand of timber for stand health</td>
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<tr>
<td>___ I have managed my property for invasive species control (ie: ailanthus, kutzu, etc.)</td>
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II. Forest Products

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<th>Check all that apply</th>
<th>Acres</th>
<th>Income Realized per acre</th>
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<td>I/we have conducted a timber harvest</td>
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<tr>
<td>Softwoods (pine)</td>
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<td>Hardwoods (oak/hickory)</td>
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<td>I have participated or begun a small forest products enterprise</td>
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<tr>
<td>Ginseng</td>
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<td>Shiitake Mushrooms</td>
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<td>Charcoal</td>
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<td>Sawmill</td>
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III. Wildlife Management

I/we have enhanced the wildlife habitat on property by:

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<tr>
<th>Check all that apply</th>
<th>Acres</th>
<th>Income realized per acre (may include hunting leases)</th>
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<tr>
<td>___ Creating snags for cavity dwelling species</td>
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II. Planting trees for wildlife habitat improvement
___ Creating supplemental food (plots) for wildlife
___ Planting native warm season grasses for cover
___ Softening edges (escape cover) of field openings by planting shrubs or harvesting trees

IV. Water Resources
I/we have practiced best management practices (BMP’s) on Virginia’s water resources by:

Check all that apply:  Acres  Income realized per acre
___ Planting to control erosion on our stream bank
___ Creating or enhancing a riparian (streamside) buffer
___ Seeding logging roads and decks following a harvest

V. Recreation and Aesthetics
I/we have implemented the following practices to enhance the enjoyment of our property:

Check all that apply:  Acres  Income/value realized per acre
___ Created a recreational trail
___ Built a road for access to areas on the farm
___ Created a place for nature study

What do you feel is the top issue or challenge facing forest landowners in your region of Virginia? (ie: available markets, development, water quality, timber sales assistance, etc.)

Share any other information you would like that is not listed above that pertains to impacts realized as a result of attending a Virginia Forest Landowner Education Program (VFLEP)

It is our intention to give you ample time to gather the needed information; therefore, the deadline for completing the survey is February 28, 2011. Please return your completed survey form in the provided self-addressed envelope by this date. Thank you kindly for your participation and time. We hope to see you at the next upcoming program!

Sincerely,

K. Jason Fisher
Extension Agent/ANR Forestry and Natural Resources
jasonf@vt.edu; Phone: Office (434) 476-2147 / Cell (434) 579-5689
Appendix B:

Proposed Landowner Survey – Self Report
Survey: Extension Forestry Program Participant Self-Reported Behaviors

1. Are you engaged with your forestland?  Yes  ________  No  ________

2. If so, in what ways? (check all that apply)
   ________ Grow small plots of specialized crops (e.g., fruits, vegetables, ginseng, etc.) that can be sold for a profit.
   ________ Plant high-value trees for future sale as timber.
   ________ Graze livestock in the woods.
   ________ Prune or cut down selected trees to improve timber value.
   ________ Develop a written management plan for my land.
   ________ Use herbicides or pesticides to control weeds and insects.
   ________ Prune or cut down selected trees to improve scenic views.
   ________ Kill vines growing in trees.
   ________ Plant vegetation to provide privacy from neighbors and roads.
   ________ Prune or cut down selected trees to improve forest health.
   ________ Have my soil tested.
   ________ Improve wildlife habitat.
   ________ Regularly inspect the condition of my land.
   ________ Enrolled land in a conservation easement.
   ________ Created or enhanced a buffer along a body of water.
   ________ Kept land in forest that I would have converted to other uses.

3. How many Extension forestry educational programs have you attended between January 1, 2012 and December 31, 2016?  ________

4. Have you taken actions on your land because of what you learned in Extension forestry programs?  Yes  ________  No  ________
5. If so, which management actions do you attribute to your attendance at Extension forestry educational programs? (check all that apply)

- Grow small plots of specialized crops (e.g., fruits, vegetables, ginseng, etc.) that can be sold locally for a profit.
- Plant high-value trees for future sale as timber.
- Graze livestock in the woods.
- Prune or cut down selected trees to improve timber value.
- Develop a written management plan for my land.
- Use herbicides or pesticides to control weeds and insects.
- Prune or cut down selected trees to improve scenic views.
- Kill vines growing in trees.
- Plant vegetation to provide privacy from neighbors and roads.
- Prune or cut down selected trees to improve forest health.
- Have my soil tested.
- Improve wildlife habitat.
- Regularly inspect the condition of my land.
- Enrolled land in a conservation easement.
- Created or enhanced a buffer along a waterbody.
- Kept land in forest that I would have converted to other uses.

6. If you had not attended any Extension forestry educational programs—or if you did not take actions because of attending Extension programs—which actions would you have taken anyway? (check all that apply)

- Grow small plots of specialized crops (e.g., fruits, vegetables, ginseng, etc.) that can be sold locally for a profit.
- Plant high-value trees for future sale as timber.
- Graze livestock in the woods.
- Prune or cut down selected trees to improve timber value.
- Develop a written management plan for my land.
- Use herbicides or pesticides to control weeds and insects.
- Prune or cut down selected trees to improve scenic views.
- Kill vines growing in trees.
- Plant vegetation to provide privacy from neighbors and roads.
- Prune or cut down selected trees to improve forest health.
- Have my soil tested.

- Improve wildlife habitat.
- Regularly inspect the condition of my land.
- Enrolled land in a conservation easement.
- Created or enhanced a buffer along a waterbody.
- Kept land in forest that I would have converted to other uses.
Appendix C:

Proposed Landowner Survey – Ground Truth
Field Visit: __________________ Property  Date ____________

1. Is the landowner engaged with his/her forestland?  Yes  ______ No  ______

2. If so, in what ways? (check all that apply)  

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<th>Year</th>
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3. How many Extension forestry educational programs has the landowner attended between January 1, 2012 and December 31, 2016?  __________

4. List programs attended:  

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