

DEMONSTRATIONS OF FOREST SUSTAINABILITY IN FOREST MANAGEMENT
PLANS AND CERTIFICATION PROGRAMS IN THE UNITED STATES

by

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(Under the Direction of Pete Bettinger)

ABSTRACT

The sustainability of forests has long been discussed around the world. The development and implementation of forest management plans and forest certification programs have been considered instruments to demonstrate and monitor forest sustainability goals (through, for example, on-the-ground indicators and resource assessments). Despite apparently understanding the main considerations that influence the sustainability of forests, scientists are still skeptical about evidentiary demonstrations of it being achieved. Three studies were developed within this dissertation. In the first study, an open-ended questionnaire and a mixed method analysis approach were employed to collect data from forest planners around the United States in regard to their perceptions and ways in which they incorporate sustainability concerns in forest plans. Results showed that the environmental aspect is better represented in plans than socio-economic considerations, and that professionals recognize the difficulty in incorporating sustainability concerns in plans as well as communicating these. A list of the 10 most frequently used terms in association with sustainability was obtained. In the second study, a review was conducted of five forest certification programs developed and implemented

in North America and Europe to determine differences in the substantiveness of these programs. Results showed that the FSC program appears to be the most detailed and prescriptive of the five. The other four programs seemed to be less substantive and rigorous/flexible in some aspects in comparison to the FSC principles. In the third study, content analysis was employed to examine the frequency of use of terms associated with sustainability and the context in which they appear in state forest management plans. A categorical system was developed to code and to identify the extent to which dimensions of sustainability are considered in the plans. Results suggested that state forest plans include most of the terms associated with sustainability. However, certain aspects that were expected to frequently occur (best management practices, forest certification, and adaptive management) seemed underrepresented. The social consideration appeared to be the least reflected of the sustainability considerations. Discourse analysis is encouraged to understand and direct better the application and progress towards sustainability as understood by social actors in a specific context.

INDEX WORDS: forest management, forest planning, frequency analysis, open-ended questionnaire, policy, qualitative analysis, snowball sampling, sustainability, state forests, timber management, FSC, SFI, ATFS.

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BS, Universidad Distrital Francisco José de Caldas, Colombia, 2007

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial
Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2020

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DEDICATION

To my precious daughter, Wren, to my husband Oscar, and to the loving memory of the strongest woman ever who I still miss every day, mamá.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my mayor advisor, Dr. Pete Bettinger. Thank you for having given me the opportunity to pursue a Ph.D. degree, for trusting in my capabilities and for providing constant and invaluable support and guidance during this process. It was an invaluable privilege to work under his guidance and I will always be grateful for encouraging to advance my career.

Additionally, I would like to thank my committee members, Drs. Jacek Siry, Bin Mei, and Jesse Abrams for their time, openness, responsiveness, and rich advice during my research projects. I also express my appreciation to my research mates Shingo Obata and Taeyoon Lee for always being open to discuss academic questions and to provide insight into my research. Further, I express my gratitude to all members of the Warnell School of Forestry and Natural Resources. Your efficiency, responsibility, and kindness made the difference during my time here.

Thank you to my sister and brother who, although being overseas, have always been there for me. Thank you for listening and thank you for loving me unconditionally.

Lastly, Oscar, thank you for all the love, patience, and support I needed to continue this program; Wren, I LOVE YOU and thank you for making me stronger and for staying with me through this adventure. Thank you all for helping me make this dream to come true.

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CHAPTER 1

INTRODUCTION

Sustainability has become one of the most common terms used in not only the environmental management field and related discussions of the environment, but also in other several fields such as forestry, agriculture, and even business. However, many authors (e.g., Scoones, 2010; Solow, 1991) have questioned whether the term is just a “buzzword” that few might understand and many use. The sustainability of forests has also been a subject of debate (Keeton, 2007), mainly due to complexity in addressing the diverse concerns that arise from managing forest resources while also maintaining and improving socio-economic welfare and other interests of stakeholders. Although forest sustainability has been discussed for over three hundred years, more active and inclusive discussions about forest sustainability became evident after the 1987 Brundtland Commission when the interdependencies between the environment, society and economy were articulated and adopted at a global scale. Through time, the meaning and interpretation of sustainable forestry has evolved, and today both forest landowners and organizations have developed and implemented different metrics to assess forest management practices and their impacts and effectiveness on different forest resources. Among the most common initiatives is the development of forest certification schemes which have become a useful tool to also gain access into the market by assuring consumers that forest products and forest services come from sustainably managed forests (Cashore et al., 2006). In the United states, the Forest Stewardship Council (FSC),

the Sustainable Forest Initiative (SFI), the American Tree Farm System (ATFS) are three of the most commonly used certification programs. One common requirement within these programs is the development and implementation of a forest plan. This planning document is also the guiding instrument in the management of both national and state forests in the United States. The descriptions and prescriptions contained in a plan usually help in controlling and maintaining continuity of the forest management practices over the long term, and serve as the basis for the monitoring of management goals and objectives (Atyi 2001; Armitage 1998).

The aforementioned challenges notwithstanding, progress has been made towards a better understanding of the concept of forest sustainability. Efforts such as those described above have contributed to lighting the path towards a balanced use of forest resources. However, many authors have found that there is still a lack of evidentiary demonstrations of sustainability within forest plans (Koontz 1997; Siry et al., 2005; Brant et al., 2014; Singh et al., 2018). Further, other authors have noted the importance and influence of the language employed in public documents for shaping the future direction of an agency and for aiding society in the understanding of the diverse planned management prescriptions (Hajer 2002; Bone et al., 2016). In general, federal agencies in the United States face more constraints on forest management than state forest agencies or private landowners. One of the most important constraints in the analysis presented in this dissertation corresponds to requirements for the public participation and involvement in the decision-making process, which has been found to be more ‘closed’ in the case of state forest agencies (Koontz, 1997) and often absent in the case of private landowners. A discourse analysis approach appears to be a helpful tool in understanding the manner in

which the construction of the meaning of *sustainability* occurs between the interested stakeholders, and within particular contexts. To aid in the analysis of forest plans, a qualitative content analysis method allows drawing inferences from analyzed texts.

Motivations of the dissertation

There is a large amount of literature that emphasizes issues addressing the ecological, social, and economic values of forests with the aim of advancing the overarching goal of sustainability. However, there seems to be a lack of qualitative analysis which emphasizes the use of language in forest management plans and other guiding documents, including forest certification guidelines for sustainable forest management. In addition, while forest managers try to incorporate and modify forest plans according to changing laws and regulations, and according to the divergent interests of stakeholders, information about the meaning and interpretation of sustainability from these professionals is not readily available. Chapter 2 aims to address this research need by implementing a survey of forest planners to identify the most frequent terms they associate with sustainability and sustainable forest management.

The demand for forest certification, one instrument that signals forest sustainability for both producers and consumers, seems to be increasing worldwide, and therefore we need to understand the advantages and disadvantages of enrolling a forest into one or another certification scheme. It is common to find general descriptions and even broad comparisons between the FSC and the SFI programs. However, a qualitative analysis that helps to identify potential strengths and weaknesses of the two and other programs (including the ATFS and European schemes) regarding the use of terms

associated with sustainability of forests, is lacking. Chapter 3 seeks to fill this research niche by examining and comparing the texts of a group of forest certification programs to identify potential equivalence between them and attempts to classify their policy style approach as “substantial”, “procedural”, or “mixed” (Cashore, 2002).

Finally, it seems more common to locate studies related to the sustainability of forest management in national forests than for state forests in the United States. State forests are important in the provision of forest products and services to the public, and therefore are important in advancing forest sustainability. Chapter 4 intends to address this gap of information through a content analysis of forest plans, conducted to obtain more information on the language employed within these plans to communicate and demonstrate forest sustainability.

Objectives of the Dissertation

The primary goal of this dissertation is to provide more clarity in understanding what terms are commonly used in communicating and demonstrating forest sustainability within forest management plans. More specifically, the objectives to address are: (1) to identify the most common terms forest planners associate with sustainability in forest plans; (2) to compare the level of prescriptiveness and substantiveness of five forest certification programs; and (3) to investigate how state agencies use terms associated with sustainability in forest plans and the extent to which these include sustainability considerations (environmental, economic, and social).

Chapters 2-4 satisfy these three objectives. Chapters 2-3 have already been published and are presented here with permission from the publisher. We present them in

the manner in which they were published, using sections required by the journals: introduction, methodology, results, and discussion and conclusions. Chapter 4 is formatted as a manuscript *to be* submitted into a journal, although it has not been published at the time of presenting this dissertation. Chapter 5 consolidates the key points for this dissertation and provides guidance for future potential research areas.

CHAPTER 2

The terms foresters and planners in the United States use to infer sustainability in forest management plans: A survey analysis¹

¹ Gutierrez Garzon, A.R.; Bettinger, P.; Siry, J.; Mei, B.; Abrams, J. 2020. Published by Sustainability, 18/12/2020. Reprinted here with permission of the publisher 17/08/2020.

Abstract

Sustainable forest management is important for advancing sustainable societal development. Effective communication plays a major role in how goals and objectives are achieved. This study aims to assess how sustainability is considered by people who develop forest management plans (or forest plans in short). We employed the snowball sample technique to locate the study's respondents. In addition, an open-ended questionnaire and a mix method data collection (phone and email) and analysis (qualitative and quantitative) were found to be adequate methods to survey forest planners who have been involved in the development, implementation, evaluation, and/or revision of forest plans in the United States. Our approach helped us to understand their perceptions of and means of incorporating sustainability concerns in forest plans. A total of 55 surveys were completed by forest planners physically located in 26 of the 50 states in the country. Results suggested that planners generally placed environmental sustainability concerns over social and economic sustainability concerns. A variety of key terms were central to forest planners' attempts to communicate sustainability, from which most were associated with philosophical and temporal principles that would then be associated with concrete actions and the human dimension. Nevertheless, respondents also acknowledged difficulties and misunderstandings in describing how forest sustainability should be demonstrated within a forest plan. Topics such as restoration, carbon sequestration, and resilience were infrequently associated with sustainability and sustainable forest management. Finally, we found that the respondents were divided on whether the language used in forest plans to demonstrate sustainability could be improved.

1. Introduction

Humans have used forest resources for thousands of years, and the sustainability of forest resources has been discussed and debated for at least the last three hundred [1]. The concept of the sustainability of forests was likely first introduced as a principle of German forestry in the 18th century by Hans Carl von Carlowitz (1645–1714) in his book *Silvicultura Oeconomica* [2,3]. At that time in human history and in the present, the concept of sustainability has signified managing a forest for ecological, economic, and social considerations [2]. In recent decades, global and national natural resource management organizations, including the International Union of Forest Research Organizations, the Food and Agriculture Organization of the United Nations, the United States Forest Service, and the Society of American Foresters, among others, have developed definitions for forest sustainability. When compared (Figure 2.1), these tend to use largely consistent language regarding the human use of forest resources at a level that provides sufficient ecosystem services for current and future societal needs.

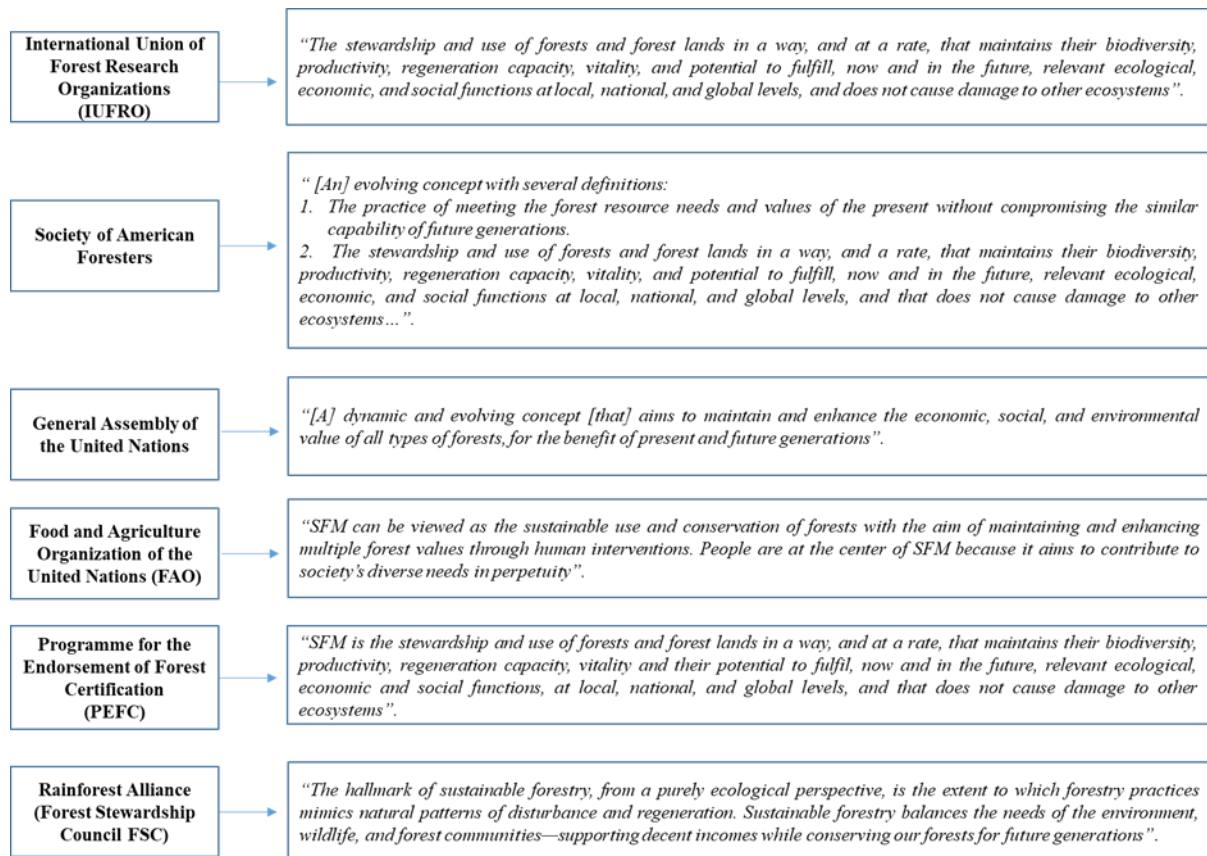


Figure 2.1 Definitions of sustainable forest management (SFM) [4,5,6,7,8].

Sustainability emerged in the late 20th century as a critical concept of policy debates [9] and today, the general concept of sustainability permeates many areas of science, management, and governance [10]. With respect to the general management of a business, sustainability can be viewed as a megatrend [11], often expressed in terms of the ability of an organization to endure and to produce goods and services for a long period of time [12]. In general, an organization that acts sustainably provides or uses resources related to human welfare that will be maintained or improved over time [11]. Some have even suggested that the concepts of peace and conflict should be included in deliberations on sustainability, as they could disrupt management direction [10]. With respect to forest businesses and forest management organizations, sustainability is an

ethical principle that addresses the long-term ecological, economic, and social outcomes of management [4]. Social foundations, economic resources, institutional characteristics, and environmental couplings are major areas of discussion that assist in determining whether a forest system is sustainable [13,14]. Definitions of sustainability, and assessments regarding whether a system is sustainable, can create controversy when shared metrics and evidentiary standards are lacking [15]. In general, the moral principle of intergenerational equity often guides actions regarding the sustainability of systems [9].

Much of the contemporary discourse on forest sustainability has its roots in the Brundtland Commission, whose 1987 report *Our Common Future* highlighted the interconnections between and within environmental, social, and economic facets [16]. Outcomes from the United Nations Conference on Environment and Development in Rio de Janeiro (the Earth Summit) in 1992 helped inspire a common understanding of sustainable forest management (SFM) as a system of management that seeks from a forest the sustained yields of several different products and services without diminishing future forest capacity [17,18,19,20], without causing damage to other ecosystems, and while maintaining vitality, regenerative capacity, biodiversity, and productivity [4]. SFM has been put forward as a way to achieve sustainable development within society by addressing the needs of the present without affecting the needs of the future [21,22]. The International Tropical Timber Organization was perhaps the first to develop criteria to evaluate the effectiveness of SFM [17]. Criteria and indicators for monitoring the effectiveness of SFM have since been incorporated into various voluntary forest certification programs [23], such as the Forest Stewardship Council (FSC), the

Sustainable Forest Initiative (SFI), and the American Tree Farm System (ATFS). The last two started in the United States, while the FSC was formed by an international consortium of actors in the wake of the 1992 Earth Summit in Rio de Janeiro. Although these programs all utilize market-based instruments as a means of promoting and identifying sustainably managed forests, they differ somewhat in their scope and focus. These efforts have continued to adapt in response to evolving understandings of forest sustainability, including those advanced by the Montreal Process in 1995 and other subsequent commissions [18,20].

Managing forests for the greater societal good is a lofty and inspiring goal that can appeal to land managers and various social actors. Three of the most well-known philosophical approaches to forest sustainability are (1) sustained-yield forestry, (2) multiple-use management, and (3) ecosystem management [24,25,26]. The basis of the sustained yield approach to sustainability entails managing a forest resource in such a manner that the intensity, location, and timing of planned activities produce a predictable and relatively constant amount of merchantable forest products over time. Multiple-use management, on the other hand, goes beyond the resource-specific consideration and, instead, aims to manage multiple resources (e.g., forest, water, wildlife) in a joined manner to produce a combination of services from the ecosystem. The crux of the ecosystem-oriented approach to sustainability involves managing a forest resource in such a manner that the intensity, location, and timing of planned activities do not affect biodiversity, ecological function, social goals, and future forest production [27]. Each of these three philosophies can act as valid approaches to forest sustainability, if supported

by projected outcomes that relate to the goals and objectives of the landowner and that illustrate how resources are maintained or improved over the long term.

The manner in which forest sustainability is demonstrated is an important issue today. Agriculture, forestry, and other land uses are estimated to account for about 23% of the total net anthropogenic emissions of greenhouse gases; sustainable forest management has been suggested as a way to lower these emissions [28]. With this increasing concern of greenhouse gases in the Earth's atmosphere, the removal of carbon dioxide through the management of forests has become an important issue in forest planning [29]. In fact, for over a decade forest carbon planning opportunities and carbon footprints have been considered in some Native American [30], public [31,32], private [33], and non-governmental organization [34] forest plans. Issues such as balancing carbon removal with carbon sequestration can be integrated into a forest management plan [35] and the blending of carbon sequestration goals into forest plans with efforts to adapt forest management to address the changing climate, has been acknowledged and demonstrated [29,36,37]. As economic incentives, documented carbon offsets offer a revenue opportunity for forest landowners [38]. Programs such as the California Air Resources Board carbon market and the Regional Greenhouse Gas Initiative (northeastern US) offer market-based opportunities for forest landowners to earn revenue through improved forest management projects that demonstrate forest carbon offset potential [39]. These opportunities may prompt forest landowners to develop forest management plans that directly address carbon sequestration and climate change. Lands that are also covered by conservation easements or other agreements [40] can be associated with forest management plans that help protect and address a myriad of

ecosystem services and public benefits, such as carbon sequestration [41]. As an example, the US Forest Legacy Program is one program that has helped conserve over 2.6 million acres through conservation easements and direct land purchases. The Forest Climate Action Team [42] in California has also encouraged collaborative planning efforts among landowners to enact forest management planning in a manner that addresses forest health and forest resilience. As a result of these advances and opportunities, forest landowners and land managers can build trust with society through an approach to forest management that demonstrates the effects of management on forest sustainability.

However, demonstrating how forests sustainably supply goods and services, maintain ecological functions, and contribute to economic and social well-being can be challenging [17]. Depending on the circumstances (ownership, geography, markets, etc.), the implementation of sustainable practices may not be easy [43]. As with any complex endeavor, there may be limitations on the data, technology, personnel, and organizational commitment necessary to achieve success [44]. Often, a written forest plan is used to demonstrate that forests are able to sustain various resources and services in the long term [45]. A forest plan is a general framework that describes proposed activities that best address the management objectives of a landowner. Broadly, a forest plan includes information on the management goals and objectives of the landowner, inventory and description of the forest's current conditions and resources to be managed, the formulation of management alternatives (which ideally would be the results of assessing environmental, social, and economic outcomes), and a management recommendation that describes the plan of action [24]. Robust ways to signal a commitment to sustainability

within forest plans would involve explicit estimates, measures, and monitored outcomes of a management process that indicate that the management path forward (through time) can sustain important social, economic, and environmental outcomes. While the simple existence of a forest plan might suggest to some that the associated forest direction is sustainable, several studies have suggested that there may be a lack of empirical evidence concerning outcomes of sustainability within forest plans (e.g., [20,46,47]).

Unfortunately, in some cases, evidence of the sustainability of a forest system within a forest plan can consist largely of vague rhetorical statements [48].

To further investigate these matters, we surveyed forest planners (the subject of this research) through an open-ended questionnaire, to inform an extensive content analysis of plans (the subject of future research) regarding the manner in which sustainability is communicated and demonstrated in forest plans. This manuscript presents the results of data-gathering and coding exercise that focused on what terms forest planners frequently associate with sustainability and SFM. The survey was intended to answer the following two questions:

1. What are the most frequent terms forest planners associate with sustainability in forest plans?
2. To what extent does the conceptualization of sustainability in forest plans include environmental, social, and economic considerations?

Language has a tremendous influence on the way we communicate concepts to others and perhaps, more importantly, the way in which individuals predispose their minds to learn and act. Our interest in understanding the use of terms associated with sustainability and SFM arose because of the overuse of these words both in the media and

organizations seeking recognition and social acceptance. This research was also crafted in response to statements such as those from [49] who discusses the loss of the environment's intrinsic values (e.g., aesthetic, cultural, and spiritual values) when these are collapsed into "weak" economic values and claims such as those from [50] who criticize the sustainability definition as given by the Brundtland Commission. Their critique is that the widely used definition does not offer any strategies to "operationalize" the concept, thus increasing its subjectivity and leading to variable interpretations (e.g., corporate sustainability initiatives that are sometimes criticized as "greenwashing"). In our study, we recognize that both the framing and the explicit demonstrations of forest sustainability are context-dependent and determined by additional aspects such as culture, economic interests, and institutional capacity, among others. Nevertheless, in light of the substantial effort by scholars and practitioners to define and operationalize sustainability in forest management since the publication of the Brundtland Report, our hypotheses are that (1) forest planners in the United States are guided by broadly similar concepts of forest sustainability and (2) that environmental, social, and economic dimensions are all addressed within forest plans. These hypotheses reflect the convergence of sustainability conceptualizations within the forestry sector (Figure 2.1) and across various fields of practice more broadly. They are influenced by prior work that suggests tradition and habit have an important role in how sustainability is operationalized, and by the growing demand to integrate multiple dimensions of sustainability into forest management [51].

2. Materials and Methods

To understand the keywords, phrases, and concepts related to sustainability as held by forest planners in the United States, we used an open-ended questionnaire. Open-

ended questions are often used to explore topics in depth, to understand processes, and to identify potential causes of a particular event [52]. On the basis of 13 questions (Figure 2.2), the survey was designed to obtain from respondents their definition of sustainability and SFM and the keywords that they associate with these concepts. In addition, the survey included questions designed to elicit responses about the manner in which sustainability is demonstrated in forest plans. This format of the survey produced information in the form of lists, short answers, and on occasion, lengthy comments. Because the structure of the survey provided rich content, iterative analysis and coding of the survey answers were needed to validate insights, themes, and ideas, as detailed below.

We considered the population of interest (and source of data for our study) to be forest planners who were working in the United States, regardless of any other sub-classification. People responsible for the coordination of maps, inventories, and schedules of proposed activities are referred to as forest planners [4]. The main criterion to select our respondents was that they needed to have participated or been involved in the design, implementation, revision, evaluation, and/or monitoring of forest plans. The population consisted of forest planners employed by both public and private land management organizations. Forest planners working for public organizations were employed by national forests, state forests, cities, and public educational institutions. Consultants to non-industrial private landowners, industry-employed forest planners, and people working for tribal organizations and private educational institutions were considered forest planners working for private organizations.

The size of the total population of interest was not clearly evident, since there is no sampling frame for forest planners. We used convenience sampling to determine the

initial seeds for a snowball sampling process [53] that would allow us to locate additional potential respondents for our survey [54,55], as it was not possible to conduct a random sample of a known population. We began our sample with an initial set of planners that we knew were actively engaged in the development of forest plans. These people included current forest planners employed by several national or state forests, forestry consultants, and other people in the field of forestry who met the criterion to participate in the survey.

The initial sample was shaped to be as diverse as possible and representative of individuals involved in the development of forest plans for private and public lands. Sample respondents beyond the initial sample were located through snowball sampling, a widely used technique in qualitative sociological research to locate potential sample respondents to surveys [54,56]. Snowball sampling has also been used to locate scientific literature pertaining to specific research agendas [57,58] and is often characterized as chain referral sampling [59] or respondent-driven sampling [60]; these terms are often used interchangeably even though the last two might in practice be used differently. Other studies have suggested this process as a way to overcome data sampling problems associated with members of special populations [61,62]. For example, the sampling process has been applied to virtual networks facilitated by the Internet to engage hard-to-reach populations [62]. However, some have expressed concern about the diversity (demographic, geographic, and occupational) of the sample developed along the referral chain and about the variance of estimates derived from these types of samples [60].

As with other similar surveys applied to other fields (e.g., [56]), the objective of the snowball sample was to collect unique knowledge among those involved in the

development of forest plans. With respect to chain referral, the study respondents were asked to provide the contact information of other potential respondents who shared similar experiential characteristics (had developed forest plans). The survey administrator controlled the initiation, progress, and termination of the sampling process, which included locating potential respondents, engaging them, and monitoring referral chains [59]. This sampling process was advantageous for locating study respondents who could adequately address a specific topic such as the development of forest plans.

Questionnaire

Name of respondent: _____

Organization: _____

Role: _____

Contact information: _____

1. Have you participated in the design _____ implementation _____ revision _____, evaluation _____ of one or more forest management plans? If so, please provide dates.
2. How would you define or describe *sustainability*?
3. How would you define or describe *sustainable forest management*?
4. What are the main regulations a planner/forester has to comply with when writing and implementing sustainable forest management?
5. How familiar are you with any *sustainable forest management* principles? Not at all _____ familiar _____ Please mention them. |
6. What do you think is *fundamental* to achieve sustainable forest management?
7. Please provide a list of terms that you associate with sustainability. List them in order of importance
8. Please provide a list of term that you associate with sustainable forest management. List them in order of importance.
9. In what way is forest sustainability demonstrated in the Forest Management Plan (FMP) you helped to develop?
10. Could commitment to "sustainability" be demonstrated more through the language employed in FMP? If so, how?
11. Could you please suggest one (or more) professional (s) who you think might be a potential respondent to this interview? Does not have to be part of your current organization.

Name: _____

Email/phone number: _____

12. Do you have any additional comments?
13. May I contact you again if I have any further questions?

Figure 2.2 Survey questionnaire.

The decision to terminate a snowball survey may be based on a high level of repetition of the data collected, the representativeness of the sample, or other practical considerations [59]. Therefore, the sampling process continues until a time when the researcher decides that the sample is sufficiently representative of the population, when the respondents begin to repeat names of potential additional respondents, or when the sample has become saturated (no new significant information is being collected) [54,55]. Our snowball sampling process was terminated at a time when (a) it appeared that people being contacted did not reply anymore, (b) study respondents stopped suggesting new potential candidates for the survey, and (c) no new information seemed to be collected with each additional set of responses. Our sample size (55 respondents), small as it may seem, was consistent with similar surveys conducted in natural resource management and other fields (e.g., [56]). For example, one survey of natural resource management professionals involved ascertaining opinions from 57 study respondents on challenges facing landscape management [63].

The main mode of initial communication with potential respondents of our survey was through an email invitation, as we considered it particularly efficient for data collection [64]; however, we made some initial contacts through direct telephone calls. All potential respondents received an “invitation-to-participate” email that contained information related to the aim of the study, the sampling process, and the expected outcomes. This information was accompanied by a consent letter and the open-ended questionnaire form. Within the body of the email, respondents were encouraged to either complete the survey questionnaire and email it back to the administrators of the survey or to schedule a time to respond to the survey by phone. Thus, to obtain survey responses,

we used a mixed-mode, or Type 3 approach (use of two different modes to collect responses from different people) according to [65]. Mixed mode approaches are often employed to improve coverage of a target population, to reduce costs, to improve response rates, to ease the efforts of the responder, and to potentially reduce nonresponse error. The Type 3 approach we employed using both a written questionnaire and telephone interview processes focused on improving coverage of the population, as we were concerned about a low response rate and proper coverage of the target population. By offering respondents a mode that they prefer can improve survey response rates, as respondents may be reluctant to participate via one mode or another [65].

For those respondents who simply received the initial email and delivered their responses back to us through email (43 completed surveys), we neither tracked nor asked them to note the time required to complete the survey questionnaire. The average time spent with telephone-administered respondents (12 completed surveys) was 20 min. Surveys completed by telephone were audio-recorded with the respondent's consent, and a complete transcription (verbatim) was carried out by the first author of this research not more than two days after the survey was conducted. Recordings were deleted after the transcription to protect the privacy and anonymity of respondents. For participation in our survey, we promised respondents a high level of data protection and confidentiality. Once written responses were received, basic demographic information was attributed to each set and any indication of respondent's identities were removed. The same held for transcribing telephone interviews into written responses. During a telephone interview, a respondent may share information and experiences that may jeopardize their employment, so while the audio record of responses may be a valuable resource, it is

suggested that recorded data should be destroyed after transcription to alleviate concerns about anonymity and confidentiality [66]. Concerns about voice recognition prompted our decision to delete these calls once the information had been properly transcribed so that respondents can never be traced or identified by other people who may access these files. We ensured respondents of these protocols in an effort to increase their willingness to participate in the survey. This action also provides a sense of confidentiality to the respondent should they have made a statement revealing more than they should, subsequently qualified by comments such as “please don’t use this” [67]. Retracting comments during the survey is required to comply with the desires of the respondent, but the oral record might still remain in the recorded version. As suggested by [68], until there exists empirical data on potential effects of survey participation, a very cautious approach to anonymity and confidentiality should be pursued, disassociating any personal characteristics (in this case, voices) from the data that has been received.

Potential limitations of this type of sampling process include variations in verbal skills, language skills, literacy levels, and visual impairments, among others [69]. The mixed mode survey (email and phone) was not considered an obstacle to deliver the questions nor to retrieve the responses. We chose these processes over face-to-face interviews so that we could access a geographically diverse set of respondents [70]. Finally, because the study involved human subjects, we obtained University of Georgia Institutional Review Board authorization prior to initiating any contact with potential respondents.

Once the surveys were compiled, we analyzed the data in order to discover potential patterns, themes, and categories. Through an iterative process, we coded the

responses and divided them into manageable units of analysis that were then categorized or put under “headings” of groups of themes. These steps are comparable to some of the components (unitizing, coding, reducing, inferring, and narrating) needed to move from textual responses to results, as described by [71]. Specifically, we performed a quantitative analysis to describe demographic patterns and to present the list of the most frequently used words to define sustainability and SFM according to our study respondents. We used ATLAS.ti qualitative text analysis software for the frequency query on responses to questions 2 and 3. Four terms (sustainability, SFM, forest, and management) were excluded from the analysis of frequency, as were their corresponding stemmed words. In addition, the qualitative analysis (used for questions 2–6 and 9–10) involved the following five stages. First, we placed the answers to each question from each respondent into a text file (using Microsoft Word). Second, we read them and made notes of possible themes within the answers so that we could get immersed into the respondent’s world [72] and be able to develop a sense for potential relations among the answers obtained [73]. Third, we read the answers again and described all aspects of the content, ignoring issues unrelated to our main topic (sustainability and SFM). This step is also known as open coding [72,73] and allowed us to freely generate categories or groups of related content. The fourth stage involved a review, reorganization, and reduction of higher-order categories [72]. Finally, with the set of categories in mind, survey responses were read one more time, allowing us to generate the results related to forest principles or main considerations for forest sustainability and the findings on demonstrations of forest sustainability within forest plans according to our study respondents.

Mixed quantitative/qualitative approaches such as these are often used in survey research (e.g., [74,75]). The two forms of research methods are not mutually exclusive; they are often used in concert to provide measurements and understand magnitudes and indicators (quantitative) and to delve deeper and provide insight through open-ended questions (qualitative). In our case, while we used open-ended questions to elicit opinions, the analysis of word frequencies (content analysis of responses) helped us support our recommendation of terms for a broader content analysis of forest plans. The methods can be integrated in a variety of ways, and both have advantages (quantitative provides facts, qualitative provides insights) and disadvantages (quantitative is limited, qualitative is more difficult to analyze).

3. Results

The survey was conducted between January and March 2019. The respondents were physically located in 26 of the 50 states in the country (Figure 2.3), even though they may have developed forest plans for properties in states other than their home state. The greatest number of responses was obtained from forest planners employed by public organizations, who represented 67.3% of the respondents (Table 2.1). This set of respondents consisted of a similar number (15) from both federal and state organizations along with a few from cities and public educational institutions.

Forest planners employed by private organizations accounted for 32.7% of the responses. Most of these respondents (10) were consultants, but forest planners working for the forest industry, timberland investment and management organizations, and other private organizations were represented in this sample. While the responses appear to favor publicly employed forest planners, we are confident that the sample represents well

the amount of land area in each ownership group that is represented by a forest plan. According to [76], 35% of the 333 million ha of United States forest and woodland is publicly owned, 16% is owned by corporate entities (timber companies, real estate investment trusts, and timberland investment and management organizations), and 43% of forest and woodland is owned by families, trusts, estates, and family partnerships. We believe that nearly all public lands and corporate entities should have an active forest plan. We also assume that 12.9% of private landowners have a plan, that 38.5% of these were written by consultants or industry-employed forest planners, and that 35.6% of these were written by forest planners from public organizations [77]. Therefore, approximately 183.5 million ha of forest and woodland has a forest plan written by forest planners employed by either a public or private organization.

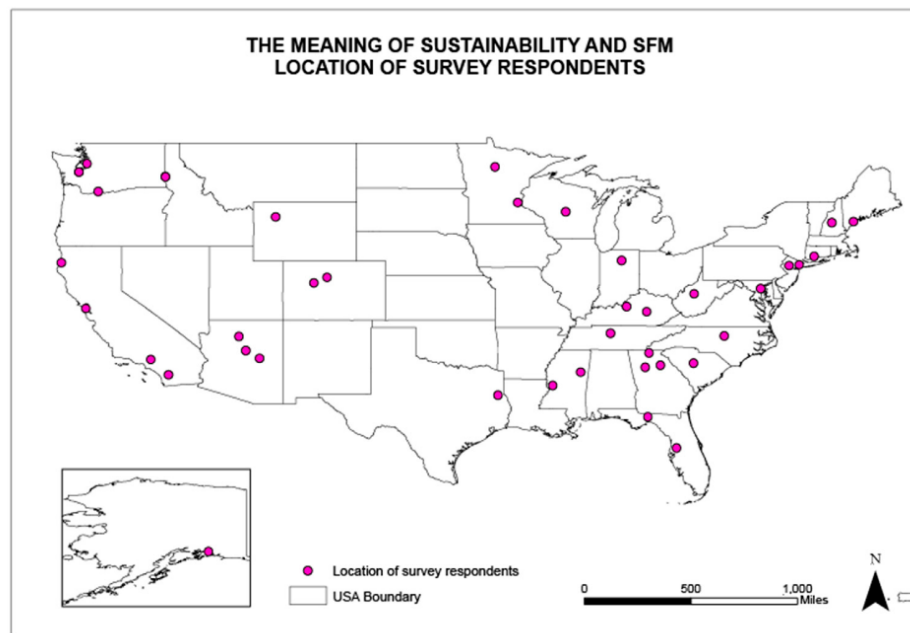


Figure 2.3 Point location of respondents to the survey in the US.

Table 2.1 Location of study respondents and their ownership group.

Region	Public land forest planners (n)	Private land forest planners (n)	Total (n)
South ¹	10	7	17
Midwest ²	4	1	5
Northeast ³	5	7	12
West ⁴	18	3	21
All	37	18	55

¹ Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia. ² Kentucky, Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, Wisconsin. ³ Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia. ⁴ Alaska, Arizona, California, Colorado, Hawaii, Idaho, Kansas, Montana, Nebraska, New Mexico, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, Wyoming.

In summary, about 67% of this forest and woodland area is covered by a management plan that was developed by publicly employed forest planners, and about 33% is covered by a management plan that was developed by privately employed forest planners.

On average, the respondents to our survey have been active in the forest management field for 17 years. Our analysis revealed that 51% of the public forest planner respondents have been involved in various stages of forest planning for more than ten years, compared with 83% of the private forest planner respondents. Table 2.2 illustrates the list of job titles for our respondents at their organization (adapted from the [78] job title classification). Results indicate the highest predominance of respondents identified themselves as foresters (36.4%) and planners (23.6%). Two issues we were unable to address in our questionnaire were the geographic reach of respondents' current forest planning efforts, and the variety of geographic situations in which they have participated in forest planning across the length of their careers. However, given the length of time the respondents, on average, have been involved in forest planning efforts,

the broad geographic coverage of their current offices, and the diversity of organizations within which they work, we consider that the survey is fairly representative of the larger population and adequate for the purposes we stated in the introduction section of this manuscript.

Table 2.2 Job titles of survey respondents ($n=55$).

Job Title	Land Ownership Category		
Category	Public lands	Private lands	Percent
Forester	9	11	36.4
Planner	13	0	23.6
Disciplinary specialist	7	2	16.4
Environmental coordinator	2	0	3.6
Others	6	5	20
Total	37	18	100

Most of our respondents completely answered all of the questions in the survey, though three people did not answer question 10, two people did not answer question 5, three people did not answer question 7, and two people did not answer question 8.

In the following sections, we describe: (1) what were the most frequent terms associated with sustainability and SFM, (2) in what manner do forest planners demonstrate forest sustainability within forest plans, and (3) to what extent does the conceptualization of sustainability in forest plans include considerations of environmental, social, and economic dimensions.

3.1. Most Frequent Terms Associated with Sustainability and SFM

Within the survey questionnaire, we specifically asked for a list of keywords that could be associated with sustainability and SFM. When asked to provide keywords (Figure 2.4 and Figure 2.5), we found that acknowledgement of social values (e.g.,

thinking long-term, supporting society's needs) and stewardship (e.g., conserve, produce, ensure forest health) were the most frequently used to refer to sustainability and SFM.

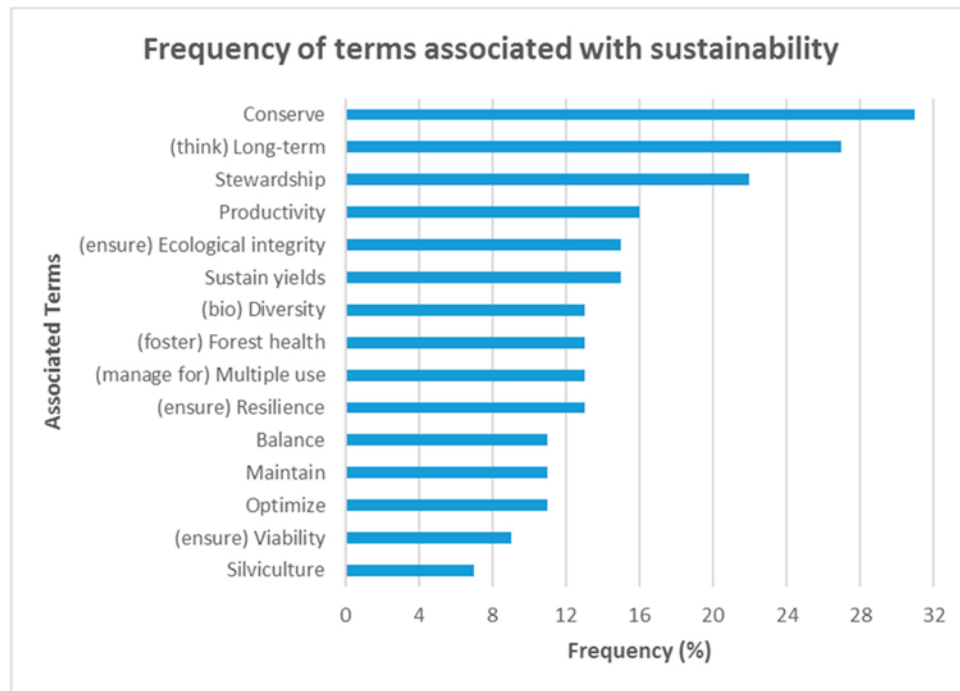


Figure 2.4 Frequency of terms associated with sustainability according to foresters and planners surveyed ($n = 55$).

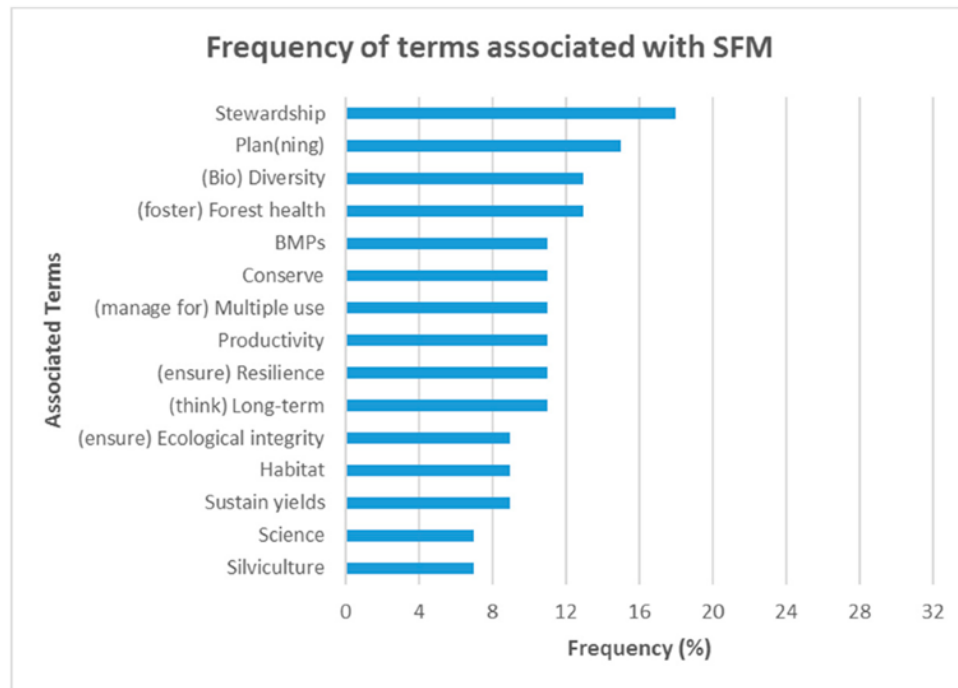


Figure 2.5 Frequency of terms associated with sustainable forest management (SFM) according to foresters and planners surveyed ($n = 55$).

The aggregated list of keywords that our respondents prioritized as to being related to sustainability and SFM were: (think) long-term, conserve, support, produce, (foster) forest health, (ensure) ecological integrity, sustain yields, (ensure) resilience, (ensure) viability, balance, plan, maintain, regenerate, perpetuate, and restore. In some cases, the use of these was similar for both sustainability and SFM (e.g., long-term was frequently noted) and in other cases dissimilar (e.g., maintain was less often noted in association with SFM and conserve was more often noted in association to both sustainability and SFM). Ecological integrity was also frequently associated with both sustainability and SFM. When asked for the order of importance of these terms, the study respondents often kept the order in which they mentioned at first. Figure 2.4 and Figure

2.5 also reflect such order. For instance, long-term and productivity were put among the first and second in the list of terms associated with sustainability, whereas ecosystem health, sustain yields, and planning were often listed among the first and second terms associated with SFM. The keyword set provided by the respondents seemed to involve natural elements of the ecosystem rather than a holistic approach that would include social and economic components.

When asked to define sustainability, with medium to high frequency (Table 2.3), we found several of the same terms involving action (e.g., maintain, sustain and provide) and time frames (e.g., long-term and future) as we did from the list of keywords, perhaps indicating forward thinking on behalf of the planners and foresters. Among responses we received were also some vague definitions such as “sustainability equals conservation,” “forestry that achieves sustainability,” and “sustainability is an adverb that describes a condition, or action as sustainable, it is an awkward term.” We also received some substantial definitions of sustainability, such as “the capacity of an ecosystem for long-term maintenance of ecological processes and functions, biological diversity, and productivity,” “a system of management to allow current and future generations to enjoy and benefit from the many benefits of forests—timber, wildlife, water, and recreation,” and “the capacity of forests to maintain their health, productivity, diversity, and overall integrity, in the long run, in the context of human activity and use.”

Table 2.3 Frequency of basic action terms associated with definitions of sustainability according to forest planners surveyed ($n=55$).

Frequency	Basic terms
High (30-45)	think (long-term), maintain, (consider the) future, (be) capable or able
Medium (10-29)	(meet) needs, provide, sustain, perpetuate, use, (ensure) quality
Low (1-9)	yield, protect, support, conserve, balance, (reach) capacity, regenerate, restore, enhance, renew, repeat

Within these definitions are embedded several of the frequently used keywords noted above and in Figure 2.4, therefore underscoring their importance in understanding how forest planners think about forest sustainability. These terms can be grouped into families of related data types of which members are somehow related, while maintaining individual type identities and are able to be used interchangeably with respect to the family type. For example, with respect to our work, these families can be characterized as those that infer concrete action or philosophical principles, those that suggest an individual or a broader system are needed, those that refer to a temporal dimension, and those that suggest human versus technological views are necessary to achieve sustainability goals. With respect to principles versus concrete actions, conserve, produce, maintain, plan, balance, and manage for multiple uses would all seem to reflect concrete actions a forest manager might employ in their quest for a sustainable system, while ensuring forest health or integrity, being biodiverse, and ensuring resiliency would reflect broader principles a forest manager might follow. The latter group is often more vaguely defined, and processes to measure progress or success may currently be lacking. Individual forest landowners or managers can conserve, produce, maintain, plan, balance, optimize, and manage for multiple uses as can a collective or broader organization. These

viewpoints are often shared amongst forest managers and landowners in North America, even though they may not act collectively to ensure that resources across broad landscapes are in fact managed in a sustainable manner. Further, actions to conserve, produce, maintain, plan, balance, optimize, and manage for multiple uses are likely unique human views of how one might manage sustainably a forest. From a technological point of view, actions to produce, maintain, plan, balance, and optimize a system may require data, technology, and knowledge beyond the scope of an individual. For some forested systems to be considered sustainable, a substantial commitment of time, energy, finances, and resources may be necessary. Inherently, many of the terms provided by the survey respondents infer a spatial dimension (the land that they manage or for which they develop a plan). However, the temporal dimension was directly mentioned once (think long-term) yet was implied in many other terms (conserve, maintain, plan, balance). These expression families help further organize the responses we received through our survey. Many responses refer to a concrete action expression family, as one might expect from practicing foresters and land managers. Similarly, many terms also fall into human expression family and the individual expression family. However, a portion of the respondents recognized that technology might play an important role in achieving a sustainable system, and that broader, vaguer ideals are still important for society to consider.

3.2. Demonstration of Forest Sustainability within Forest Plans

Respondents generally conveyed through their responses that the identification of forest-based objectives and goals was one way in which a commitment to sustainability is demonstrated in their forest plans. The objectives and goals are often linked to the desired

conditions of a forest, to the compliance with relevant laws and regulations, and to the fulfillment of the standards and guidelines of forest certification programs. For example, in California landowners who desire to participate in the forest carbon program are required to develop a management plan with clear strategies and management activities to demonstrate, among others, the permanence (over a period of 100 years) of the forest carbon project. Requirements such as these suggest that forests managed to comply with these and other standards (e.g., forest certification) could be meeting a higher standard of forest sustainability that is verifiable. Objectives and goals also inform management prescriptions and guide management direction. A monitoring report and an assessment and implementation of forest modelling were also elements mentioned by forest planners as ways to demonstrate sustainability in the forest plans. An emphasis on specific “drivers,” such as forest health, restoration, regeneration, control of invasive species, particularly when added to economic viability, collaborative partnerships, and silviculture practices, were identified as other ways to demonstrate a commitment to sustainability through forest plans.

More definitive responses for demonstrating sustainability in forest plans included “... through the articulation of its policy such as harvest volume flow control from decade to decade and the available merchantable inventory shown available through forest modeling” and “... specific tables demonstrating forest volumes recovery time, or maintained/increasing volumes, specific silviculture outlines for each property condition or stand.” Explicit examples like these clearly indicate that a plan of action may lead to a sustainable system. In contrast, among responses to this portion of the survey were some ambiguous statements such as “our plans demonstrate commitment to sustainable forest

management through maintaining our timber program’s certification ...” and “the forest plan is the expression of sustainability by imposing constraints and goals.” There appeared to be a consensus among respondents that the language employed in forest plans may not be sufficient to demonstrate sustainability of forests. What may truly be required (according to our respondents) are statements of measurable progress toward sustainability indicators and planned accomplishments. Our results also suggest that the use of language, and its ability to provide clarity on forest management and demonstrations of forest sustainability, has not been very deeply considered by some forest planners. For example, some respondents indicated that sustainability should be implied by the presence of a forest plan.

3.3. Considerations of the Dimensions of Sustainability

Four important considerations for forest sustainability were identified by our respondents: (1) ecological (environmental dimension); (2) production (economic dimension); (3) socio-cultural (social dimension); and (4) policy and legal frameworks (Table 2.4). The latter is understood as a functional element that connects the previous three. It is important to mention that the frequency of key statements in Table 2.4 is not necessarily associated with the weight given to each consideration. Instead, the statements indicate how often each consideration was communicated by our respondents in forest plans. Our study respondents emphasized most often a general “long-term production” of a forest ecosystem as a condition that determines a forest system to be sustainable. Similarly, general statements regarding “long-term management” and “long-term management for future generations” were also frequently offered and suggest that successful management over time can act as a condition that determines a forest system

to be sustainable. We also found that meeting owners' objectives plays an important role as a condition of being sustainable, as well as compliance with laws, regulations, or standards associated with certification programs. We expected the responses to more specifically reflect one or more considerations of the three dimensions of sustainability (environment, society, and economy), but this was not the case.

With regard to the extent to which each of the considerations are employed when developing and implementing forest plans (according to our respondents), we determined that the conceptualization of sustainability in forest plans often includes considerations of environmental, social, and economic dimensions regardless of who owns the land. However, we noted that the environmental dimension prevailed over the social and economic considerations. Consideration for the environment was communicated through statements such as "stay true to ecology and biodiversity and don't let social or economic pressures dictate your actions," "... protect watersheds and manage for wildlife habitats," "conserve ecological function across the landscape ...," and "understand species interactions and their performance in different sites and soil type." Economic and policy considerations were communicated by some respondents through statements such as "achieve economic profitability while maintaining or improving land for wildlife, wood production, soil and water conservation," "use certification guidelines," and "use of best available science."

Table 2.4 Main considerations for forest sustainability according to respondents.

Principles	Key statements
Ecological	Maintain forest biodiversity
	Maintain soil and site productivity
	Maintain health and vitality of forest
	Provide for forest regeneration
Economic	Provide a sustained yield
	Use appropriate silvicultural practices and harvesting systems
	Follow management objectives
	Use an adequate modeling approach to incorporate multiple goals and constraints
	Ensure long-term social and economic well-being
	Maintain forest-based employment and community stability
Social	Protect cultural resources
	Engage with stakeholders
	Respect indigenous people's rights
	Respect tenure and use rights
Policy	Comply with best management practices
	Follow guiding principles of certification programs
	Develop a forest management plan
	Engage in long-term planning
	Utilize adaptive forest management
	Monitor and assess progress
	Use updated scientific information

4. Discussion

In the near future, we intend to conduct an extensive content analysis, involving several hundred current forest plans that we have collected from public and private organizations in the United States. The purpose of the pending content analysis is to determine how the path to forest sustainability is explicitly demonstrated in forest plans. Certainly, we could have pursued this endeavor using a keyword set that we developed internally, yet we decided to inform this future work with the survey of forest planners

that was presented here. We learned from this survey that, in spite of decades of scholarly and practical development of forest sustainability definitions, principles, and concepts, multiple potentially incommensurable definitions of sustainability and SFM are understood and operationalized by forest planners. Each definition provided by our study respondents had a distinct focus, and each had the potential to be applied in diverse contexts. The diversity in responses to the definitions of sustainability and SFM prompt us to reject our first hypothesis, that forest planners are guided by a consistent concept of forest sustainability. For various reasons we mentioned, including their employment situation, we observed a considerable amount of variation in survey responses by our sample set of respondents. Sustainability, when defined, is often broad and vague, and therefore open to diverse and conflicting interpretation [9].

European thoughts on forest management are integrated into North American educational and professional systems, as in general it is held that the purpose of forestry is to secure permanent benefits to human society and nature [79]. The terms we obtained to describe sustainability can arguably be interrelated and used similarly by different people depending on their educational and social backgrounds. For example, to “conserve” a resource can suggest to “preserve” a resource [80]. Within the context of forestry educational and professional systems, a sustainable forest ecosystem is often described as being productive, natural, and diverse. Interestingly, the terms productive, stable, sustainable, and equitable are sometimes considered separate properties of managed systems that might conflict, depending on the management circumstance [81]. However, it has long been considered in forest management that sustained yields of wood products can equate to constant production [82]. Many of the terms we derived from

survey respondents therefore suggest that a sustainable forest system involves the management of nature, and a possible sacrifice by current generations of society for future generations.

Our second hypothesis (that environmental, social, and economic dimensions are thoroughly addressed in forest plans) was somewhat supported given the responses provided by forest planners. An acknowledgement of each dimension was observed, yet the depth to which they were addressed in the responses we obtained varied, perhaps due to the diversity of objectives and goals important to the people or organizations that own the land. Further, these three dimensions of sustainability were accounted for in an uneven and partial manner. Even though all respondents to our survey recognized the importance of the three dimensions of sustainability, our results revealed a greater emphasis on the environmental considerations than on the social and economic considerations. Arguably, the social component of sustainability may be the most difficult to address, but the economic component may have the best potential to be demonstrated explicitly through, for example, well-known quantitative assessments of yields, costs, and prices. Perhaps, forest planners and the interdisciplinary teams developing forest plans can describe more thoroughly how demonstrations of forest sustainability (e.g., volume flow control, volume yields, and modeling) or even the implications of the management alternatives and activities that reflect sustainable solutions, affect communities and the environment. Perhaps, linking technical aspects such as these to specific impacts on local communities could not only improve the understanding of the decisions made by public and private forest organizations, but also the social acceptance and support for their implementation. An increase in the use of

language reflecting the concrete actions an organization might pursue with respect to social and economic outcomes of a sustainable plan considerations may be necessary, rather than language that addresses broader principles. However, as we noted, a substantial commitment of time, energy, finances, and resources may be necessary. For private lands forest planners, many seemed to recognize the importance of public participation in the decision process, yet the social dimension was emphasized to a lesser extent in their responses likely because public participation is not required in the private land forest planning process in the United States. For public land forest planners who are employed by the federal government, it may still be difficult to determine whether statements that address sustainability correspond to the most recent representation of sustainability adopted (that emphasizes the interdependences between environment, society, and economy) or a previous conceptualization (represented by intersected dimensions of sustainability, but not fully integrated into the forest system) [83].

There are important limitations to this study. It needs to be understood that this study was part of a broader project that aims to conduct a content analysis of forest plans in the United States to understand how sustainability and SFM are communicated and demonstrated through these plans. We recognize that it is possible that longer, in-depth interviews would have provided much more detailed information about the terms foresters and planners use to infer sustainability within forest management plans. However, there are also benefits in consistency, replicability, and the advantage of providing greater depth than a closed-ended survey [84]. Certainly, future studies should take into consideration their particular interests as the specific constraints for choosing to deliver a survey via email or via phone (as described by for example [69,70]). In addition,

more in-depth interviews could allow for the collection of richer qualitative data. In addition, the level of preparation each respondent underwent to address each question was unknown. We believe that their answers reflect their beliefs and the manner in which they develop forest plans. We understand that it is possible certain terms which could be used to demonstrate sustainability were not mentioned by our respondents even though they may appear in the forest plans. Examples of this could be the terms “restoration” and “resilience” infrequently mentioned by our respondents, though one might expect to be included on a list of terms referred to sustainability and SFM. While most of the terms we obtained from survey respondents focused on stability (standing, enduring, maintaining original condition) the ability of a system to be resilient (to absorb changes and persist) was not one of these. Resilience suggests that the management system would take a broader view and keep options open [85]. It has been suggested that to cope effectively with change, a resilient system would be more advantageous than a stable system [9]. Pending research will be able to better understand the use of terms such as these in forest plans.

Finally, statements regarding the projected management prescriptions, the estimated management direction, and descriptions of the current and future conditions could contain explicit demonstrations of sustainable environment, social, and economic dimensions of a forest. However, these were not well described through our survey, perhaps due to the manner in which the open-ended questions were presented. Ultimately, the desired outcome of concerns about the sustainability of a system involves the maintenance of human and ecosystem health needs [9]. Human needs are both tangible and intangible, and they contribute to society’s health and well-being [9]. Although we

acknowledge that sustainable forestry plays a fundamental role in maximizing the amount of carbon stored over time and that by maintaining forest processes, forest managers can help forest ecosystems resist natural events associated with climate change, the association was not explicitly made by our study respondents. Certainly, the objectives and goals of the landowner for whom a plan is developed guide what is to be sustained within a forest. Yet, contributing to carbon sequestration and reacting to climate change were not high on the list of objectives and goals, perhaps due to the immediacy of a forest planning effort (a limited time horizon). These limitations notwithstanding, we found our survey to be a useful tool for identifying the list of key terms that foresters and planners frequently associate with forest sustainability and SFM and the potentially explicit ways by which these professionals think sustainability of forests is demonstrated through forest plans.

5. Conclusions

In the last century, the overarching goal of forestry has been to manage sustainable forest ecosystems. Yet, time, social values, and perspectives on the environment have changed. Simply saying forest management is sustainable without demonstrating this through analysis may not suffice. Real, positive impacts on forest ecosystems and social well-being may not be evident until a consistent use of language and terms associated with sustainability and SFM is employed. We based our need for this project in the lack of clarity and explicit or empirical evidence of forest sustainability that previous studies suggested (e.g., [20,46,47]). We found that while forest planners may have a clear knowledge base to address forest considerations thoroughly, when asked to communicate it, some struggle. A few respondents of our survey recognized that

an improvement in the language in forest plans might help demonstrate forest sustainability since they heavily rely on terminology that is employed in their daily routines, policies, and forest certification guidelines. Some respondents also felt that the discourse contained in a forest plan should be valid and sufficient to demonstrate a commitment to sustainability. Our results should benefit both public agencies and the private sector by providing unique information on how language is being used to communicate and demonstrate sustainability. Our hope is that forest landowners will acknowledge the need to maintain a continuous dialogue among diverse stakeholders to facilitate understanding and clarification about concepts and interpretations for sustainability and SFM. Ideally, a consensus among actors should reveal a more comprehensive way to demonstrate a commitment to sustainability in their forest management documents and to communicate outcomes that reflect progress towards sustainability goals. As the general public becomes more aware and informed about environmental issues and their influence in the socio-economic characteristics of local and national livelihoods, we expect that forest planners and policy makers may consider the results of this study as an evidence of the active need to improve the communication of sustainability in forest plans. Recognizing that sometimes interdisciplinary teams work on the development and implementation of forest plans, and that the structure of these teams is of particular importance to ensure an integrated participation of subject-matter experts to address particular environmental issues [76], we suggest that future studies consider a deeper analysis of the education and experiential background of the study respondents to assess the potential effect of such efforts for influencing and changing the discourse around forest sustainability. The quality and depth of training on forest

sustainability, and the uptake of concepts by planners, may be difficult to measure, yet may be influential in their ability and willingness to expand the language contained in a forest plan. These considerations could also help to better understand how and why each group of people, based on their associated demographics, differ in how they address and demonstrate sustainability in forest plans.

Author Contributions

All authors were involved in designing this research. The first author carried out the surveys and performed the analysis. All other authors provided advice, comments and substantive input to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding

This research was funded by USDA NIFA grant 2015–10780.

Conflicts of Interest

The authors do not have any conflicts of interest to declare.

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CHAPTER 3

A comparative analysis of five forest certification programs²

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Abstract

International expansion of forest certification programs has occurred over the last three decades. Both public and private organizations have shown increased interest in becoming certified by one or more forest certification bodies, to assure the public that forest resources are managed adequately in sustaining forest health and socio-economic viability. The Forest Stewardship Council (FSC) program is globally used as a benchmark to implement forest certification at the national and regional levels. The Sustainable Forest Initiative (SFI) and the American Tree Farm System (ATFS) are also used throughout the United States. In Europe, individual countries such as Bulgaria and Turkey have also developed national forest certification programs. The SFI, ATFS and Bulgarian programs are further endorsed by the Programme for the Endorsement of Forest Certification (PEFC). The results of a qualitative analysis comparing the FSC forest certification program with the SFI, the ATFS, and the two European national programs (Bulgarian and Turkish) suggest that differences in these programs are not necessarily related to their language, but to the level of detail and prescriptiveness of each program. We find that the FSC is much more detailed and prescriptive in nearly all aspects considered for forest certification. In particular, we find that most of the elements considered in the FSC Principle 6 (Environmental Impact) are either only superficial, or not addressed at all, in the other four programs. Furthermore, the other programs appear to be less comprehensive and detailed in the substance of the FSC monitoring and assessment principles. In a few areas, the Turkish program requires more quantitative indicators for assessing forest management than the other programs. Though a comparison of the legal framework related to forest management in each of the studied

countries was briefly introduced, our study focuses on the certification schemes themselves; it may contribute to policy discussions in the future development and implementation of other certification programs.

1. Introduction

One of the earliest certification processes, the American Tree Farm System (ATFS), was developed in 1941 to improve forest management practices on private lands in the United States through education and self-discipline, under forest production and protection premises [1]. This concern for sustainable forest management is held by many private landowners, as about 74,000 family forest owners are currently enrolled in the ATFS program, representing 7.69 million ha (19 million acres) of forest land in the United States [2]. In the early 1990s, the promotion of a more contemporary understanding of “sustainability” was further advanced through the development of other certification programs that promote sustainable forest management and potentially help forest landowners (individuals, organization, companies, etc.) address market requirements [3,4]. The development of some forest certification programs has been prompted by environmental requirements and the increasing concern over deforestation and forest degradation in the tropics, which have also led to the addressing of social issues associated with plantation forestry [3,5,6]. Today, forest certification is also sought by landowners and other organizations to enhance their public image [7] and to signal to consumers that forests are being sustainably managed [8]. Despite some differences across programs, contemporary certification processes generally consist of five steps: (1) initial contact with the certifying body, (2) a pre-assessment, (3) an on-site verification

visit, (4) certification approval, and (5) subsequent audits, inspections, and re-certification when applicable.

Over the last three decades, forest certification programs have evolved, with all now including standards, criteria and indicators of performance. In general, when a forest is enrolled in a certification program, the forest management practices employed are assessed against a series of standards to assure consumers that the wood products produced come from a forest managed under independently verified ecological, economic and social sustainability principles [9]. When compared with traditional state-led regulation, forest certification may lead to more timely changes in forest management practices [1,10]. One recent survey of foresters suggested that certification might positively affect overall forest management [11]. In addition to strengthening forest management practices, forest certification programs have also been shown to facilitate improved dialogue among stakeholders, thus enhancing sustainable forest management [12].

From a global perspective, the Forest Stewardship Council (FSC), the Sustainable Forestry Initiative (SFI) and the Programme for the Endorsement of Forest Certification (PEFC) are three of the most well-known forest certification organizations. The FSC program emerged in response to the failure of international bodies to address the loss of high conservation value forests, particularly in the tropics [13]. The FSC program was initiated, and continues to be managed, by a non-governmental organization; membership is open to private, community, and tribal landowners, as well as many governmental forest owners. The FSC has developed a formalized stakeholder structure in which the primary governing body is an international general assembly composed of three

chambers to which members that want to join may apply: environmental, social and economic. Each chamber is further divided into a northern and southern sub-chamber, with equal representation [14]. One of the main functions of that government body is to approve regional and national forest management standards developed by the corresponding working groups. Public input is required, particularly in the development of regional standard processes. Membership in the FSC is voluntary, but each applicant needs the support of at least two other members [15]. The FSC requires third-party audits once every five years by auditors accredited by the FSC, in addition to annual surveillance audits to verify continual compliance with the FSC certification requirements [16]. Although the SFI program currently has rigorous standards, now independently managed, it was established by the American Forest and Paper Association in 1993 as a less prescriptive alternative to FSC [17]. The PEFC program was established in 1999 in response to environmental, socio-economic, political and cultural issues of forest landowners in Europe, and now acts as an umbrella organization that endorses forest certification systems through independent third-party certification. In 2004, the first non-European national standards (Australia and Chile) were endorsed under the PEFC umbrella [18]. Today, the SFI and ATFS programs are also endorsed by the PEFC program, and the SFI showed the greatest growth in 2018 among PEFC-endorsed programs [19].

In places where there is legitimate sovereign control over forest management standards, certification schemes exist as complements to, rather than substitutions for, legal forest management standards. As [20,21,22] and others have noted, regulatory policy and state capacity play important roles in creating enabling environments for the

adoption of certification. Governmental entities may go beyond simple context-setting roles, to actively develop, encourage or frustrate various certification schemes [23,24,25]. While individual landowners and forest management organizations independently seek forest certification, a forest certification program can also be driven by national concerns and applied in a widespread manner throughout a country. For example, Turkey's forests cover about 26.7% of the country's land area, and more than 99% of the forests in Turkey are owned and managed by the government [26,27]; therefore, a single program addressing all national concerns was developed. In the process, the Ministry of Agriculture and Forestry included the General Directorate of Combating Desertification and Erosion and the General Directorate of Nature Conservation and National Parks when developing the comprehensive national standard. Because Turkey covers three phyto-geographical regions (Euro-Siberian, Mediterranean and Irano-Turanian), the General Directorate of Forestry blended criteria and indicators adopted from Pan-European and Near East forest certification efforts. The Near East process was used as the base because of its wider range and overlapping characteristics with Pan-European criteria [28]. The observation, evaluation, planning and reporting processes of the Turkish program are now conducted by the General Directorate of Forestry. Although the Turkish government has only recently begun using the national program, about 2.4 million hectares (10.7%) of forests in Turkey, as of 2014, were also certified under the FSC program [29]. In 2019, Bulgaria obtained endorsement from the PEFC program for its national forest certification program. Under this program, the verification of standards is conducted by an independent third-party organization, which meets the requirements of ISO 17011 [30].

As the demand for forest certification by public and private landowners continues to increase worldwide, there is concern that consumers of forest products might conclude that all certification standards are equivalent (which may not be true), and there is also a lack of a mechanism to allow consumers to determine which program label pertains to the most sustainably managed forests [31]. Further, interest has arisen in comparing the relative strengths and weaknesses of certification programs from academic institutions in southern Europe. Recent research on this subject has investigated the process of forest certification through the FSC program in North and South America [3], the challenges facing the implementation of national standards for sustainable forest management in Chile, Argentina and Uruguay [32], the challenges facing FSC certification in Nepal [33], and the motivations to adopt FSC- or PEFC-endorsed programs in Chile [6]. The objective of this research is to compare the forest management certification standards most commonly used in North America (FSC, SFI, ATFS) with each other, and with two southern European standards (Turkish, Bulgarian). It is important to note that in the United States, more than half of the forest land is privately owned, while forest land in Turkey and Bulgaria is primarily publicly owned (99% and 89%, respectively) [26,27,34,35]. Consequently, it is expected that this difference in land ownership signature may influence the emphasis each program places on certain standards [4]. Comparisons of the five forest certification programs will be made along one specific line: the equivalence and prescriptiveness of four programs (SFI, ATFS, Turkish, Bulgarian) when compared to the FSC program in the United States. It is important to underscore that our analysis focuses exclusively on the requirements and frameworks associated with the certification schemes themselves, and not on the broader legal and

regulatory frameworks present in each of our studied countries. Nonetheless, a brief survey of these frameworks is provided in the results section.

2. Methods

This research involved documentary work describing the differences in characteristics among forest certification programs based on published materials provided by those programs. The current FSC-US, SFI and ATFS standards were obtained directly from each organization's Internet site [36,37,38]. Containing 10 principles, 55 criteria and 200 indicators related to the management of forests, including requirements for biodiversity, pesticide use, worker rights standards, local and indigenous groups' rights to traditional uses of the forest, etc. (Table 3.1), the FSC program likely has the highest global recognition amongst these programs [27].

Table 3.1 Forest Stewardship Council (2010) principles used in the comparison.

1	Compliance with laws and FSC principles
2	Tenure and use rights and responsibilities
3	Indigenous peoples' rights
4	Community relations and worker's rights
5	Benefits from the forest
6	Environmental impact
7	Management plan
8	Monitoring and assessment
9	Maintenance of high conservation value forests
10	Plantation management

The SFI forest management certification program contains 15 principles (Appendix A Table 3.A1), 37 performance measures and 101 indicators. The ATFS program contains 8

standards (Appendix A Table 3.A2), 14 performance measures and 22 indicators. The Criteria and Indicators for Turkish forests were obtained from the General Directorate of Forestry Internet site [39]. The Turkish program consists of 6 criteria (Appendix A Table 3.A3), 40 quantitative indicators and 11 qualitative indicators. The Bulgarian forest management standards were acquired from the PEFC website. The Bulgarian program contains 6 criteria (Appendix A Table 3.A4) and 41 indicators [40]. Additional characteristics of these five certification programs are shown in Table 3.2.

Table 3.2 Forest certification programs analyzed: general characteristics.

Program name	Enforcement	Endorsement	Scope	Type	Costs
Forest Stewardship Council	Voluntary		International	Performance-based	Minimum variable ^a
Sustainable Forestry Initiative	Voluntary	PEFC	Regional	Systems-based	Variable ^a
American Tree Farm System	Voluntary	PEFC	National	Performance-based	Free ^b
Turkish Criteria and Indicators for Sustainable Forest Management	Mandatory ^c		National	Performance-based	None ^d
Bulgarian forest certification system – Standard for Sustainable Forest Management	Voluntary	PEFC	National	Systems-based	Unknown

^a Depending on mainly ownership size class, tract size, and region [41]. ^b For individual certification. ^c Submission of a periodic report. ^d All data are gathered by official institutions, there are no apparent additional costs.

The five forest certification programs were developed independently; three were written in English and two were translated to English. During this investigation, we found that a standard can refer to the entire set of criteria and indicators of a program, or to a specific area of emphasis within one of these programs. Therefore, for the analysis presented here,

we employ the generic term program to refer to each of the five collections of standards, criteria and indicators. This approach is meant to avoid any confusion with the use of the term standard. Being perhaps the most complex of the five programs (Table 3.3), and knowing that in general the FSC program seems to have more elaborate ecological and social criteria and indicators [31], we chose it as the benchmark against which others were to be examined.

To address our main line of investigation, we reviewed the main document of each certification program to determine whether topics related to each FSC principle were acknowledged. Definitions and glossaries of terms were not analyzed even if they were included in the program's main document. However, we did review Appendix C of the FSC program in order to be precise in assessing the substantiveness of their Principle 6, which includes additional requirements and guidance for the regions of the United States. We sought equivalence between the FSC principles and similar aspects of the other four certification programs. We carefully searched the other four certification programs for correspondence with each topic within each FSC principle, and, if located, we noted the extent to which the topic was described or mentioned in the other programs. We analyzed all 10 FSC principles and examined whether the programs appeared to require evidentiary demonstrations of forest sustainability by establishing thresholds for a minimum acceptance of a requirement. Where appropriate, we describe certification programs as being substantive when specific on-the-ground forest practices are required, procedural when practices appeared to be suggested, and mixed when practices appeared to involve both the substantive and procedural policy styles to some degree [42].

Table 3.3 Structure of forest certification programs analyzed.

Name of forest certification program	Description
Forest Stewardship Council	10 Principles 55 Criteria 200 Indicators
Sustainable Forest Initiative	13 Principles 15 Objectives 37 Performance measures 101 Indicators
American Tree Farm System	8 Standards 14 Performance measures 22 Indicators
Turkish Criteria and Indicators for Sustainable Forest Management	6 Criteria 40 Indicators 216 Variables 11 Qualitative and descriptive indicators
Bulgarian forest certification system – Standard for Sustainable Forest Management	6 Criteria 41 Descriptive indicators

3. Results

Although we have not preformatted the formal analysis of the forest policy frameworks on any of the studied countries, we set the stage for the analysis of the forest certification programs by first providing a brief overview of the forest policy context in which forest landowners operate in the United States, Bulgaria and Turkey. In the United States, about 56% of the forest land is privately owned, 33% is owned by the federal government, and about 11% is considered as other public land [43]. For national forest lands, a number of statutes govern the management and planning of forest activities [44], including the National Environmental Policy Act (42 U.S.C. §§ 4321–4347), the National Forest Management Act (16 U.S.C. §§ 1600–1614) and the Endangered Species Act (16 USC 1531–36, 1538–40). A number of these laws relate only to the management of

national lands, however some national laws, such as the Endangered Species Act, the Clean Water Act (33 U.S.C. §§ 1251–1387) and the Clean Air Act (42 U.S.C. §§ 7401–7602) also pertain to, or affect, the management of private and other public lands. For example, most states have developed Best Management Practice (BMP) guidelines for forest landowners that serve to meet the goals of the Clean Water Act and other laws. Some states (e.g., California, Maine, Oregon and Washington) have also developed state-level forest practices laws that regulate the actions of private and state forest lands. Various counties and cities have also developed other regulations that affect public (county or city) and private forest land management. An example is the environmental review of forest practices that is required under certain circumstances in Pierce County, Washington [45]. The policy environment is therefore quite diverse depending on the type of land (public (federal, state, county, city, etc.) or private) and the state in which the land is located. In addition to complying with applicable laws, landowners (public and private) can attempt to certify their forests so as to demonstrate that they are being sustainably managed. However, certification is a voluntary endeavor.

In Turkey, the forest area covers about 29.2% of the land, of which 99% is owned and managed by the state, and the remaining 1% is either owned by non-state public entities or private entities. Privatization is considered in Turkey a drawback to the public benefit. The nationalization of nearly all forest areas in Turkey occurred in 1945 through Law 4785 [46]. The administration of state forests is organized hierarchically in 28 Regional Forest Directorates controlling 246 State Forest Enterprises, which comprise a total of 2140 Forest Chiefdoms (also called forest units) [47]. Forest-related legislation in Turkey includes Article 169 of the Turkish Constitution of 1982, which delegates the

General Directorate of Forestry as the agency responsible for managing, exploiting and protecting the state-owned forests in Turkey. The related laws in Turkey include: the statutory laws, of which Forest Law 6831 of 1956 is fundamental for forest management activities; regulatory laws, such as the Forest Planning Regulation and the Forest Afforestation Regulation; and the Forest Exploitation Regulations [48]. In addition, one of the most important restrictions of forest lands is given in the National Parks Law 2873, which designates protected areas where timber production is prohibited. Other laws that also support forest management activities are the Soil Conservation and Land Use Law 5403, Agriculture Law 5488 Pasture Law 4342, Environmental Law 2872 and the Afforestation Regulation [47]. It has been found that while 40% of the forest industry firms in Turkey do not experience problems in sales due to the absence of certification, 90% of them believe that certification is indispensable [49]. For this reason, the General Directorate of Forestry started the certification of forest management activities in 2010 so as to meet the certified products demand of the wood products market [11,50].

In Bulgaria, the state owns about 74% of the forest land, and about 12% is owned by municipalities, about 11% by private landowners, and the remainder by other land ownership groups [51]. All forms of forest land ownership are equivalent, thus the Forest Act (SG No. 19/8.03.2011), among other regulations, ordinances and orders, guides the management of all forests in Bulgaria. The Regional Forest Directorates of the Executive Forest Agency control forest activities, and managed and farmland forests require a forest management plan or extraction plan before wood can be harvested, regardless of ownership [52]. Forest certification is a voluntary endeavor, but within the guise of the Forest Act, special preference for harvesting large volumes of wood and for the

development of management plans is given to organizations that have certified their forests [52].

The associations between the FSC program principles and the objectives, standards, criteria or principles of the other programs is complex (Figure 3.1 and Figure 3.2). In the following subsections, we describe the main similarities and differences among these, with each FSC principle as a reference point (see also Table 3.4).

Table 3.4 Consistency among certification programs for the FSC principles.

Forest Stewardship Council principles	1	2	3	4	5	6	7	8	9	10
In comparison with:										
Sustainable Forestry Initiative objectives	9	NP	8	9	1 7	1 to 4 11 12	1	NP	NP	NP
American Tree Farm System standards	2	NP	NP	8	NP	4 5	1	NP	5	NP
Turkish Criteria and Indicators for Sustainable Forest Management	N3 N6 to N9	1	NP	6	1 3 6	2 4 5 N5	1	NP	4	NP
Bulgarian Forest Certification System – Standard for Sustainable Forest Management	5	6	NP	6	1 3 6	1 2 4 6	1 6	NP	4	NP

NP: Not Present * Refer to Annex 3 for description

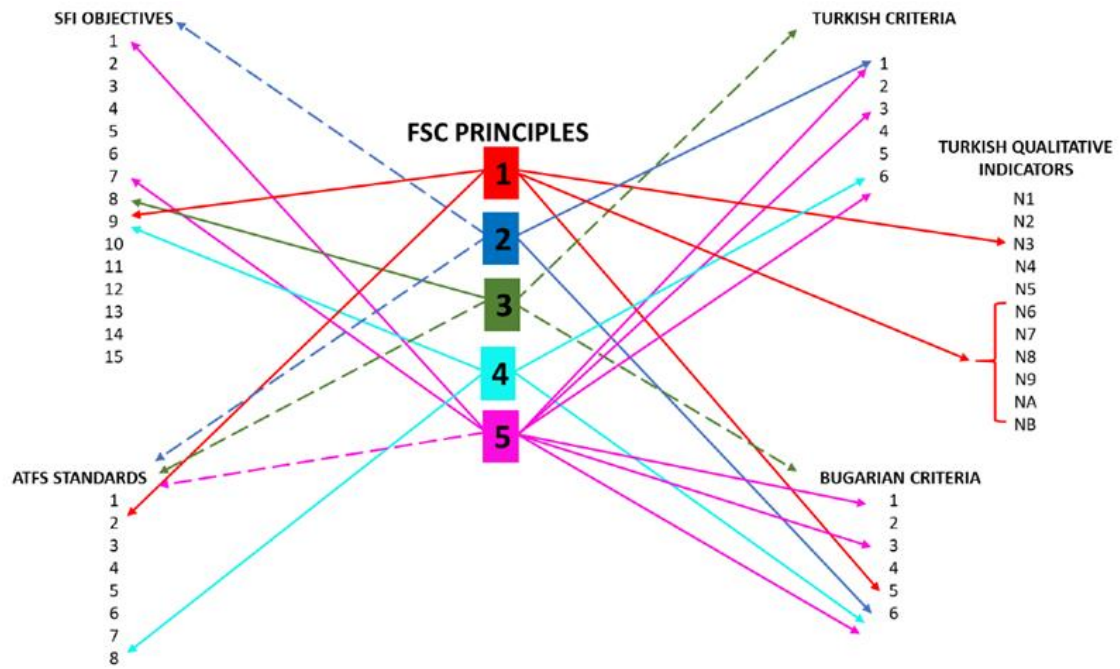


Figure 3.1 Consistency among certification programs for FSC principles 1 to 5. (Dashed lines “---” indicate the absence of a specific requirement or language related to the specific FSC principle).

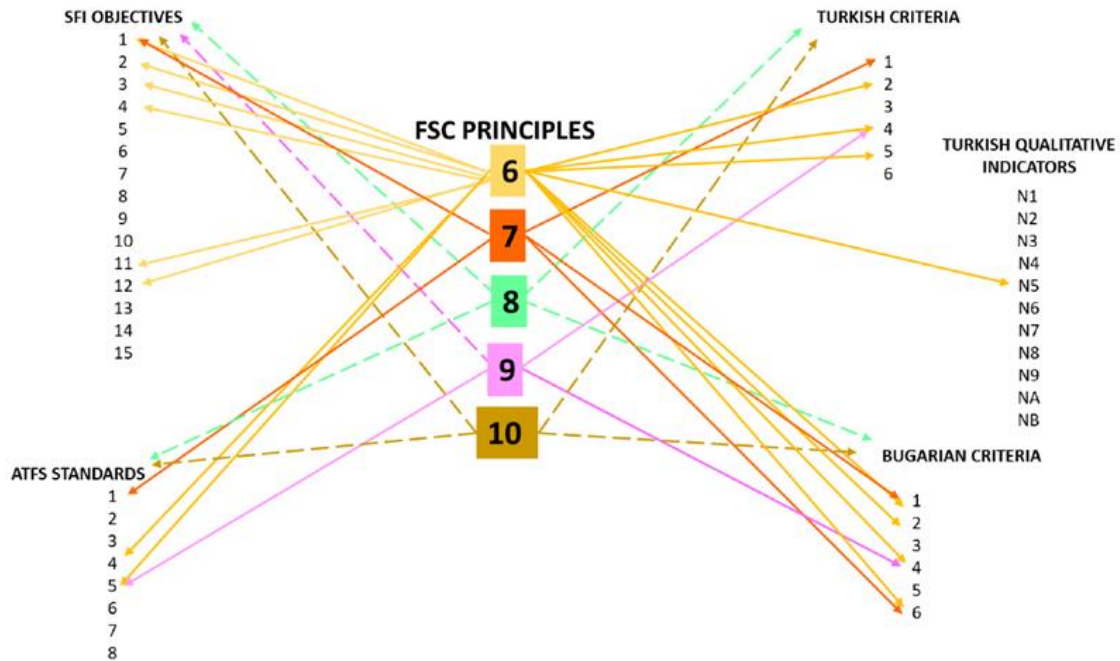


Figure 3.2 Consistency among certification programs for FSC principles 6 to 10.

(Dashed lines “---” indicate the absence of a specific requirement or language related to the specific FSC principle).

3.1. Principle 1: Compliance with Laws and Principles

The FSC program contains more indicators to account for regulatory compliance and is more detailed in the description of these requirements than the other programs. In general, the FSC and SFI programs use similar language in regard to compliance with laws and regulations, although the FSC program requires landowners to consider complaints and investigations associated with certified forests for a 5-year period prior to certification assessment.

The SFI program refers to this principle under its Objective 9, and like the FSC program it mentions accounting for the compliance of applicable forest laws and regulations, and requires a commitment to social sustainability (e.g., worker’s

compensation, prevailing wages, people's rights, etc.). The FSC program also directs its principles towards supporting activities that avoid the illegal harvesting of trees. The SFI program requires participants to demonstrate a commitment to legal conformance through the available regulatory action information, which refers to regulatory compliance data compiled by national, provincial, or state, and local agencies [53]. While conformance is the intent within the SFI program, the spirit and general record of compliance is really what is encouraged.

The ATFS program refers to this principle in its Standard 2; however, the standard is much briefer and more permissive than the FSC program. While the ATFS program is less prescriptive, it is clear that compliance with laws and regulations relevant to forest management is required within the certified forest area. The ATFS proposes a three-tiered process to verify compliance, which appears to be rather flexible (e.g., verbal or written claims of legal compliance). Further, the ATFS program recognizes that landowners might make mistakes in implementing management practices, but landowners need to correct them once full knowledge has been acquired.

Within the Turkish program, Indicator N3 relates to the legal and regulatory framework for the implementation of forest management and could be comparable to this FSC principle. It is important to note that the indicators contained in the Turkish program are all related to policy and institutional frameworks. Within the Turkish program, the National Forest Law Articles are cited often, prompting the need for permission for certain activities (e.g., mining). Furthermore, policies, institutions and instruments are adopted under each criterion of the Turkish program and appear within the list of qualitative and descriptive indicators, rather than as separate criteria.

Criterion 5 of the Bulgarian program corresponds to this FSC principle. In the Bulgarian program, compliance with similar language in the PEFC program and with European Union legislation is mandatory. Conformance with legal, regulatory, and other specific requirements and applicable legislation at the national and international level, including the PEFC guidelines, appears under each criterion. Like the FSC program, the Bulgarian program also requires the avoidance of illegal activities, and proof of preventive and corrective actions of the occurrence of such. The aspect of knowledge and experience in the Bulgarian program is shared with the FSC requirement, in that not only do professionals and contractors need to have knowledge of all applicable laws and regulations, but also employees and workers must be experienced and sufficiently competent to perform the management tasks (for example, through training and supervision). With respect to this area of concern, the FSC program is the most substantive. The Bulgarian program represents a mixed approach, and the other three programs represent the procedural policy style.

3.2. Principle 2: Tenure and Use Rights and Responsibilities

Within the FSC program, the legal right to manage forest resources needs to be clearly defined and demonstrated by the certificate holders. The term “tenure” within the SFI program includes a requirement of being aware of the forest land ownership status. The ATFS program does not have a specific requirement for landowners to present evidence of long-term forest use rights. As nearly all forest land in Turkey is owned by the government, Criterion 1 (indicator 1.4 Forest cadaster) of the Turkish program is meant to assess forest land ownership through documentation of forest use rights, but it is not specific. Criterion 6 in the Bulgarian program addresses part of this principle, in that

the right of use and ownership of forest resources needs to be defined, demonstrated and taken into account within a forest plan. With respect to this area of concern, the FSC program is the most prescriptive in comparison to the other four programs.

3.3. Principle 3: Indigenous Peoples' Rights

The FSC program notes that indigenous peoples' rights should be recognized and respected, and provides a series of actions to consider in order to achieve these goals. Although the FSC program encompasses more criteria and indicators associated with this principle, the SFI program is very similar, as noted through the terminology used in SFI Objective 8. An important detail to mention is that the FSC program requires consultation with tribal representatives in order to develop measures to ensure protection of their rights and resources, while the SFI program only addresses this matter as it pertains to public lands. In addition, one component that is less clear in the SFI program involves compensation for the application of traditional knowledge (which is required under the FSC program). This type of indigenous peoples' rights standard is absent in the ATFS, Turkish and Bulgarian programs. This is understandable in the Turkish case, as there are no communities in an indigenous people's category in Turkey or Bulgaria. However, people who live near the forests, and forest villagers, have rights that emanate from the Forest code; one mission of forestry in Turkey is to contribute to the welfare of these people. They can be employed through forestry activities and they can benefit from products derived from these through lower prices.

3.4. Principle 4: Community Relations and Workers' Rights

The FSC program places community relations and workers' rights together to highlight the importance of supporting both the local economy and the well-being of

communities. In the SFI program, compliance with social laws and workers' rights are considered within Objective 9. In the FSC program, there is greater focus on, for example, the consultation components (or "right to know", as stated in the SFI program), and potential compensation or mitigation measures for loss of or damage to people's property and resources. Both of these programs require compliance with core conventions from the International Labor Organization. However, mechanisms for addressing disagreements between workers and management are not specifically outlined in the SFI program. This FSC principle is briefly addressed under ATFS Standard 8, mainly advising landowners to hire contractors who have adequate insurance, abide by fair labor rules, and have a record of compliance with applicable law and regulations. Criterion 6 of the Turkish program seems to be most comparable to this FSC principle. Aspects such as considerations for hiring local employees (forest villagers), non-discrimination and the enhancement of local communities appear to be accounted for under this indicator. Nevertheless, emphasis is placed on the scope of employment, rather than other rights, such as fair wages. The Turkish program focuses on determining the number of appeals and complaints, but a process to resolve disputes is not required. Criterion 6 of the Bulgarian program gives brief attention to this FSC principle. Compliance with International Labor Organization conventions is mentioned, as well as the right that workers should have to associate with other employees when negotiating conditions of employment. The resolution of potential conflicts related to the management of forest resources is also mentioned and seems to focus on applying the appropriate legislation (e.g., labor rights, rights of use, etc.) to each situation. In general, with regard to this FSC principle, the five programs take a procedural mandatory policy approach.

3.5. Principle 5: Benefits from the Forest

Locality (e.g., use of local products and employment) is emphasized in the FSC program under this principle, as are requirements to minimize harvest waste and loss, and to promote forest product diversification. Objective 7 of the SFI program addresses some of the same requirements in terms of the management of harvest residue and waste and suggests the exploration of alternative markets. In addition, considerations about sustained harvest levels included under this FSC principle are described within SFI Objective 1, but in less detail. The ATFS program refers to sustainable harvest levels by requiring an organization to achieve adequate timber stocking, according to both the landowner's objectives and applicable regulation. The ATFS program does not mention the management of residues and waste specifically, though it is considered a visual quality measure. Nor does the ATFS program specify the marketing of products, but non-timber products are included in the definition of forest products. Within the Turkish program, Criterion 6 can be interpreted as addressing economic viability and offering support to local forest landowners and communities. The aspect of sustained yield harvest levels might be included under Criterion 1 of the Turkish program, where detail is provided about the distribution of growing stock, and within Criterion 3, about forest production and wood increment, illustrating the balance between harvest and growth. Criterion 3 of the Turkish program addresses the capability of a forest to produce goods and services. Although it includes some of the FSC principle elements, information about the harvest of forest products is not contained within the criteria, but rather at the end of the document where implementation of the standard is described. Criterion 6 of the Bulgarian program could also be seen as comparable to this FSC principle, as it requires

the promotion of rural development and encourages local production and employment, although the FSC program's language is more detailed. The issue of harvest residue management is not addressed in the Bulgarian program, but management of waste is addressed under Criterion 2. Criterion 1 of the Bulgarian program mentions that forest management must ensure a balance between use and growth, which is comparable with the FSC program's requirement of a sustained yield harvest. Criterion 3 also alludes to this requirement, but in relation to non-wood products, hunting and fishing. Both the FSC and the Bulgarian programs clearly state the need to conduct harvesting operations in such a manner that they do not negatively affect forest ecosystem functions. For this aspect, the FSC program remains the one that shows a broader scope of the aspects to consider under this principle, though specific thresholds are not evident. The SFI and ATFS, and the Turkish and Bulgarian programs resemble a procedural policy approach.

3.6. Principle 6: Environmental Impact

The FSC program classifies environmental impacts as being both short- and long-term. Each type is defined, and examples of how each could be interpreted across a landscape are suggested. The FSC program requires certified forest owners to conduct a baseline assessment of resources to be incorporated into management planning. Although there is no specific quantitative indicator, the FSC program requires the maintenance of naturally occurring processes, which could be assessed through the density and size of trees, and the application of silvicultural systems and harvesting practices that contribute to such a goal. With regard to silvicultural systems, the FSC program sets thresholds for harvest opening limitations according to the region and requires spatial-temporal details of the opening areas. For rare, threatened and endangered species, the program

specifically requires the assessment of certain species and the protection and enhancement of unique habitats. For large ownerships, consideration of diversity as well as habitat connectivity at the landscape scale is suggested.

The SFI program is similar in many respects. While the SFI program does not require the same level of substantive compliance as the FSC program, it requires the accounting for, and documenting of, potential impacts on biodiversity, soil productivity and social values. For example, Objective 4 of the SFI program mentions the use of scientific information to inform management practices, the protection of threatened and endangered species and forests of exceptional conservation value, and the conservation of old-growth forests, among other issues. The FSC program has more specific requirements for rare, threatened or endangered species, whereas the SFI program requires awareness of rare forested natural communities and the development of a program to protect such species. Thus, the prescriptiveness of this SFI objective is low (no specific thresholds), and instead the procedural approach of this standard is evident. Similarly, language regarding the protection of old-growth forests is more specific in the FSC program, whereas the SFI program does not include the concepts of maintaining, restoring or enhancing natural processes, as described in the FSC program. In general, the performance measures within this objective are assessed by the presence of a program (e.g., a program to incorporate biological diversity, a program to protect endangered species, among others) and the development of additional documents, such as wildlife plans and criteria, and the implementation of practices.

Some aspects of this FSC principle are addressed in the ATFS program. For example, under Standard 5 the accounting for potential management impacts on forest

health is noted. In the ATFS program, the topic of rare, threatened, and endangered species is a mandatory component of a forest plan. However, a landowner is not required to perform an extensive search for threatened or endangered species; instead, they merely need to show a good-faith effort to identify their presence or absence. The program requires that landowners consult with professionals and acquire information to identify and protect threatened or endangered species and forests of recognized importance when these occur on their property. Although the ATFS program references forests of importance, the language employed suggests flexibility, as landowners are advised to consult related information at the state level. In general, the use of the word “should”, and the lack of stringency within ATFS standard 5, create advisory measures rather than substantive requirements.

Criterion 4 of the Turkish program addresses surveys to determine the presence of endangered species and requires monitoring of the number of permissions for hunting. The Turkish program is the only one that provides field-based sub-indicators to determine the number of endangered species in forest ecosystems, according to the International Union for Conservation of Nature Red List. The program specifies the range of measurement and potential data sources. Protected forests in the Turkish program are dealt with in a more quantitative manner than in any of the other programs. Again, information on the range of measurement and the variables to assess is provided. Within the Turkish program, Criterion 2 also refers to damage to forests caused by different agents (biotic and abiotic). The program focuses on the area of damage due to a particular factor, but a requirement to assess potential impacts of planned activities (as specified in the FSC program) is not evident within the Turkish program. Although the Turkish

program requires the informing of the public about management activities (Indicator N5), there is no reference to a formal process for public consultation.

Under Criterion 1 of the Bulgarian program, an impact/compatibility assessment of planned management activities is required. However, it lacks specific language on which elements to include, and leaves the forest manager to interpret the regulatory requirements. Under Criterion 2, the management of waste is required but only in a general scope, emphasizing inorganic waste. Impacts on endangered and threatened species and vulnerable forest ecosystems are alluded to under Criterion 4 of the Bulgarian program, which also requires the development of measures to protect endangered, threatened or vulnerable species, and other representative ecosystems. The assessment of these elements “shall” be included in the forest management planning.

The FSC program requires the establishment of riparian management zones to protect their habitat and function. The program suggests that the extent of the zones should go beyond the habitat to be protected, and the use of regional and local guidelines and scientific information available would determine the dimensions. Buffer widths for stream management zones are based on geographic region, and ground slopes are specified in an appendix of the FSC program. To protect water resources, the FSC program generally requires landowners to operate beyond the scope of forestry best management practices (BMPs), which may have been developed to reduce nonpoint source pollution generated by forest management activities [54]. Nonetheless, the program notes that non-compliance with BMPs does not necessarily mean a nonconformance with the indicator. This could be interpreted as a flexible requirement, but the FSC program further prescribes on-the-ground action to be addressed. In addition,

region-specific limitations and conditions for minimizing soil and water disturbance are noted. Objective 3 in the SFI program addresses the protection of riparian zones and other water resources. As with other SFI objectives, this is also plan-based (e.g., “program to implement...BMPs...”, “...plans to manage and protect rivers...” etc.). The SFI program emphasizes adherence to BMPs yet requires meeting and exceeding the requirements of any other pertinent law or regulation. The protection of water bodies is also considered under ATFS Standard 4. The ATFS program focuses on compliance with BMPs, and specifically mentions riparian zones and wetlands. The protection of water resources is detailed within the Turkish program indicators under Criterion 5. Although the protection of riparian forests is not specific, it requires forest managers to collect data for river and stream-side afforestation. However, this program is different from the other four in that the sub-indicators require field-based evidence, with the purpose of illustrating which forest areas are managed for the conservation of water. These areas are classified in four types and are to be reported annually along with the information of at least the previous 10 years. Soil and water protection are contemplated in the Bulgarian program under Criterion 2. In comparison to the other programs, this program does not provide a similar level of information in regard to the protection of water resources. As with the SFI program, the Bulgarian program emphasizes developing plans or documenting information about planned activities to maintain the protective functions of forests (soil and water). However, the relevant documents are not detailed in the program.

With respect to the use of pesticides for forest management purposes, the FSC program is more restrictive on what chemicals are allowed. The FSC, the SFI and the Bulgarian program specifically prohibit the use of Type 1 and Type 2 (World Health

Organization) and chlorinated hydrocarbon pesticides. However, the SFI program allows these where there is no other viable alternative. Written strategies that justify the use of chemical pesticides and a specific prescription are only required under the FSC program. The FSC program also requires compliance with its list of highly hazardous pesticides, while the SFI program prohibits the use of pesticides banned under the Stockholm Convention. The ATFS program requires pesticides to be approved, applied, stored and disposed of in accordance with the U.S. Environmental Protection Agency, but the level of detail is not comparable with what is described in the FSC program. The ATFS program states that pesticide application is allowed when other control measures for unwanted plant species are deemed ineffective or impractical. None of these requirements are noted in the Turkish program, although forest managers are asked to report the area, expenditure, and success percentage of chemical control. Finally, the Bulgarian program mandates landowners to provide information about the use of any chemicals in forests in compliance with existing Bulgarian and European Union regulatory framework.

Integrated pest management is encouraged in the FSC, SFI and ATFS programs, but the use of biological control agents is specifically limited only under the FSC and Turkish programs as part of a pest management program. The use of exotic species is addressed by both the FSC and the SFI, although the FSC program is more detailed in requiring documentation of their provenance, location, and potential impacts. Restrictions about the use of biological agents are neither defined nor described within the SFI program. The management of invasive species in the SFI program appears under Objective 2 and Objectives 11 and 12, but mainly as requirements to participate in programs and efforts that address the issue. The use of biological agents is not mentioned

in the ATFS program, while the management of invasive species is approached under the need to promote forest health. In the Turkish program, one standard briefly addresses the issue of exotic species (non-native or introduced species in the Turkish program) under Criterion 4. The Bulgarian program allows the use of non-local or introduced tree species as long as negative impacts on diversity can be avoided or minimized. Genetically Modified Organisms (GMOs) are prohibited under the FSC and the Bulgarian programs (Criterion 4). In contrast, the SFI program supports participation in research programs and efforts related to the use of GMOs. The use of GMOs is not mentioned in the ATFS or Turkish programs.

With respect to this area of concern, the FSC program is broader in scope and is more substantive than the other four certification programs, which maintain a procedural policy approach. One particular difference is evident in the Turkish program, which takes a field-based approach to documenting potential environmental impacts.

3.7. Principle 7: Management Plan

Except the Turkish program, all programs studied here explicitly require landowners to write and implement a forest plan as a core element of forest certification. These programs use the word “shall”, which we interpreted as a mandatory element. The FSC program is detailed and prescriptive in requiring certain elements to be incorporated into the forest plan and dedicates Principle 7 to describing the specifics pertaining to this requirement. The FSC program notes that the existence of a management plan is important, and that the document should be made available to the public. Of the other programs, only the Bulgarian program suggests the latter aspect. This FSC principle concerning a management plan corresponds to Objective 1 of the SFI program. While the

SFI program centers its discussion on maintaining long-term harvest levels, it uses less stringent language to refer to the biodiversity, conservation, and social aspects of a plan. Other components of forest plans that are required in the FSC program, but are not specifically stated in the SFI program, include the monitoring component, the history of land use and past management, the description of the legal status of the forest unit, the transportation network, consultation processes, and the requirement of qualified professionals to implement the plan.

This FSC principle also corresponds to Standard 1 in the ATFS program, and although the ATFS program does not include all of the mandatory elements noted in the FSC program, those included are well described. The ATFS program tends to focus a forest management plan's design on ecological elements and supports the adaptive management approach. The ATFS program only requires a description and evaluation of individual elements (e.g., biomass, carbon, desired species, wetland, fire, etc.) when these are relevant to the property and consistent with the owner's objectives. Within the Turkish program, Criterion 1 indicates that areas managed under forest plans need to be monitored, so the development of a plan is assumed even though little other language that refers to a plan is provided. Despite the lack of clarity on this aspect, all forested areas in the country are covered by a forest management plan that was developed by the government or a private firm. The General Directorate of Forestry is responsible for the 2140 forest units across the country, and every unit has a forest management plan that is updated every 10 years according to regulations. The Bulgarian program indicates that a forest plan is the guiding document for forest management, and the requirement for developing a forest management plan appears under Criterion 1. The Bulgarian program

also notes that a plan should cover at least 10 years and suggests that no more than 10 years should pass before subsequent updates. As components of a management plan, a forest inventory, the management objectives, maps of resources, and an impact assessment are all mandatory. Although it is mentioned that public interests should be taken into account, the Bulgarian program does not require specific evidence of a process conducted for this purpose, other than making existing forest planning information publicly available.

An up-to-date inventory to inform a management plan is required across the five programs. However, the ATFS program only uses the term once, and without any other detail. The Turkish program, on the other hand, goes further than the other four programs by providing examples of tables to be used for inventorying diverse landscape elements features, such as bird species and fragmented forest area. With respect to this aspect of analysis, the FSC program is again the most detailed of the five programs with a mixed policy approach, while the other four certification programs are largely procedural.

3.8. Principle 8: Monitoring and Assessment

The monitoring and assessment of various management activities is required within the FSC program. The program also alludes to this throughout other parts of the standard (e.g., annual monitoring of high conservation value forests). Although monitoring and assessment are not specifically noted as objectives within the SFI program, the program requires the monitoring of water quality and the protection of water bodies, and BMP implementation, utilization and progress in implementing management activities. Similarly, the ATFS program does not have a specific requirement regarding this principle, yet the ATFS program broadly requires the monitoring of any changes that

could obstruct the achievement of the management objectives. Within the Turkish program, monitoring only appears under Criterion 2 in relation to soil resources, and under Criterion 4 in relation to biodiversity. However, it is also implied in an assessment of tree growth and tree damage. A monitoring and assessment plan is not specifically required under the Bulgarian program, but it mentions that the results of monitoring are part of the information to make publicly available. Although there are no quantitative thresholds specified in the FSC program for this area of concern, it is the most substantive of the five programs, as none of the other programs list this process specifically, and none include as many aspects as does the FSC program.

3.9. Principle 9: Maintenance of High Conservation Value Forests

The FSC program notes that the maintenance of high conservation values is an imperative part of the forest planning process. The reconsideration and adjustment of management activities that could impact high conservation value areas is required. This principle is very detailed within the FSC program, but less so within the other programs. High conservation value forests are comparable to the “forests with exceptional conservation value” noted in the SFI program, wherein program participants need to collect information, develop a program to locate and protect these areas, and support conservation efforts concerning these areas. However, public consultation during the assessment and management of these areas is not a requirement (as it is within the FSC program), nor is the monitoring of these areas. Under ATFS Standard 5, forest landowners need to identify and take appropriate measures to protect forests of recognized importance, but the indicators are not very specific. Criterion 4 of the Turkish program addresses some of the elements required in the FSC program for these areas.

However, there are no measures noted to ensure the maintenance of these areas. Under Criterion 4 of the Bulgarian program, the requirement to include important forest biotopes and representative ecosystems into a forest management plan is noted, in addition to a clear statement that degradation and change within these areas is not justified.

With regard to this area of concern, the FSC program presents a substantive policy approach, and a broader scope of this requirement. Meanwhile, the SFI, ATFS and Bulgarian certification programs are more procedural in regard to policy style. The Turkish program implicitly suggests a procedural approach, though the indicators under this principle are field-based.

3.10. Principle 10: Plantation Management

Of the five certification programs, the FSC is the only one that has a plantation management section, which suggests that plantations shall not interfere with any conservation and protection management objectives, nor with any natural processes. Areas converted to plantations after 1994 are generally not eligible for certification, unless a forest owner demonstrates that they were not directly or indirectly responsible for such conversion [55]. Although the conversion of natural forests to plantations is generally prohibited under the FSC program, there are three conditions that allow the conversion, and FSC provides some definitions and examples of what would be considered conversion of forest land (e.g., for road construction). Within this indicator, the threshold for conversion is less than 2% of the certified forest area. An indicator also suggests the need to develop a compensatory management plan to address the potential negative impacts caused by the conversion. The question of FSC certification of non-

native tree plantations is controversial, given the assumed incompatibility of plantations with many of the conservation goals in the program [56,57]. The FSC program represents a substantive policy approach for this area of concern. There is no specific language concerning the development of plantations in the SFI, ATFS, Turkish or Bulgarian programs. The Bulgarian program only states that a change in the purpose of managed forests is allowed if needed, and if the change follows the terms of the program (Criterion 4, Section 4.8).

4. Discussion and Conclusions

The main differences between the forest certification programs analyzed here primarily occur at the level and scale of measurable impact, rather than regarding language employed. Perhaps differences in the degree of prescriptiveness could help evaluate the control these certification programs have on forest management. For example, recommendations for specific impact thresholds and other field-based audits make the FSC program stand out from the SFI, ATFS, the Turkish and the Bulgarian programs. The detail and the substance of the FSC program as documented in this analysis could indicate a positive impact towards sustainable forest management, although other studies have concluded that the FSC (and the SFI) program may fail to adequately address several ecological issues (e.g., [31]). Certainly, additional and updated studies may be needed to verify any of these statements, as well as to evaluate, among others, the public (dis)satisfaction with any existing forest management practices under a certification body, and the impact of the FSC program, with its broader scope regarding local environmental quality and socio-economic well-being. Nonetheless, our analysis benefits both the public and private sectors, whose interest in becoming certified

by one or more of the certification programs presented here has been increasing in recent years. The analysis highlights distinct approaches to improving forest practices, including differences in wording and in the level of prescriptiveness these programs use to demonstrate a commitment to sustainability. Similarly, our results emphasize the treatment given to a single environmental element by different programs in order to assess the success of an indicator and the performance of a program in general. For instance, we noted, as in [31], the importance of obtaining measurable field data to assess the impacts of implementing particular indicators such as “maintenance of biodiversity”, but in other cases, written protocols, reviews or oral warnings can serve as the measure of success.

The FSC certification standard for sustainable forest management is the most extensive of all the programs examined. As noted by [42], we found through our analysis that the policy scope of the FSC program is broader, as it includes labor, indigenous rights, and a wide range of environmental rules while in the cases of the SFI and ATFS programs, the scope appeared to be limited to forest management rules and the allowance of flexibility for continual improvement, which in the second case would primarily be required and implemented in the forest management plans. The Turkish and Bulgarian programs also appeared to fall into the narrow policy scope. In the first case, the Turkish program focuses generally on field-based indicators and provides very little guidance in regard to terms for the applicability of the standard for data collection in general. It is difficult to conclude whether this approach (in sum) might be considered procedural or substantive, because there are no established thresholds for management outcomes. The Bulgarian program contains language much like that employed in the SFI program, which

suggests that the approach of the program is procedural and goal-oriented. As with other programs, few specific management outcomes are noted in the Bulgarian program.

The Turkish program applies to nearly all forests in Turkey, which are owned and managed by the government. The standard developed for Turkey encompasses numerous quantitative indicators that reference numbers or areas of features. Unlike the other four programs, the Turkish program presents a series of descriptive and qualitative indicators that relate mainly to the existence of policies and institutional capacity for sustainable forest management. Within the program, these are listed at the end of the document, but we learned that the qualitative indicators included five general indicators and, in theory, one additional indicator under each criterion [39]. This procedure differs from the other four programs, which often contain a single criterion to assess compliance with existing national, international, state and local law, and regulations relevant to the management of forest resources. We also find that within the FSC program, some terms could be confusing when they refer to applying a regulation “when necessary”. The use of such language can leave an issue open to interpretation and may lead to unnecessary disputes between landowners (or land managers) and other stakeholders.

We recognize that the use of specific terms within the different forest certification programs might be a product of either language differences, potential errors in the translation to English, or simply based on national convention. Local conditions and characteristics could also influence what aspects are emphasized and considered in each program. Further, the structure of the forest sector in the countries where these national certification standards are developed and implemented, the public policy approach to sustainable forest management, and economic factors (e.g., forest product exports and

gross domestic product) all could support forest certification initiatives or stifle them [13,58]. In this sense, it is important to mention that even though both the Turkish and the Bulgarian certification programs are new (established in 2019), these countries have worked on establishing partnerships with international organizations in order to promote sustainable forestry and to provide incentives to address the supply and demand for products obtained from certified forests [59].

Many requirements of the FSC program were lacking or minimally taken into account in the other programs that we considered. There are multiple reasons why these five programs differ, both in the way they are written and how they are implemented. Further, metrics for monitoring progress toward sustainability may differ based on the social, economic and political context within which they are measured [60]. Some countries may also lack the technology for data collection or assessment and monitoring (e.g., geographic information systems), a situation that may make the transition to sustainable forestry slow [28], and forest certification is not well established in developing countries. The potential participants in the programs are also different (FSC: nearly any organization; SFI: any organization in North America; ATFS: private landowners in the United States; Turkish program: government-managed forests in Turkey; and Bulgarian program: all landowners in Bulgaria). The programs analyzed appear to be designed to address the needs and concerns of their target audience, whether they are environmental groups, non-governmental organizations or the industry and private forest landowners. Further, inadequate policies, ineffective legal and administrative tools, and the inefficient administration of programs can limit the implementation and enforcement success of forest certification programs [28,61].

Perhaps these were in the minds of the people who developed the certification standards, criteria and indicators, which may have unknowingly triggered the high levels of mistrust and polarization that exist between supporters of the different forest certification programs, as expressed by [61]. We found it interesting that although we used the most current available documents, some topics of global importance had not been fully considered (e.g., climate change) in the programs studied. These and other considerations are helpful in understanding why some countries develop and implement certification programs, and why public and private landowners in other countries might enter into certification programs, to demonstrate their commitment to sustainable forestry. For example, under the FSC program, the monitoring and assessment of management activities is considered an integral component of certification, but we did not find this requirement to be as fundamental within the other programs. Although we recognize that the ATFS program is very specific to small private forest landowners, additional clarity in terms of demonstrating compliance with the standard might be provided. For example, terminologies such as “good-faith effort” and “landowners are advised to” may be too permissive for the purposes of sustainable forest management. Any needed improvements of the certification programs analyzed here would depend on the performance of each program in each country, when the specific requirements, criteria and indicators are assessed to determine if they are being met and if they are advancing forest sustainability. An important issue that needs to be studied in the future corresponds to a deeper understanding of the cultural variables that have direct effects on the policy process [62]. The diverse definitions and interpretations of sustainability may be another factor that

results in a forest certification program appearing more rigorous (substantial) or flexible (procedural).

Political differences between countries, and the cultural context in which programs are developed and implemented, are not always apparent [62]. It is understandable that our results may reflect the specificities of each program, the environmental, social and economic issues they seek to mitigate, the cultural spaces in which they were developed, or some combination of all the above [62]. This study could be complemented by additional analyses, to determine the extent to which these certification programs exceed other requirements set in federal and state environmental law and regulations. For example, is an FSC program threshold for a riparian buffer more restrictive than a government requirement? Or would a plan-based approach be more effective in strengthening the whole ecosystem? It might be relevant for future studies to consider other existent complementary documents, such as definitions, guidance or procedures, and rules that accompany the forest certification programs.

Finally, a comparative analysis of national forestry law and regulations in each of the countries, and the potential influence of them on the development and implementation of forest certification programs, can provide deeper insights into the origin of the differences exposed in this study. It is possible that certain terms or more detailed information about compliance measures might be found in the laws and regulations that are assumed to be applicable to all potential certificate holders. In the United States, the laws related to forestry vary by owner type and by the geographic location of the forest. Therefore, it is understandable that a single certification program (FSC, SFI, ATFS) for all possible combinations of owners and locations would need to be flexible in many

regards, and would need to incorporate more detail that was not already included in other over-arching laws and regulations. In Turkey and Bulgaria, the policy environment is more encompassing of all forests, regardless of owner or location, and therefore some aspects of forest certification would likely already be treated by national laws and regulations, and would not necessarily need to be included in the national forest certification program. Some of these issues were evident in our analysis, yet an open area for investigation seems to involve the deeper linkage between national (or sub-national) legislation and forest certification languages.

Author Contributions

All authors were involved in designing this research. The first author carried out the review and the analysis of the documents. All other authors provided advice, comments, and substantive input to the writing of the manuscript. All authors have read and agreed to the published version of the manuscript.

Funding

This research was supported by the U.S. Department of Agriculture, National Institute of Food and Agriculture, Grant 2015–10780.

Acknowledgments

This work was also supported by the Scientific Research Projects Coordination Unit of İstanbul Üniversitesi-Cerrahpaşa, Project number 27751.

Conflicts of Interest

The authors declare no conflict of interest.

Appendix A

Table 3.A1. Sustainable Forestry Initiative (2015) principles used in the comparison.

1	Forest management planning
2	Forest health and productivity
3	Protection and maintenance of water resources
4	Conservation of biological diversity
5	Management of visual quality and recreational benefits
6	Protection of special sites
7	Efficient use of fiber resources
8	Recognize and respect indigenous peoples' rights
9	Legal and regulatory compliance
10	Forestry research, science and technology
11	Training and education
12	Community involvement and landowner outreach
13	Public land management responsibilities
14	Communications and public reporting
15	Management review and continual improvement

Table 3.A2. American Tree Farm System (2019) standards used in the comparison.

1	Commitment to practicing sustainable forestry
2	Compliance with laws
3	Reforestation and afforestation
4	Air, water, and soil protection
5	Fish, wildlife, biodiversity and forest health
6	Forest aesthetics
7	Protect special sites
8	Forest product harvest and other activities

Table 3.A3. Turkish standards (General Directorate of Forestry 2019) used in the comparison.

1	Forest resources and their contribution to global carbon cycle
2	Health, vitality and integrity of forests
3	Production capacity and functions of forests
4	Forest biodiversity
5	Protective functions of forests
6	Socio-economic functions of forest
	Qualitative and Descriptive Indicators
N1	National forest programs or equivalents
N2	Institutional framework
N3	Legal and regulatory framework
N4	Instruments of finance and economy
N5	Information and communication
	Policies, institutions and instruments to sustain and improve forest resources and their contribution to the global carbon cycle in an appropriate way
N6	
	Policies, institutions and instruments to maintain the health, vitality and integrity of forest ecosystems
N7	
	Policies, institutions and instruments to maintain and promote the productive functions of forests
N8	
	Policies, institutions and instruments to sustain, protect and properly increase biodiversity in forest ecosystems
N9	
	Policies, institutions and instruments in forest management to maintain and properly improve the protective functions of forests
NA	
	Policies, institutions and instruments to maintain socioeconomic functions of forests
NB	

Table 3.A4. Bulgarian standards (Council for Sustainable Forest Management and Certification in Bulgaria 2019b) used in the comparison.

1	Maintenance of capacity of the forest resources and their contribution to global carbon cycles.
2	Maintaining the vitality, health and protective functions of forest ecosystems.
3	Maintenance and promotion of productive functions of forests.
4	Maintenance, protection and possible improvement of biological diversity in forest ecosystems.
5	Applicable international, national and local legislation and forest management.
6	Maintenance of socio-economic conditions and functions of forests.

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CHAPTER 4

Forest sustainability in state forest management plans: A content analysis³

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Abstract

A commitment to sustainability is often demonstrated through both management plans and the implementation of associated practices. Steps toward meeting this social expectation include articulation of sustainability principles and specification of activities to achieve them. We applied content analysis to a sample of state forest plans from the United States to examine the terms associated with sustainability and to assess explicit demonstrations of a commitment to sustainable forestry. We expected that the language employed would signal a substantial interpretation of terms associated with forest sustainability. We queried the plans for a list of terms associated with sustainability and analyzed the associated textual context. Eight categories and 11 subcategories were developed to code the plans for the presence/absence of statements associated with dimensions of sustainability (environmental, economic, social, and institutional). Our results show that certain terms generally associated with sustainability did not appear in the text of the forest plans sampled. Also, differences between regions regarding the use of terms and the emphasis given to each sustainability consideration are evident. Our findings suggest that forest plans may lack some discursive components that might be important in aiding public understanding of forest management planning, and more importantly, evidentiary demonstrations of forest sustainability.

1. Introduction

The concept of sustainability gained widespread visibility following the publication of the Brundtland Commission report *Our Common Future* in 1987. The term was subsequently applied to various fields of scholarship and practice, and thus several

definitions and interpretations were developed by the 1990s (Basiago, 1995; Scoones, 2010). In addition, Agenda 21 and the Forest Principles were adopted by the United States in 1992 in commitment to manage forests in a sustainable manner. However, despite the wide appeal that *sustainability* and *sustainable forest management* appears to have, there is a recognition of, first, the complexity of the term and, second, of that it is not widely understood by forest policy and management professionals, and even researchers in the field (Sample et al., 1993). A lack of understanding and the openness of the concept to be interpreted in different ways has also led to question its operationalization. In general, the operationalization of sustainability has mainly been guided by initiatives that promote the use of criteria and indicators to measure the state of the different forest values. For example, the federal government in the United States relies on the Montréal Process Criteria and Indicators (MP C&I) for Forest Sustainability to report the condition of forests at a national level in terms of the environmental, social, and economic aspects of sustainability. At the state level, the MP C&I framework is also used in different ways in the implementation of forest plans. More recently, the National Report on Sustainable Forests-2010 (Robertson et al., 2011), noted that the “core concept of strong sustainability is that the benefits of nature are irreplaceable and that the entire economy is reliant on society, which in turn is entirely dependent on the environment” (p.17) and that “better data leads to a better dialogue, and therefore, to better decisions” (p.11). With these statements in mind, one might expect to find robust evidentiary demonstrations of forest sustainability within forest management plans. This is particularly true given the widespread social expectations and demands regarding sustainable forest management, evidenced most clearly in the 1990s when timber retailers

in the US and elsewhere faced boycotts fueled by environmental concerns and when sustainability certification systems such as the Forest Stewardship Council and Sustainable Forestry Initiative were developed in response.

The management of forests in the US is conducted in compliance with complementary or overlapping federal, state, and local laws and regulations along with organizational goals and policies that aim to protect resources such as water, soil, and wildlife, among others (Food and Agriculture Organization of the United Nations, 2015). However, it has been noted that there are substantial differences between federal and state policymaking. Some authors have argued that state and local governments are expected to prioritize economic development over the management of environmental concerns. Although federal agencies face more institutional standards and are constrained by diverse law and regulations to implement forest management activities, neither federal or state agencies are inherently “better” at both protecting the environment and producing economic benefits since they appear to complement each other in the provision of these benefits (Koontz, 1997). An important question in this context is whether forest plans developed for state forests exhibit a greater emphasis on economic considerations than on environmental and social considerations.

State-managed forests may be important contributors to achieving forest sustainability. In the US, state forests occupy more than 9% of the total forest land (Oswalt et al., 2019). As with federally owned national forests, state forests are constrained by legislation and agency regulations including the requirement that their management be guided by a written plan according to the laws in each state (Koontz, 1997). The management of state forests generally aims to accommodate harvesting,

tourism, and recreational activities, along with many other uses. State forestland management can also be complex as it must often confront conflicts between competing interests and uses of the diverse interested stakeholders. Conflicts may arise over issues such as the intensity of management, managing for multiple benefits, and balancing social needs for economic development, protection and conservation of forest values, and recreation at different scales (Cubbage et al., 2017).

Often, a forest management plan is the primary instrument used to guide the management of state forests through a definable time horizon. Well-defined management objectives and robust measures and estimates to demonstrate progress towards management goals are important components of a management plan (Gutierrez Garzon et al., 2020a; Siry et al., 2018). Likewise, the understanding of how state forestry agencies conceive of and operationalize sustainable forest management contributes to scholarship on the discursive dimension of natural resource management. It also helps to build a deeper understanding of an ownership category that has received relatively little attention in the literature (Koontz, 2007). Keeping in mind the historic development and intents of operationalizing sustainability, this study aims to (A) investigate how state forest agencies in the US use terms associated with sustainability in forest plans; (B) investigate whether the language employed in forest plans leads to the assignment of one of the following three management approaches as predominant: (1) sustained-yield forestry, (2) multiple-use management, and (3) ecosystem management (Sedjo & MacCleery, 2010); and (C) determine the level of comprehensiveness of the plans as viewed through the inclusion of environmental, social, and economic considerations.

As applied to forest management specifically, Gutierrez Garzon et al. (2020a) demonstrated that managers' definitions appeared to employ similar language to refer to the use of forest resources in a manner that accounts for the opportunity to continue with the provision of products and services over the long term. However, guidance on how to operationalize specific understandings of sustainability is not always clear (Anderies et al., 2013). Instead, agency documents (e.g., forest management plans) tend to use alternative terms associated with sustainability (Gutierrez Garzon et al., 2020a; Scoones, 2010), rather than relying upon the term sustainability itself.

Analyzing both the strategic and unreflective uses of discourse is a critical element in understanding the dynamics of policy design and implementation (Hajer, 1995). Similarly, acknowledging the relationship between language and social reality is vital. On the one hand, language serves as a lens (clear or blurry) that influences the interpretation (through observation and use of empirical data) that one can make of the world "out there" (Potter & Wetherell, 1987; Alvesson & Kärreman, 2007) and on the other hand, social representations are themselves the product of causal processes which influence the explanations people give for events, issues, solutions, etc. (Potter & Wetherell, 1987). Language not only provides an outlet to describe a situation or issue but also facilitates discussion and debate, and more importantly serves to demonstrate a commitment to an idea (Norton, 2005). Further, social representations are constructed through communication processes that occur through diverse media (casual conversation, official pronouncements, bureaucratic representations). Many discourse analysts would claim that these processes do not necessarily lead people closer to the 'truth' but, rather,

generate means of “providing coherent and consistent explanations for events” (Jacobs, 1999, p. 208; Sharp & Richardson, 2001).

Discourse analysis has roots in both social theory and linguistics (Hastings, 1999) and has increasingly been used in planning and policy research perhaps due the constitutive effect of language, in essence “creating” lived realities that reflect changes in policy into broader social changes (Sharp & Richardson, 2001). In this sense, the social constructionist approach has great appeal in planning and environmental policy (Sharp & Richardson, 2001) because the decision-making process in forest management, for example, occurs via complex interactions between stakeholders and their variant and sometimes divergent interests. In fact, collaborative planning in policy making can encourage a discussion that leads to strategies of action with social meaning that can be put into practice and produce needed social and organizational changes. In the field of forest management, words have an impact in shaping how forests and other elements of the environment are governed (Leipold, 2014). The use of certain terms and phrases in planning documents can be seen to affect how resources are managed and how key actors operate with regards to those resources (Bone et al., 2016). In the analysis of environmental issues that are interrelated with socio-economic concerns and contexts, language matters because the way a society constructs, interprets, and discusses those issues can have both positive and negative impacts (Dryzek, 2013; Norton, 2005).

A discourse analysis approach enables an analysis of texts beyond the terms or sentences as written in a document, so that these can be interpreted according to particular contexts or purposes (Krippendorff, 2019; Yanow, 2006). This type of analysis might also help identify the potential influence that actors have in defining a problem

(Hajer & Veersteeg, 2005). A qualitative discourse analysis involves the reading of a more focused phenomena as represented in a document. This type of analysis can be enhanced by computer-aided content analysis, which provides additional advantages in identifying word frequencies and patterns from larger quantities of text with the aim of systematically drawing inferences from the texts (Krippendorff, 2019). Considering sustainability as a common term to communicate in the policy discourse arena with all of the interested stakeholders, it might be possible to discover through the view of a wider lens how a community seeks to develop, adopt, and implement cooperative actions to maintain the range of options available for managing forest resources (Koontz, 1997; Norton, 2005) instead of assuming sustainability can be achieved through the mere act of implementing a policy. Even though there is not only discourse in referring to environmental issues (Dryzek, 2013), and although a forest plan for public lands is not a piece of legislation per se, we expect that these documents might reflect public concerns regarding the management of state forests as a way to ensure support and participation during the implementation of planned management activities.

Some studies (Gutierrez Garzon et al., 2020a; Lehtonen, 2004; Newman, 2006) have noted social considerations are the weakest dimension of sustainability, and environmental or ecological dimensions as those most often considered in forest plans. Further, in the field of natural resource management, other studies have also been conducted employing content analysis to analyze different environmental and policy aspects in the forest management field, including ecological disturbances (Altaweel et al., 2019) and the concept of resilience (Bone et al., 2016), among others (Erol & Yildirim, 2017; Selles, 2020; Sutterlüty et al., 2018; Xu & Bengston, 1997, etc.). However, there

has been limited research on state forests and their management, so this research contributes to science by filling an important niche in the forest management and planning fields.

2. Methods

For this study we used only current (as of 2020) forest plans developed by individual state resource management organizations for state-managed forests in the US. As in Korhonen et al. (2016), ultimately the sample size for this study was determined by content freely available through the Internet. We employed a purposive sampling method (Krippendorff 2019; Ritchie et al., 2014) by targeting forest plans developed for state forests across the US. The data collection was performed by conducting a standard Google-based Internet search. Our sampling and analysis methods involved five main steps: (1) searching for and downloading forest management plans for state-managed forests in the US that were publicly available on the Internet, (2) filtering the documents to retain only the most recent and current plans, (3) searching for the existence/absence of expressions associated with sustainability according to the frequent terms as listed in Gutierrez Garzon et al. (2020a), (4) developing a categorical system to code the plans to identify the extent by which sustainability considerations are included, and (5) interpreting the results in relation to the goals of this study. The keywords used in the search for forest plans included “[State] state forest management plans”, “[forest name] management plan”, and “state forest plans”. The publication date of the documents was not a constraint; the plans needed to be in effect as of 2020. Only plans specifically developed for individual state forests were downloaded, and thus regional plans were not

analyzed. A two-step sampling technique was manually applied to the sample data as to ensure that the documents collected were up-to-date and not marked as “draft” or “under revision”.

We obtained and analyzed the entire text of 30 forest plans developed for state forests in 10 different states. Of the plans analyzed, we classified northeastern states as inclusive of Pennsylvania, Connecticut, Maryland, and West Virginia. Southern states included Florida and North Carolina. Western states included Oregon, California, and Alaska, and Iowa was classified as a Midwestern state (Table 4.1). Each forest plan was carefully examined, and in this process, we recorded the state forest’s name, the region of location, the date of publication, the area of the state forest, and the lead agency (when provided).

Table 4.1. Number of forest plans analyzed by US region.

Region	Number of states included	Number of plans
Northeast	4	16
Southeast	2	5
West	3	6
Midwest	1	3
Total	10	30

The use of qualitative methods in policy research is not new and content analysis is one of the methods for analyzing data in this field (Yanow, 2006). Through the analysis of these forest plans (our data) we aimed to corroborate some of the findings in Gutierrez Garzon et al. (2020a) regarding the terms associated with sustainability and sustainable forest management, and evidentiary demonstrations of forest sustainability within forest plans. To develop this comparison, we blended the lists of terms in Gutierrez Garzon et al. (2020a), which were identified by forest planners to be important

in demonstrating forest sustainability, and reduced them to a new list of 10 terms: (bio)diversity, silviculture, productivity, (think) long term, conserve, (foster) forest health, (ensure) ecological integrity, (manage for) multiple uses, sustained yields, and (ensure) resilience. Most of these terms also coincided with the concepts proposed by Foster et al. (2010) as those that indicate sustainable forest management practices. We expected to find similar terms in the texts of the state forest plans. For this specific part of the analysis, the text search criteria in NVivo involved each of the terms noted above with the option of “with stemmed words”. The results were scanned manually to ensure that the frequency analysis would not include terms used as part of an agency’s name, a law or regulation, a group, organization, or other similar entity. In addition to the list of terms noted above, we also queried the plans for “certification”, “best management practices”, and “adaptive management”. These terms were suggested by foresters as ways forest sustainability can be demonstrated within forest plans; these terms are also frequently used within the standards of major forest certification programs including the Forest Stewardship Council, Sustainable Forest Initiative, and the American Tree Farm System. Finally, this collection of terms composes concepts and approaches to forest management that have become a way to deal with the multiple and undeniable relationships between the environment, the society, and the economy (American Tree Farm System, 2015; Bolte et al., 2009; Forest Stewardship Council, 2010; Gutierrez Garzon et al., 2020a; Rist & Moen, 2013; Sustainable Forest Initiative, 2015).

The analysis of term context was conducted using NVivo qualitative analysis software. This step consisted of the exploration of paragraphs and sentences in which the collection of terms appears in the text, to discover different interpretations of terms

according to what is intended to be communicated. To identify the extent to which sustainability considerations are included in the plans, we developed a categorical system of eight sustainability dimensions and eleven attributes or subcategories (Trueb, 2012; Pitcher et al., 2013) (Figure 4.1). Category analysis has been found to be useful in policy analysis (Yanow, 2006) to assist in understanding the language and structure of the content used in forest plans for the purpose of communicating and demonstrating sustainability. Through our analysis we intended to answer the following questions: Does a forest plan include a definition for sustainability? In what way(s) is sustainability interpreted in a plan? Does a plan prioritize any aspect of sustainability (environmental, social, and economic) over others? Does a plan present evidentiary signs of forest sustainability? And, which management approach seems to be most commonly implemented within the sample of state plans?

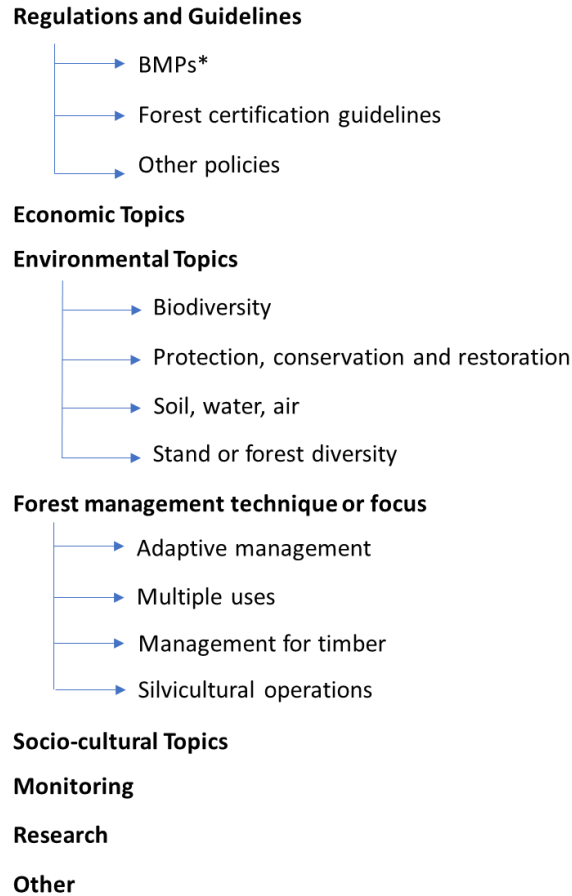


Figure 4.1. Hierarchy of the coding categories system.

*BMPs: Best Management Practices

Source: Modified from Gutierrez Garzon, et al. (2020a)

Each of the categories and subcategories was described within the properties of the “node” (as called in NVivo). The text of the plans was coded to a category as follows: (1) *Regulations and Guidelines*: Statements related to law and regulations at the national, regional, and state level. If it was specified, codes fell into the subcategories BMPs (for Best Management Practices), forest certification or "other policies"; (2) *Economic topics*: Statements about generation of income or revenue, employment, economic well-being, market conditions, expenses, financial feasibility, etc.; (3) *Environmental topics*: Statements related to the environment such as “ecological resources” or “environmental conditions”. If more specific, codes fell into one or more of the subcategories within this

topic; (4) *Forest management technique or focus*: Statements regarding the management approach adopted. To be coded into the subcategory of silviculture the phrase(s) did not necessarily have to contain the term but rather the specific treatment (e.g., “...management to create an even-aged forest structure...”); (5) *Socio-cultural*: Statements about public participation or consultation, protection of cultural resources or public value, recreation, and cultural and aesthetic values; (6) *Monitoring*: To be coded under this category, statements did not necessarily need to contain the term *monitoring*. Similar words such as *assessments*, *follow-ups*, *timely observations*, *audits*, and *tracking of activities* were considered as being part of a monitoring process; (7) *Research*: Besides statements that specifically contained the term *research*, others such as *investigation of*, *study of*, or to obtain *new/nonexistent* information, and *demonstrations* also fell into this category; (8) *Other*: Statements related to the development and maintenance of roads and trails, forest health, prescribed fire, management of invasive species, mineral and material exploration and extraction, and partnerships and cooperation between stakeholders were coded here.

Appendices, footnotes, titles of figures and tables, and the glossary of terms were not included in the coding. We did not use an intercoder reliability test. Schreier (2012) recommends that if a single coder is used, one third of the material should be re-coded within 10-14 days. Thus, to ensure consistency and reliability in the coding process we examined a random sample of 10 of the 30 plans and re-coded them within 12 days. The same methodology was followed, and the results were consistent with the initial findings of the first round. Differences were given mostly in the annotations rather than the type of statements put into each category.

3. Results

On average, the length of the state management plans sampled was 150 pages. There were some short plans with 20 pages and some lengthy ones with more than 200 pages. Of the shortest plans, the majority came from Southeast and Northeast states. The organization of the plans was broadly similar, though the detail of the description provided within sections varied. Some of the plans did not present their “forest work plan” as a section in the main text of the document but rather as an Appendix and therefore, these were not coded.

Next, we present the main findings of our review and content analysis of the state forest plans sampled. We begin with the frequency of terms results, followed by an analysis of the context of the terms, and lastly the findings derived from the coding of the text according to the category system (Figure 4.1).

1.1. Frequency analysis

We found that not all analyzed plans included an explicit definition of *sustainability*. Some plans included the term in the glossary section of the plan; others explained the benefits of practicing sustainable forestry, what it involves, or how it is demonstrated without ever defining the term. Examples of the latter were typically encountered in the context of discussions of “...proper land stewardship...”; “achieving a long-term sustained yield”; “fostering stewardship and ensuring communication...”, and the like. In many of the plans, the *sustainability* of forest ecosystems was represented as the ultimate long-term goal that would ensure a wide range of environmental, social, and economic public benefits. But it was also understood as the capacity or ability of the forest ecosystem to maintain its health and ecological processes and functions, or

understood as the actual *human* action of implementing sound management practices to bring forests into a state of protection, restoration or maintenance of their productivity.

Sustain and stemmed terms appeared in all the state forest plans sampled. However, the action verb *sustain* was more frequent than *sustainability*. Terms such as *productivity*, *diversity*, and *silviculture* more frequently occurred in state forest plans (Figure 4.2). Terms such as *resilience*, *sustained yield*, and *multiple use* were less common by comparison.

Of the other three terms queried, *certification* was the least used within the plans (30% of the sample). Implementation and compliance with *best management practices* was mentioned at least once in each plan. *Adaptive management* was included in a little over half of the plans analyzed. In general, these terms were sporadically mentioned in the plans, but at a higher rate than *resilience*. All three were found in higher frequency in Maryland's state forest plans. One of the characteristics of the forest plans from Maryland is their descriptiveness. A reason for this could be their interest in achieving dual certification under both the Forest Stewardship Council and the Sustainable Forestry Initiative. The plans are detailed in, for example, describing stream and wetland buffers, planned silvicultural systems, forest modeling, high conservation value forests, and chemical use, among others. This is true for other plans that include *certification* within the text although the emphasis and detail in each topic vary.

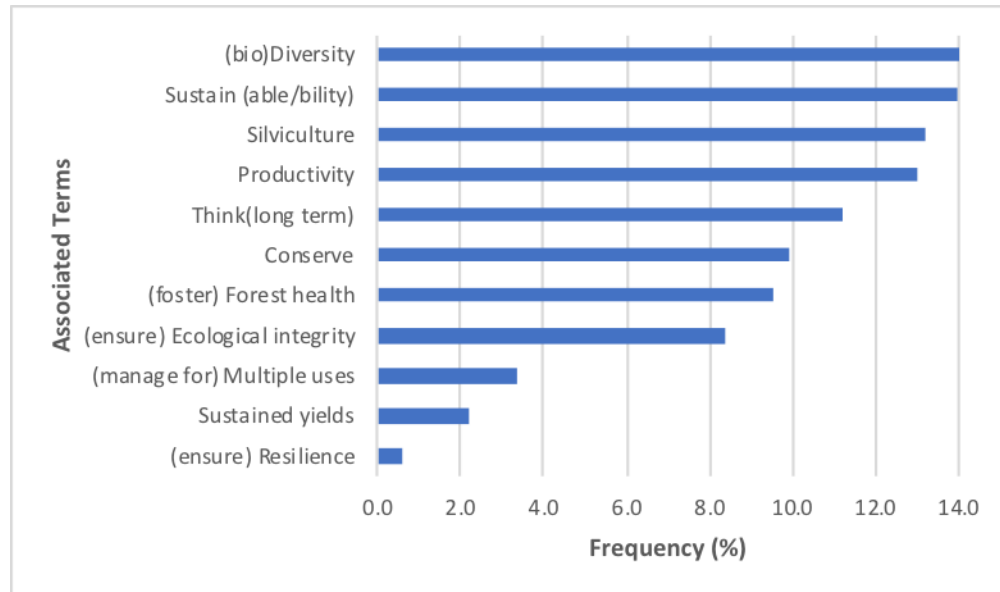


Figure 4.2. Frequency of terms associated with sustainability in state forest plans ($n = 30$). *Note here that the *association* has been directly given by the results of a survey administered to forest planners in the US in Gutierrez Garzon et al. (2020a).

As shown in Figure 4.3, the list of terms used in the frequency query were found at least once but not all were included in all the 30 sampled forest plans. For instance, only *(bio)Diversity* and *Productivity* appeared in all the plans while other terms such as *sustained yield* and *resilience* appeared in only 16 and 12 plans, respectively. There were also some remarkable differences between and within regions. *Multiple use* and *resilience* were, in general, two terms infrequently found in the text of the plans. The highest count for *resilience* in a single plan was 7 times. When comparing regions, the highest frequency for *multiple use* was found in forest plans in the Western and Southern regions. In particular, forest plans in Alaska and Florida mentioned the two terms more frequently. One of the main reasons for this finding is that, these two states are mandated, by State statute and in consistency with the purpose of establishment of the forests to manage them in accordance with the *multiple use* principles, which become the overall management goals for these forests.

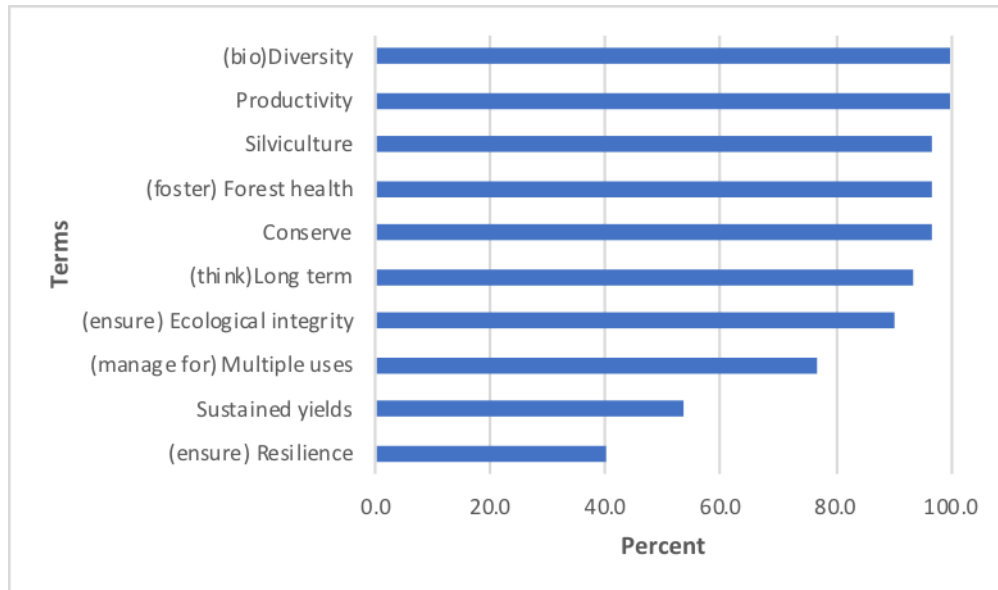


Figure 4.3. Proportion of state forest plans containing various of the terms associated with sustainability ($n = 30$).

3.2 *Analysis of the terms' context*

3.2.1 (bio)Diversity

When used in state forest plans, this term was found in discussions regarding the diversity of wildlife species and habitats that were to be protected, enhanced, or maintained. The term was also used and directly related to the creation of a diverse forest (age, species, and vertical and horizontal array of the canopy) and to a desire to increase the variety of habitats and therefore create the needed conditions that contribute to biological diversity. Often, the forest plans used language such as *wildlife diversity* and *genetic diversity* specifically according to landscape type (e.g., aquatic, terrestrial, and aerial species), and used similar terms in association with broader contexts such as ecological and forest community diversity. The term *diverse* was also found to be employed in contexts other than ecological. For instance, it was expressed in conjunction

with different interests, objectives, and goals of management. With respect to social considerations, the term *diverse* was related to the variety of recreational opportunities that needed to be created or maintained (e.g., aesthetic diversity).

3.2.2 Silviculture

For the most part, state forest plans were written to present balanced silvicultural practices and operations as primary techniques for achieving biodiversity objectives and creating healthy forests in general. In some cases, a forest plan justified and described the specific silvicultural techniques planned to be implemented (e.g., creation of a balanced age class distribution of the forest, prescribed fire, vegetation control, and regeneration and reforestation methods, etc.). In other cases, silvicultural practices were mentioned with less detail. The term *silviculture* was found neighboring other terms such as *sustained yield* (e.g., “silviculture methods...utilized to demonstrate sustained yield management”), *research* (e.g., “measure effect of silviculture practices...”), *education* (e.g., “silviculture as a tool to educate the general public...”), *best management practices* (e.g., implementation of silvicultural activities according to water quality considerations), *landscape conditions* (e.g., presence of high conservation value forest), and *multiple-use management*. Silviculture seemed to be understood to be a tool to combat an issue (e.g., species decline due to disease or other environmental factors). Rarely was the term near to terms related to social considerations. But examples could be identified, such as “use of silviculture...to retain a higher economic and social benefit” or “silviculture may be required in areas with high commercial or aesthetic values...”.

3.2.3 Productivity

Productive and *productivity* were terms that frequently appeared within ecological contexts in the state forest plans sampled. These terms were also surrounded by action verbs such as *maintain* (e.g., soil productivity or productive capacity of the forest). On the other hand, *production* was used often to relate directly to the economic contexts of forest plans, for the *yielding* of wood fiber, hard mast, and even seeds and food for wildlife. The term *productivity* appeared near the term *long-term* to present it as a goal rather than a current state of the forest (or soil). The term *productivity* also appeared near the term *forest health*, which suggests that one could be conditioned to the other. In addition, these terms (*productive* and *productivity*) were also found along with silvicultural techniques that were planned to achieve a certain level of *productivity* of a site and were often accompanied by the term *wildlife*. Rarely would the terms be used in a social context such as “productive educational programs” or “research activities that support forest productivity”.

3.2.4 (think) Long-term

This term was used to describe the future state of a forest. Two examples include “...long-term subclimax type...” and “to achieve long-term forest structure goals...”.

Long-term was also used to underscore an expectation of the duration of a forest management project (e.g., “long-term goal” or “long-term protection measures”). Within the ecological context, *long-term* was surrounded by other terms such as *ecosystem*, *wildlife*, *protection*, *ecological integrity*, *forest health*, and *control* (of a pest or disease). With social considerations in mind, this term referred to the achievement of various sustained (into the future) public benefits. Within the economic context, *long-term* referred to the generation of present and future revenues and investments, the

maintenance of the productivity of the forest, and to increases in management efficiency. Sporadically was the term related to long-term goals of information management, cooperative endeavors, and partnerships. It was found near other terms such as monitoring, projection, modeling, research, planning, and data. Similarly, it appeared in sentences that included *adaptive management* and in language associated with global warming and fire, among other topics.

3.2.5 Conserve (or conservation)

In general, it appeared that *conservation* was considered a self-explanatory term throughout the sample of forest plans. Within the ecological context, *conservation* was accompanied by other terms including *protection and utilization* or *protection and restoration*. The term often referred to forest resources and/or cultural resources, wildlife and biodiversity, soil, habitat, ecological value, and water quality, among others. Further, *conservation* was also understood to be a label assigned to an area (e.g., conservation area) that was described to generally provide greater ecological benefits. Regarding socio-economic considerations, *conservation* was suggested as a type of activity or action to implement (or even teach to the public) that would have not only a positive impact in the environment, but also improve local economies.

3.2.6. Forest health

Within the state forest plans analyzed, the term *forest health* itself was not common. However, we included in the frequency analysis synonyms such as *tree health*, *stand health*, and *health of the landscape*. It was found that the term *health* was very frequently associated with aquatic ecosystems (e.g., stream, wetlands, and watershed in general) and less frequently with *ecological* and *soil*. As a state or condition of the forest,

health was associated with other terms such as *invasive species*, *forest composition*, *presence of pests or diseases*, etc. In this regard, *forest health* would be one condition of the forest on which management would be based. When seen from the socio-economic perspective, *forest health* appeared as an outcome of the forest management which also would provide public benefit. The term also appeared near *timber harvest* (and silvicultural practices) perceived as an activity needed to improve *forest health* as one management objective. Common action verbs surrounding *forest health* were *maintain*, *sustain*, *improve*, and *restore*. The term could also be seen near *long-term*, *productivity*, *vigor* and *vitality*, and *monitoring* and *indicators*. In few of the plans reviewed was *forest health* directly stated as a priority management goal. However, it was common to see *forest health* as a secondary management goal.

3.2.7. Ecological integrity

The term *ecological integrity* itself was not a frequent term in the sample of state plans. However, when divided in two terms, *ecological* and *integrity*, the frequency of finding these increased, with *ecological* and its stemmed words being the most frequent of the two. These appeared accompanied by action words such as *protect*, *maintain*, *restore*, and *improve*. Fewer times was it found along with *cultural resources*. In addition, *ecological* mostly paired with terms that included *resources*, *communities*, *processes*, *interactions*, *diversity*, *value*, and *benefits*. As an objective, *ecological* benefits would be in the same line with economic and socio-cultural values. Finally, *ecology* was interpreted as to “extend” when referring to, for example, “ecological delineations”, “ecological community”, “ecological context”, and “ecological role of...”, and as to a

“process” when referring to “ecological development (of the forest)” and “ecological potential (of a stream)”.

On the other hand, *integrity* was mainly associated with water resources in, for example, “protect the integrity of stream banks...” or “watershed integrity” and to cultural and historic values (e.g., “integrity of archeological sites” and “integrity of scenic views”). In the ecological context, the term could be found in sentences such as “integrity of communities (biodiversity)”, “structural integrity”, “genetic integrity”, and “habitat integrity” or simply as an attribute of the forest. It was uncommon to see either of these terms with *monitoring*, *research*, and *resilience*.

3.2.8 Multiple uses

In several of the state plans studied, *multiple uses* appeared to be used as a justification of the planned management activities. For example, some sentences included “management is consistent with the implementation of the multiple-use management concept”. Where present, a definition was often provided on the concept of this management approach and it was described in general as an approach that would “provide the greatest public benefit...” with “minimum conflict”. In addition, the economic consideration was strongly noted in association with this term mainly because of the interpretation of having the potential to generate income from diverse and simultaneous activities. In this sense, *multiple uses* was often used with *sustained yield*; it seemed to demonstrate an interest to balance and integrate timber harvest with other activities such as recreation. We found that managing in accordance with *multiple-use* was in response to the state’s statutory regulations. In other contexts, the term was found as “multiple use trails types”, “multiple use areas”, and “multiple use characteristics”. It

was also interesting to see that a definition for *multiple use* was sometimes given in the glossary of the plan but the term itself was not employed throughout the document.

3.2.9. Sustained yields

For the most part, *sustained yield* was interpreted as a timber harvest model to be followed in managing a forest. This approach was found to be put in harmony with other uses of the forest including protection and recreation. The term was always associated with *production* of timber and other forest products, including wildlife, and so, to an economic benefit (e.g., “economic stability”) that would also be linked to enhance the social values. *Sustained yield* was sometimes followed by *long-term*, *over time* or *perpetual*. In some of the plans, *sustained yield* was considered an objective stated as to “develop and maintain the sustained yield of products”, for example. Other terms that could be found near *sustained yield* were *monitoring* and *multiple uses*.

3.2.10 Resilience

This term (and its cognates, such as *resilient* and *resiliency*) appeared in less than half of the sampled state plans. In these, *resilience* was used as an attribute of the forest but also as a management objective that could be stated as, for example, “...to build -or create- resiliency into the forest ecosystem-or species”. Some other action verbs used with this term were *promote* and *provide*. Maintain the *forest function* and *resilience* of a forest were sometimes put together as a result of employing other management strategies such as increasing biodiversity and stand diversity. It was possible to perceive that a *resilient* forest would be less impacted by disturbances such as health threats and climate change.

3.3 Reporting and interpretation of content analysis

Figure 4.4 depicts the relative frequencies of all the coding categories developed for the analysis presented here. Of the categories, “Environmental topics”, “Forest management technique or focus”, “Socio-cultural topics”, “Monitoring”, and “Other” appear in all the forest management plans sampled. Of these, the “Forest management technique or focus” is the most frequent coded category (14.48%). It is important to mention that the “Environmental topics” category is showed to appear only in half of the plans and with a low frequency because during the coding process, there were general statements such as “...environmental values...” or “...ecological resources...”, among others, that were coded into this category. However, three of the four subcategories within this category were found in all the 30 plans sampled. The most frequently coded subcategories are “Protection/Conservation/Restoration” (11.72%) and “Biodiversity” (7.56%), followed closely by “Soil, water, and air” (7.15%). “Silvicultural operations” is another subcategory present in all the plans but with a lower frequency of occurrence (5.99%) than those associated with environmental topics. The least frequently occurring categories were “Research” and “Economic topics” both coded in 26 forest plans with a relative frequency of occurrence of 2.20% and 2.58%, respectively. Interestingly, the subcategories “Forest certification” (8 plans), “Adaptive management” (17 plans), and “Multiple use” (24 plans) were the least occurring topics in the analyzed plans.

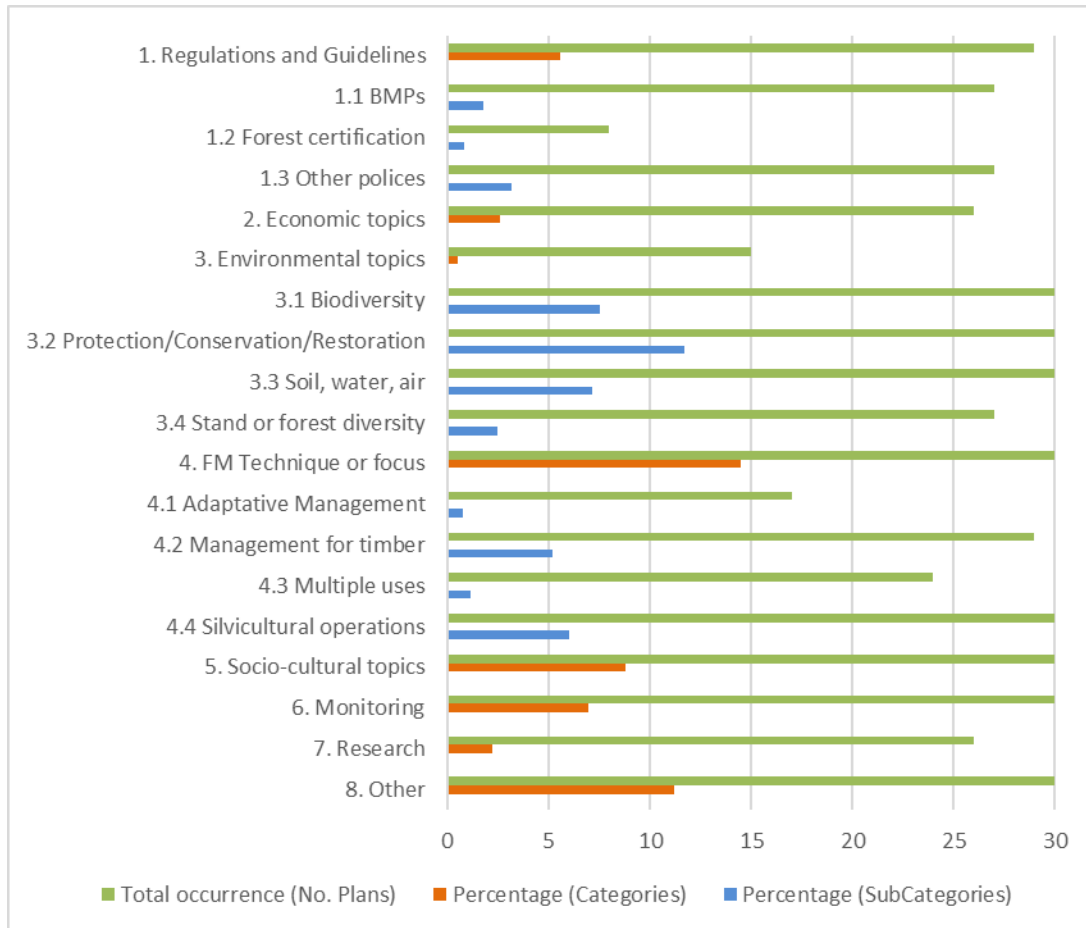


Figure 4.4. Relative frequency of the category system for state forest management plans ($n = 30$).

When compared by region (Table 4.2), one of the first things to mention is that the three most well-known dimensions of sustainability (environmental, economic, and social) appear in all the 30 sampled state forest plans. More specifically, we found that nearly 46% of the coded material comes from forest plans in the Northeast region and 33% from plans developed for state forests in the West region. From these results, we note that the subcategory “Protection/conservation/restoration” has the most frequent occurrence while “Adaptive management” and “Research” are the least frequently occurring subcategories within the Northeast plans. On the other hand, the highest

frequency is for the “Forest management technique or focus” category, of which the subcategory “Management for timber” is the most frequently occurring in plans from the West region. The “Socio-cultural” subcategory is also frequently occurring in both the West and Northeast regions. “Forest certification” and “BMPs” are two of the lowest frequently occurring subcategories whose numbers could only be comparable with those obtained within the Midwest forest plans which are also low. The lowest frequency of occurrence for any of the topics in the category system is for the Midwest forest plans. However, notice that within this group are the least number of plans sampled (3 of 30), all from a single state. Despite being among the longest plans in terms of number of pages, the Midwest plans place the “forest work plan” component in the Appendix section but in this study, Appendices were not coded. For this group of plans, the category “Forest management technique or focus” and “Other” occur the most frequently.

The frequency of occurrence of the “Forest certification” subcategory comes mainly from plans in the Northeast region and more specifically from plans developed for state forests in Maryland. State forests in Maryland are dual certified by the Forest Stewardship Council and the Sustainable Forestry Initiative and thus one of their central management goals is to maintain this designation. In summary, these plans are substantially described in all of the chapters within the text of the plan. Because of their interest in complying with the Forest Stewardship Council and the Sustainable Forestry Initiative guidelines, it is possible to notice the inclusion of aspects such as a multi-tiered monitoring plan (which is a principle of the Forest Stewardship Council program) that specifies the type of sampling method to be used for different purposes and according to the tier monitoring specified in the plan. This type of detail is not found in other plans.

Table 4.2. Absolute frequency of the category system in sampled forest plans by region of the US.

Category system	Total Southeast	Total West	Total Northeast	Total Midwest
1. Regulation and Guidelines	60	132	196	8
1.2 BMPs	29	9	86	3
1.3 Forest certification	0	2	58	0
1.4 Other polices	37	122	59	5
2. Economic topics	22	77	79	5
3. Environmental topics	7	12	16	0
3.1 Biodiversity	51	138	324	23
3.2 Protection/conservation/restoration	130	252	435	14
3.3 Soil, water, air	74	163	263	7
3.4 Stand or forest diversity	11	57	98	8
4. Forest management technique or focus	150	358	461	58
4.1 Adaptive management	2	24	25	3
4.2 Management for timber	27	203	117	22
4.3 Multiple uses	24	20	31	4
4.4 Silvicultural operations	67	93	230	35
5. Socio-cultural topics	91	250	264	17
6. Monitoring	98	88	295	11
7. Research	17	86	40	13
8. Other	152	243	367	34
Total	1049	2329	3444	270

Likewise, the “socio-cultural” subcategory is also frequently present due to the remarks within the text about making public participation and communication key aspects for the success of these plans. Finally, the Maryland forest plans also account for more current topics such as climate change impacts on forests, which is not a common concern found in other plans studied. It is important to mention that, unlike the Midwest plans, Northeast plans have the forest work plan included as part of the *main* text of the plan document and not as part of the appendices.

Although the management objectives of the Midwest forest plans could be considered substantial, the plans appear to present a more extensive description of the forest resources and the cultural history. In these plans, the “Forest management technique or focus” category and the “Silvicultural operations” subcategory frequently occur. This might be due to the fact that their definition of sustainable forestry is understood from the silvicultural perspective of management through which *secondary* benefits (wildlife, recreation, personal use resources, etc.) are obtained.

We expected to find more specific use of the “Multiple uses” and “Adaptive management” approaches to sustainable forestry represented in these plans, as these concepts were found important in other studies (Başkent, 2018; Gutierrez Garzon et al., 2020a). However, this was not the case, although multiple use management may have been implied by the sum of the parts of each forest plan. In comparison with other subcategories, these fall within the lowest frequency of occurrence and do not appear in all the sampled plans. The management of state forests based on the “Multiple uses” management approach was mainly mentioned in state forest plans of the Southeast, West, and some of the Northeast plans. In these cases, forest managers are mandated through legislative codes to implement multiple-use principles in the management of state forests. On the other hand, the “Adaptive management” approach occurred frequently in some of the plans in the Northeast and West regions. The successful implementation of this approach is found to be linked to the capacity of developing and conducting a monitoring program which are found to be generally underfunded.

The “Economic topics” category occurred somewhat more evenly in plans developed for state forests in the West region and in those from Maryland in the

Northeast region. The timber resource in both regions has historically been important in the economy of the states. This could be one of the reasons for which these plans emphasize the management of this resource while also recognizing the importance of maintaining a healthy forest in the achievement of a long-term forest production that benefits the economy and the society at all levels.

Our “Other” subcategory frequently occurs across plans mainly because it contains different aspects important to forest management. Among these are the development and maintenance of roads and trails, the identification and management of invasive species and forest health, and the use of prescribed fire, among others. All of these are components that are mentioned in all the 30 state forest plans with different detail. This category corresponds to 11.2% of the frequency of occurrence. The management of invasive species and pests is considered fundamental in maintaining a healthy functioning forest. In the plans, a history of previous issues and suppression strategies are always described and it seems like planned activities are based on what can be detected and suppressed on-the-ground at the time of implementing other treatments (e.g., silvicultural). With respect to *fire*, the topic can be viewed as a silvicultural treatment understood to be fundamental in restoring forest ecosystems and leading to greater resiliency, and so “fire return intervals” are managed to achieve this goal. The topic can also involve the management of incidents (human-caused or natural) that were not planned. Education and public outreach are fundamental to address this issue.

We noted that in most of the forest plans sampled, *funding* and *personnel* seem to be two of the most important constraints to both prioritize and monitor management activities, which might limit state agencies’ ability to have continuity of management in

the long term. We see in Table 4.2 (for “monitoring” and “research”) that forest managers know and acknowledge the importance of being able to continually gather information to evaluate the effectiveness of the different treatment recommendations. Within the text of the plans we located several research opportunities identified by forest managers, as well as statements related to a need for establishing relationships with other departments (e.g., fish & wildlife, heritage & historic divisions, etc.), private landowners, and organizations who share boundaries with these state forests.

4. Discussion and Conclusions

Understanding the dynamism of language as influenced by the context of its application, the concept of *sustainability* might not be used to describe an entire system, but instead be used as a representation of a way to proceed according to certain purposes. Similarly, the shaping of an idea occurring during social discourse is also influence by diverse factors including the socio-economic context where it occurs. Perhaps, this is one of the reasons why the concept of sustainability should be expected to evolve. Our analysis indeed evidenced that terms associated with sustainability and sustainable forest management are used in different contexts that seemed to be dependent mainly in the management goals for a specific forest (e.g., management of the forest as a “working forest”, management of the forest to contribute to the local economy while also protecting ecological values, or management of the forest to protect the forest’s diversity). For example, broader or strategic plans where the text was more descriptive and specific indicators to evaluate the effectiveness of forest management were not as substantial as in other plans. The substantiveness of the plan can be given by the presence of, for example, specificities on the allowable cuts, growth and yield models, or even indicators and

thresholds associated with the protection of water resources and wildlife, as well as specific measures for the development and maintenance of roads and trails. Deeper analyses are suggested to complement our study to better understand whether the compliance with laws and regulations and forest certification programs influence the language employed in forest plans in terms of their prescriptiveness level.

A multiple-use management approach could be considered the one that was mostly undertaken in the planning and implementing of state forest management plans, as a combination of sustained-yield and multiple-use management approaches were noted (perhaps not explicitly) in some of the plans analyzed. As described in our results section, where the term *multiple uses* was found in forest plans, it was mainly in conjunction with language involving a state's mandate to comply with the principles of such a management approach. For example, an Alaska statute assigns the purpose of the establishment of the state forests as for timber management while allowing other uses of the forest. In general, though, a state's multiple-use mandates do not require timber uses to be equally weighted with other uses of the forest (Koontz, 1997). Rarely was a management approach identified as "ecosystem management", but where found, the definition or the purpose of the approach appears to emphasize the maintenance of the ecosystem's "state" or "condition". Contrary to what we found for plans adopting the multiple-use management approach, the outputs from management (e.g., timber) under the ecosystem management approach are a product of achieving ecosystem-based goals such as the maintenance of the biological diversity or the improvement water quality, among others.

The task of determining the level of substantiveness of the plans analyzed here is complex. As mentioned in our results, these plans indeed accounted for environmental,

economic, and social aspects of forest management. However, the depth, detail and emphasis given to each varied across plans. Furthermore, we noticed that measures of success can be both substantial when requiring measurable data and procedural when the compliance with legal frameworks is encouraged. Consistent with the policy classification in Cashore (2002), we noticed some specific requirements and guidelines for on-the-ground forest practices mainly related to the protection of riparian forests, wetlands, and other water resources when forest harvesting and/or road development is planned. Also, there were some thresholds in place for the protection of historic and cultural resources commonly noted to be subject of vandalism. These could be considered as “prescriptive” management requirements which are based on a policy specification (e.g., best management practices or any other state mandate). In contrast, several of the plans seemed to involve broader requirements and were more flexible. In such cases, the plans called for the development of protection or mitigation measures as activities were being implemented and issues were encountered.

The interdependence between the different considerations of sustainability was not always evident. However, direct relationships between sound management techniques or adequate silvicultural treatments and their influence on the ecological components of the forest ecosystem could be perceived within the text of the plans studied. A similar situation occurs between sound silviculture and the economic consideration as it was obvious that to obtain economic benefits, forest managers needed to plan forest prescriptions accordingly to maximize sales and revenue. Over time, these two connections impact social considerations by, for example, generating recreation opportunities, improving local well-being, and protecting historic and cultural landmarks

of a particular place. In this regard, our analysis makes evident that strong sustainability (Robertson et al., 2011) may be unsuccessful without a strong policy framework and institutional capacity that supports all the planning, implementation, and monitoring and assessment of forest management. State agencies are strongly conditioned on these two considerations. Therefore, we suggest that the interdependencies between environment, society, and economy would only be possible when these are strongly held by “policy framework and institutional capacity” consideration (Figure 4.5). This need was evident in most of the forest plans analyzed, where budget constraints were noted as having an impact on an agency’s ability to conduct research to better understand the influence of different management prescriptions on the sustainability of forest resources. A potential lack of financial resources as well as of specialized staff can limit an agency’s ability to develop and conduct research projects. Important to note here is that this consideration is also influenced by other interrelations occurring between environment, economy, and society. In the model, “time” is added as to account for the intergenerational component that seems to be accounted and acknowledge for in most of the definitions for sustainability (Gutierrez Garzon et al., 2020a). Also, the aspects noted below each dimension are considered examples of what their analysis often, but not necessarily, involve.

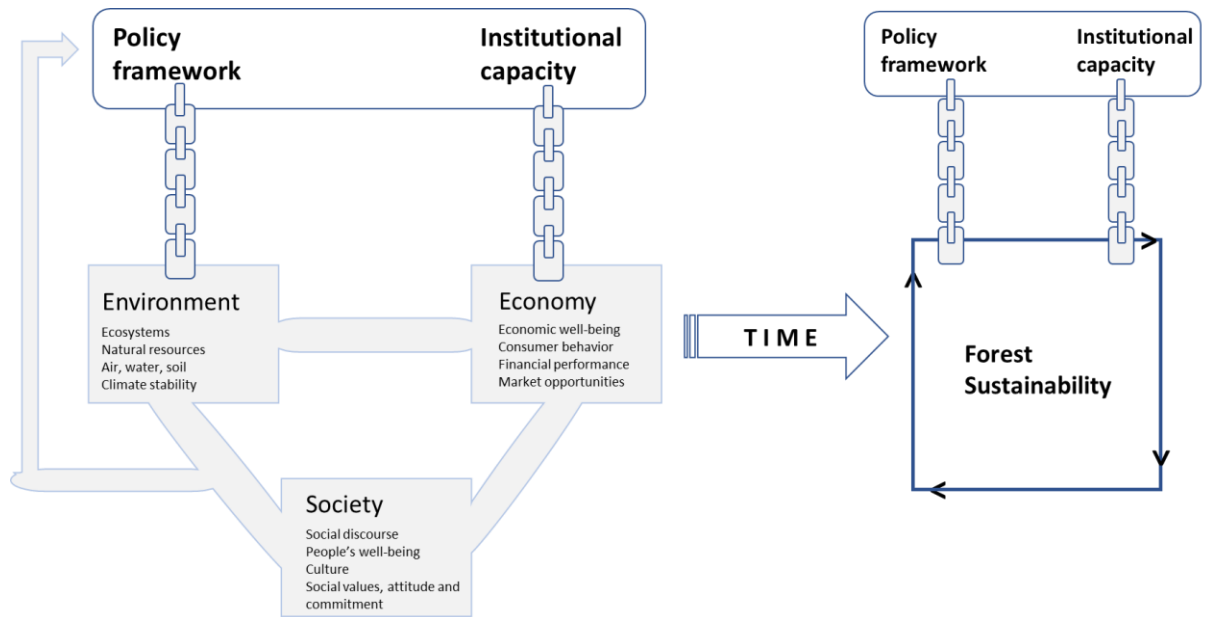


Figure 4.5. Sustainability model resulting from the content analysis of state forest plans in the US.

Although all dimensions of sustainability were present in the plans examined, there was not a balance by any means on the emphasis given to each of them. As in other studies (Gutierrez Garzon et al., 2020a; Lehtonen, 2004; Newman, 2006), our results reaffirm the perception that the social dimension of sustainability, understood as the diverse mechanisms to promote and demonstrate social engagement with forest management, is one of the weakest treated in forest management plans. Perhaps difficulties in measuring social values persist, but not many ideas seemed to be proposed in the plans. In our case, for state forest plans the category “Socio-cultural” frequently occurred mainly because the category included aspects related to recreation opportunities, which was found to be a component discussed in all the plans sampled. This category also consisted of statements associated with the management of historic and heritage sites, education and outreach strategies, and items about public participation in the planning and implementation of the plans. However, all these aspects were mainly

descriptive and lack evidentiary measures to assess the effectiveness of moving towards a sustainable social component.

In comparison with our findings in Gutierrez Garzon et al., (2020b) and with what other authors (e.g. Moore et al., 2012 and Cerutti et al., 2014) have suggested about the social component of sustainability, it appears that this consideration in particular might be better addressed and demonstrated when forests are enrolled in certification. For instance, Moore et al., (2012) and Cerutti et al., (2014) found that several social improvements are evident (e.g., a better relationship between local population and logging companies) when certification is pursued. Similarly, the requirements for public consultation and relations, outreach and extension (as presented within the FSC and SFI, for example), more clear written procedures to implement practices and of the minimum indicators for the acceptance of a requirement, and conflict resolution mechanisms (as in the FSC) also might, in general, help to improve the ways in which local communities can express their commitment to participate and contribute in advancing forest sustainability. In comparison, social sustainability as expressed in forest plans seems limited in the planning of activities and mainly accounts for the offering of recreational opportunities to the public, and less so for the promotion and support of social processes that encourage discussion, debate, and actual decision-making to ensure public commitment to the implementation of the forest plan. For example, some of the monitoring strategies within the social component within the forest plans analyzed consisted of gathering information of the public use of recreation opportunities offered, through the application of surveys, or were as simple as the tracking of visitors. It was interesting to find that one approach to demonstrating sustainability was by presenting

information about a project (e.g., restoration, road development, etc.) on a sign at the project's location. Communication strategies are also well underlined across plans, but they are not used to motivate discourse nor discussion between stakeholders. Instead, these are centered in the sharing of information about upcoming sales, projects, and volunteer opportunities which are uploaded to the agency's webpage and delivered through, for example, visitor guides and other publicity. The content of this material may also include the impacts of the planned forest management activities on the ecological, social, and economic elements of the forest as well as the efforts to avoid, minimize, or restore any potential alterations to these. In this sense, and as in Korhonen et al. (2016), future studies could investigate whether these types of instruments are efficient in communicating different issues and opportunities affecting the sustainability of state forests, as this type of evidence was not identified in our analysis. Furthermore, more information on consultation with stakeholders, and the communication instruments they would prefer, may benefit engagement and illustrate a commitment to open participation in the sustainability of forests. We noticed that it has become more common to invite the public to comment on the revision of forest plans, or for example to review a sales opportunity, or to be part of training and education opportunities that increase people's understanding and knowledge of diverse forest ecosystem processes. However, whether these initiatives serve as demonstrations of forest sustainability continues to be unclear at least as expressed in the text of forest plans. These mechanisms instead seem to show that public participation is considered in the decision-making at the state level, but at more "closed" level than it would happen at the federal level as described by Koontz (1997). Still, the invitation to participate and the virtual inclusion of public comments, concerns

and feedback in the management of forest resources is considered to support and legitimize a state agency's actions.

As suggested by Koontz (1997) we found that in many cases, state forest plans emphasized the need to maintain economic revenue from timber sales while also protecting the ecological and social values of forests, to address the lack of financial resources and to address expenses in other areas for the functioning of the agency. We also think that given such a limitation, the plans examined here did not present much content under the research category, as this term did not frequently occur in comparison with other topics. However, and in contrast with Koontz (1997), the research component in the state forest plans sampled here included both research related to timber and revenue enhancements and research about the impacts and effectiveness of management over ecological elements of the forests. Although our analysis was not able to determine what limits the capability of conducting research and applying science to the management of state forests, decisions in this regard are certainly influenced by policy processes, political ideals and interests, or the perceived need to account for social views in the decision-making process (Kleinschmit et al., 2009).

Because the sample of plans examined represents a small fraction of forest land in the United States, we suggest developing additional research to assess on-the-ground demonstrations of forest sustainability, as well as the development of additional comparisons of the type and level of outcomes from the implementation of state forest management plans. Our analysis suggests that the policy and institutional dimension of sustainability plays a fundamental role in an agency's capability to accomplish their forest management goals and objectives for restoring, maintaining, and adapting forests

to healthier and resilient ecosystems capable producing diverse products and services, despite potential impacts from current and future human usage and from other factors such as climate change. As with the other three dimensions of sustainability, more attention to the role of policy and institutional considerations should be drawn.

There are some limitations to our study. First, not all the forest plans included their forest plan work within the main text of the plan and therefore such content was not analyzed. The inclusion of this information and other external information, such as the monitoring program, the public consultation process, and the specific policies to which the state complies, could help one understand and clarify whether these plans have a greater *prescriptive* or *procedural* approach to forest management. Second, for those state forest managers interested in gaining or maintaining forest certification, it would be interesting to determine the extent of the achievement of *sustainable* forest management goals and objectives proposed in forest plans as a result of compliance with certification standards. A more comprehensive analysis should be conducted by including forest plans developed for national forests in the US. Unfortunately, at the time of conducting this research, new US National Forest plans and the revision of forest plans under the 2012 Planning Rule were still in transition, few US National Forests had completed the revision process under the 2012 Planning Rule, and many had not initiated a revision (United States Department of Agriculture, Forest Service, 2019). Lastly, while it is true that field-based evidence might provide an easier way to quantify sustainability progress and outcomes, the inclusion of qualitative descriptions and attributes that are not always easy to define and inform should be investigated with stakeholders involved in the

decision-making process, to determine their usefulness in describing the sustainability of forests.

Conflict of Interest

The authors have not conflict of interest.

Acknowledgements

This research was funded by USDA NIFA grant 2015–10780.

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CHAPTER 5

CONCLUSION

While forest management is understood as the stewardship and use of the forest resources, the management goals and objectives are influenced by and involve a diverse set of conditions and characteristics of the context where it is applied. Often, these aspects are classed as environmental, social, and economic considerations. While there have been numerous initiatives and studies to implement metrics that assess the effectiveness of forest practices, not much research has been conducted to clarify the concept of forest sustainability, the social construct of its interpretation, nor the evidentiary forms that operationalize the different understandings of sustainability (as associated with context and social values). This dissertation presented three studies conducted along one main line: demonstrations of forest sustainability within forest plans and forest certification programs.

Chapter 2 revealed the most frequent terms forest managers in the United States associate with sustainability and sustainable forest management. By applying an open-ended questionnaire, results showed that there are common terms used by forest planners in attempting to communicate forest sustainability. However, other terms expected to frequently appear were not as commonly mentioned by respondents (e.g., resilience and restoration). In addition, responses observed the acknowledgement of the three considerations of sustainability (environmental, social, and economic) but at different levels of emphasis and detail, with the social consideration the most difficult to address.

Further, forest planners commented on the difficulties in describing how demonstrations of sustainability can be communicated in forest plans. It is suggested that professionals focus a little more on language that evidence concrete actions that an agency plans to pursue as to address social and economic concerns, rather than language related to general principles. The limitations to this study were considered to be mainly in regard to the survey administered. Future research could consider the administration of in-depth interviews to acquire more detail data from forest planners as to infer forest sustainability within forest plans.

Chapter 3 examined a different type of document, forest certification program standards, which are also related to sustainable forestry and often require the development and implementation of forest plans within their guidelines. This study consisted of describing the characteristics and differences between three forest certification programs commonly used in the United States (FSC, SFI, ATFS) and two European programs (Turkish and Bulgarian). More specifically, the objective of this research was to determine the levels of substantiveness among programs when compared with the FSC principles, which was used as the benchmark program for the comparison. Results revealed the FSC as the most comprehensive and substantive certification program of the five, based on the description in each of the principles and guidelines as well as the presentation of robust thresholds and field indicators for management outcomes. The SFI, the ATFS, and the Bulgarian programs were considered to have a procedural policy style. These programs employ some language that gives a sense of permissiveness, although forest management guidelines are emphasized to mainly allow for continual improvement. The Turkish program seems more difficult to accommodate

into either of the policy approaches because it focuses on field-base indicators but does not provide much guidance for the applicability of the standard it provided. Our study highlights the different treatments that could be applied to a single set of forest resources to address sustainability concerns and to demonstrate a commitment for a continual path forward. Future studies could possibly examine the relationship between forest certification programs and the broader legal and regulatory frameworks with the aim of providing deeper insights of why the differences between programs examined in this study may occur.

In Chapter 4, a content analysis on forest management plans for state forests in the United States was conducted with the aim of identifying the presence/absence of terms associated with sustainability and sustainable forest management based on the findings of the study presented in Chapter 1. In the process, a categorical system was developed to code the plans and present results regarding the extent to which considerations of sustainability were incorporated within the plans and to identify substantial signals of commitment and demonstration of forest sustainability. As with our first study, it was possible that certain terms that were expected to appear in the text of the plans were not frequently located (e.g., resilience, multiple uses, and adaptive management). Similarly, and although the literature notes that there is an increasing interest from both public and private organization to become certified, *forest certification* was not found as frequently occurring within the plans sampled. *Research* and *monitoring* were two subcategories infrequently occurring in the plans. Further, results showed that depending on the region and the management objectives for a forest, a plan can be very descriptive of the forest resources condition and the desired scenarios or be more detailed and present an

operational approach by providing measurable indicators of management outcomes and the compliance with specific on-the-field thresholds (e.g., to protect or restore habitat or to develop roads). Furthermore, the interdependencies between the different sustainability considerations was not always evident, the sampled plans all included environmental, social, and economic values of the forest. The policy and institutional dimensions also play a fundamental role in achieving forest sustainability goals, according to what it was possible to infer from the text of the plans. Budget and staff constraints were frequently found annotated in the plans and so these should be better addressed as to increase forest management agencies' capacity to accomplish their mission. It is suggested that future analysis include additional documentation that is not always part of the forest plan such as the monitoring plan, and the verification report (when subject to forest certification compliance), among others. It would be interesting to assess the level of forest *sustainability* when an agency complies with forest certification requirements and/or when it follows another applicable regulatory framework.

Together, the studies presented in this dissertation evidence a need to clarify the diverse terms employed in forest planning documents, in particular the use of *sustainability*, by both public and private organizations as to facilitate their implementation by foresters, planners, and other professionals and the public who are involved in the operationalization of management goals and in advancing forest sustainability. Further, notwithstanding the progress that has been made in addressing the social component in a more substantial manner, these studies showed that in general, this consideration appears to be approached in a superficial way (e.g., by ensuring recreation opportunities mainly) rather than actually encouraging and supporting social debate and

balancing the decision-making among stakeholders. Perhaps, forest planners can better address this concern by including clearer socio-economic benefits which are of meaning to the local community, instead of generalizing these issues and appearing too technical in the use of terminology within the plans. Finally, despite some of the weaknesses found in the analysis presented here for forest plans and certification programs, it is important to acknowledge that both professionals (including policy makers) and society seem to have an interest in demonstrating that their choices, with respect to the use of natural resources, are *sustainable*, although these are influenced by the context in which management plans and actions are implemented.

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