Forest sustainability in the state of Tennessee, USA

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Project No.: 130373

July 2014

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1. Introduction

The combustion of wood for energy purpose is not considered to contribute to the augmentation of greenhouse gases concentration in the atmosphere, as long as the CO2 emissions released during the combustion of wood are balanced by the growth of new trees. It is therefore essential to investigate if the forests in the region where the wood used for energy purpose are managed in a sustainable way, avoiding resources associated with overexploitation of forests, land use change, depletion of carbon stocks, etc...

In this framework, literature research was carried out to produce a summary of forest management in Tennessee, including general condition, management and sustainability assessment.

2. Tennessee forests overview

2.1. Location and distribution

Tennessee is located in the South East of the USA and covers a total surface area of 109 247 km². The State of Mississippi has 95 counties and is bordered by Kentucky and Virginia to the north, North Carolina to the east, Georgia, Alabama and Mississippi to the south, and Arkansas and Missouri to the west.

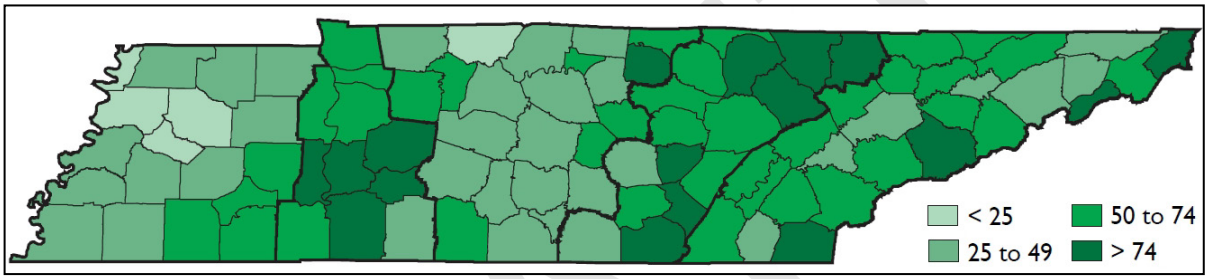
Figure 1: General maps of Tennessee

Source: NETSTATE – Tennessee
(http://www.netstate.com/states/geography/mapcom/tn_mapscom.htm)

Tennessee's forest is part of the large forest area in South East USA. Nowadays, Tennessee's forest covers about 52% of the State's land area with 5.64 million ha[1]. Nearly all of the forest land (97%) is considered available for timber production.

As seen on the figure below, of 95 Tennessee counties, 56 are estimated to be more than 50% forested and 17 counties more than 75% forested. The Cumberland Plateau unit contains the greatest number of counties with 75% or more of the land forested (the units in Tennessee concerned by the survey used as source for these percentages are shown in Figure 14 in section 2.1). Five counties are estimated to be less than 25% forested and are mostly located in the heavily agriculture dominated western portion of the State. The Cumberland Plateau and West-Central Tennessee are the most forested areas within the State.

Figure 2 : Percentage of land in forest by county



Source: Forest Inventory & Analysis factsheet (Tennessee, 2004)[2]
(USDA – Forest Service & Tennessee Forestry Division)

2.1. Ecological zones

The highest point in Tennessee is Clingman's dome at 2025 m above the sea level (in the extreme east of the State). The lowest point is 54 m at the Mississippi River (in the extreme west of the State). The average elevation of the State is 275 m above sea level.

Most of the State has a humid subtropical climate, with the exception of some of the higher elevations in the Appalachians, where the climate falls into the category of "mountain temperate climate" or a "humid continental climate" due to cooler temperatures.

Summers in the state are generally hot and humid. Winters tend to be mild to cool, increasing in coolness at higher elevations.

Depending on the place, the typical daily high temperatures recorded in July and August are in the range 30°C to 33°C while the typical average of lowef daily temperatures recorded in January is in the range -3°C to -1°C[3].

[1] Situation as per 2011 Forest Inventory and Analysis, USDA – Forest service
[2] Source: http://www.tn.gov/agriculture/publications/forestry/FIA-2004_factsheet_%20TN_2007revision.pdf
[3] Source: http://www.ustravelweather.com/tennessee/

Depending on the place, the average precipitations range generally from 1050 to 1850 mm per year[4].

Tennessee is divided in 8 main ecological zones (level III ecoregions)[5].

A. South-eastern Plains (n°65 on Figure 3)

These irregular plains have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation is mostly oak-hickory-pine and Southern mixed forest. The Cretaceous or Tertiary-age sands, silts, and clays of the region contrast geologically to the older igneous and metamorphic rocks of the Piedmont, and the older limestone, chert, and shale found in the Interior Plateau. Streams in this area are relatively low-gradient and sandy-bottomed.

B. Blue Ridge Mountain (n°66 on Figure 3)

The Blue Ridge extends from southern Pennsylvania to northern Georgia, varying from narrow ridges to hilly plateaus to more massive mountainous areas, with high peaks reaching over 2000 m. The mostly forested slopes, high-gradient, cool, clear streams, and rugged terrain occur primarily on metamorphic rocks, with minor areas of igneous and sedimentary geology. The southern Blue Ridge is one of the richest centers of biodiversity in the eastern U.S. It is one of the most floristically diverse ecoregions, and includes Appalachian oak forests, northern hardwoods, and, at the highest elevations, Southeastern spruce-fir forests. Shrub, grass, and heath balds, hemlock, cove hardwoods, and oak-pine communities are also significant.

C. Ridge and Valley (n°67 on Figure 3)

This northeast-southwest trending, relatively low-lying, but diverse ecoregion is sandwiched between generally higher, more rugged mountainous regions with greater forest cover. As a result of extreme folding and faulting events, the region's roughly parallel ridges and valleys have a variety of widths, heights, and geologic materials, including limestone, dolomite, shale, siltstone, sandstone, chert, mudstone, and marble. Springs and caves are relatively numerous. Present-day forests cover about 50% of the region. The ecoregion has a great diversity of aquatic habitats and species of fish.

D. South-western Appalachians (n°68 on Figure 3)

Stretching from Kentucky to Alabama, these open low mountains contain a mosaic of forest and woodland with some cropland and pasture. The eastern boundary of the ecoregion, along the more abrupt escarpment where it meets the Ridge and Valley (67), is relatively smooth and only slightly notched by small, eastward flowing streams. Much of the western boundary, next to the Interior Plateau (n°71), is more crenulated, with a rougher escarpment that is more deeply incised. The mixed mesophytic forest is restricted mostly to the deeper ravines and escarpment slopes, and the

[4]Source : http://average-rainfall.weatherdb.com/

[5]Source: Primary Distinguishing Characteristics of Level III Ecoregions of the Continental United States (http://www.hort.purdue.edu/newcrop/cropmap/ecoreg/descript.html)

upland forests are dominated by mixed oaks with shortleaf pine. Ecoregion n°68 has less agriculture than the adjacent Ecoregion n°71.

E. Central Appalachians (n°69 on Figure 3)

The Central Appalachian ecoregion, stretching from central Pennsylvania to northern Tennessee, is primarily a high, dissected, rugged plateau composed of sandstone, shale, conglomerate, and coal. The rugged terrain, cool climate, and infertile soils limit agriculture, resulting in a mostly forested land cover. The high hills and low mountains are covered by a mixed mesophytic forest with areas of Appalachian oak and northern hardwood forest.

F. Interior Plateau (n°71 on Figure 3)

The Interior Plateau is a diverse ecoregion extending from southern Indiana and Ohio to northern Alabama. Rock types are distinctly different from the coastal plain sediments and alluvial deposits of ecoregions to the west, and elevations are lower than the Appalachian ecoregions to the east. The natural vegetation is primarily oak-hickory forest, with some areas of bluestem prairie and cedar glades.

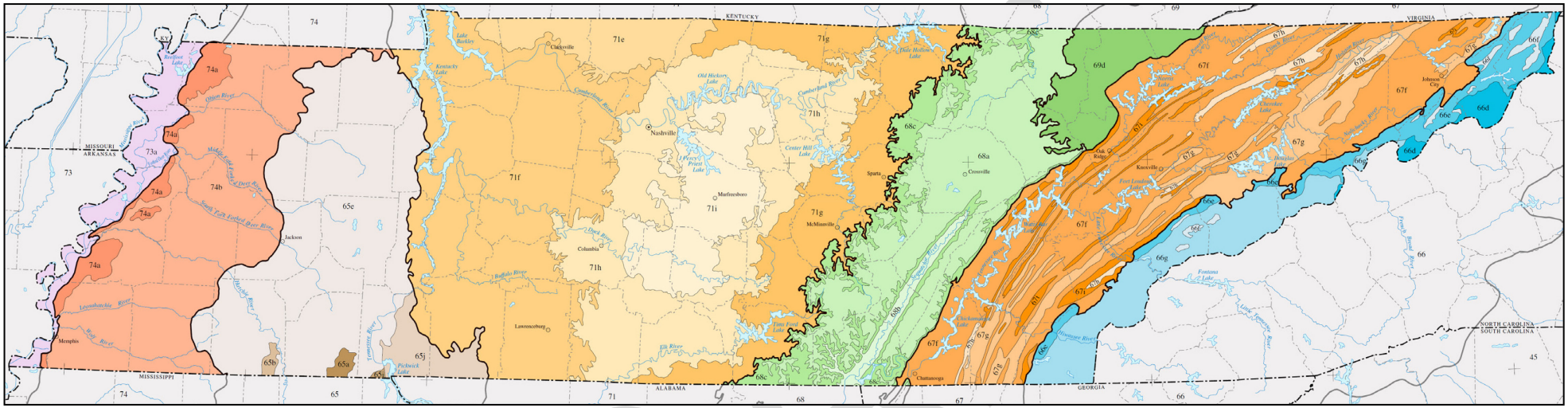
G. Mississippi Alluvial Plain (n°73 on Figure 3)

This riverine ecoregion extends from southern Illinois, at the confluence of the Ohio River with the Mississippi River, south to the Gulf of Mexico. It is mostly a flat, broad floodplain with river terraces and levees providing the main elements of relief. Soils tend to be poorly drained, except for the areas of sandy soils. Bottomland deciduous forest vegetation covered the region before much of it was cleared for cultivation. Presently, most of the northern and central parts of the region are in cropland and receive heavy treatments of insecticides and herbicides. Soybeans, cotton, and rice are the major crops.

H. Mississippi Valley Loes Plains (n°74 on Figure 3)

This ecoregion stretches from near the Ohio River in western Kentucky to Louisiana. It consists primarily of irregular plains, with oak-hickory and oak-hickory-pine natural vegetation. Thick loess tends to be the distinguishing characteristic. With flatter topography than the Southeastern Plains ecoregion to the east, streams tend to have less gradient and more silty substrates. Agriculture is the dominant land use in the Kentucky and Tennessee portion of the region, while in Mississippi there is a mosaic of forest and cropland.

Figure 3: Ecoregions of Tennessee (Levels III & IV)



65 Southeastern Plains
- 65a Blackland Prairie
- 65b Flatwoods/Alluvial Prairie Margins
- 65e Southeastern Plains and Hills
- 65i Fall Line Hills
- 65j Transition Hills

66 Blue Ridge Mountains
- 66d Southern Igneous Ridges and Mountains
- 66e Southern Sedimentary Ridges
- 66f Limestone Valleys and Coves
- 66g Southern Metasedimentary Mountains

67 Ridge and Valley
- 67f Southern Limestone/Dolomite Valleys and Low Rolling Hills
- 67g Southern Shale Valleys
- 67h Southern Sandstone Ridges
- 67i Southern Dissected Ridges and Knobs

68 Southwestern Appalachians
- 68a Cumberland Plateau
- 68b Sequatchie Valley
- 68c Plateau Escarpment

69 Central Appalachians
- 69d Cumberland Mountains

71 Interior Plateau
- 71e Western Pennyroyal Karst
- 71f Western Highland Rim
- 71g Eastern Highland Rim
- 71h Outer Nashville Basin
- 71i Inner Nashville Basin

73 Mississippi Alluvial Plain
- 73a Northern Mississippi Alluvial Plain

74 Mississippi Valley Loess Plains
- 74a Bluff Hills
- 74b Loess Plains

Level III ecoregion
Level IV ecoregion
County boundary
State boundary

Source: Environmental Protection Agency – Western Ecology Division[6]

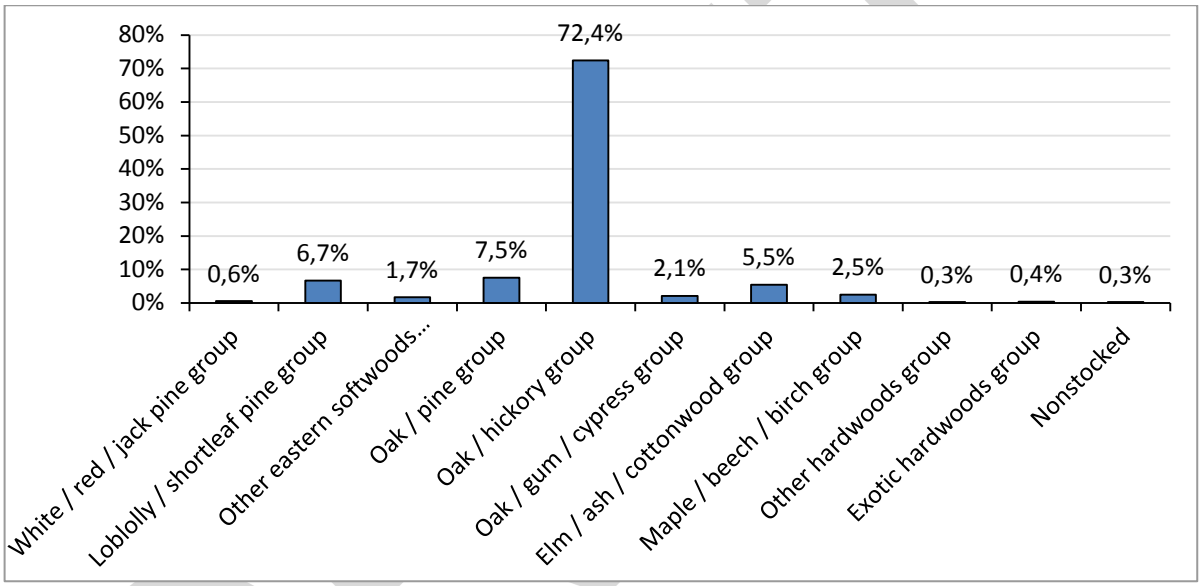
[6] http://www.epa.gov/wed/pages/ecoregions/tn_eco.htm#Ecoregions

2.2. Forest species

The oak-hickory (Quercus spp.–Carya spp.) forest-type occupies the largest proportion of forest land in Tennessee with 72.4%. The loblolly-shortleaf pine type accounts for only 6.7%, the majority of which is located in the eastern portion of the State. Mixed stands of the oak-pine type account for an estimated 7.5%.

The area distribution (2011) occupied by the different forest-type group is presented on the figure and table below.

Figure 4 : Area distribution of forest land by forest-type group (2011)



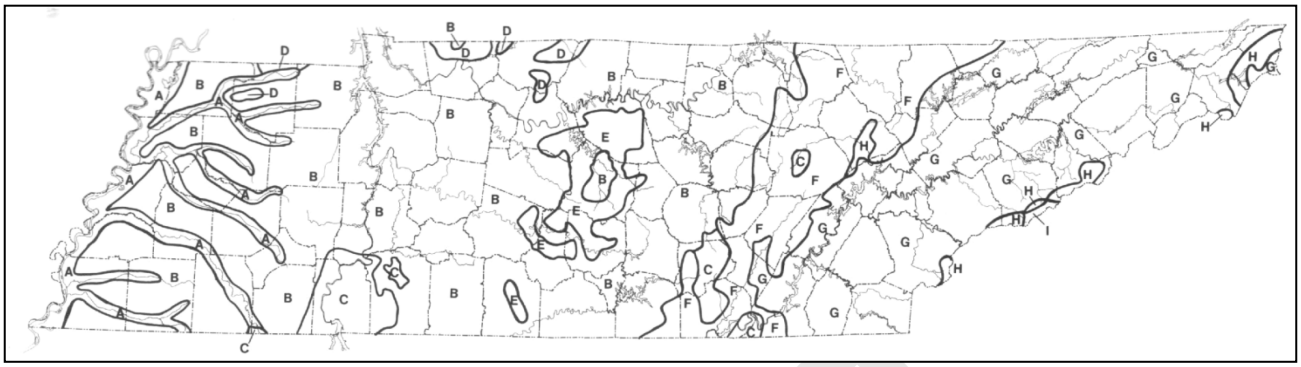
Source: adapted from US Forest service, FIA Program (http://apps.fs.fed.us/fido/standardrpt.html)

Table 1 : Area of forest land by forest-type group (2011)

Forest type group	Area (ha)	% of total forestland area
Oak / hickory group	4086522	72.43%
Oak / pine group	424205	7.52%
Loblolly / shortleaf pine group	378906	6.72%
Elm / ash / cottonwood group	308096	5.46%
Maple / beech / birch group	141721	2.51%
Oak / gum / cypress group	120627	2.14%
Other eastern softwoods group	97427	1.73%
White / red / jack pine group	32881	0.58%
Exotic hardwoods group	20076	0.36%
Nonstocked	17110	0.30%
Other hardwoods group	14290	0.25%
Total	**5641862**	

Source: adapted from US Forest service, FIA Program (http://apps.fs.fed.us/fido/standardrpt.html)

Figure 5 : Major forest types of Tennessee



A	Denote Southern Floodplain Forest	F	Mixed Mesophytic Forest
B	Oak-Hickory Forest	G	Appalachian Oak Forest
C	Oak-Hickory-Pine Forest	H	Northern Hardwoods
D	Mosaic of Bluestern Prairie and Oak-Hickory Forest	I	Southeastern Spruce-Fir Forest
E	Cedar Glades		

Source: Vegetative features (Kuchler, 1964)[7]

According to a 2010 FIA inventory[8] (Figure 5, only 5% of forests across the State were of artificial origin (planted). The rest, 95% of all forests in the State, originated though natural regeneration (Table 2). A large proportion of the stands originating from artificial plantation are of the loblolly-shortleaf pine forest-type group (the extent of plantations exceeds the extent of natural stands for this group).

Table 2 : Area of forest land by forest-type group and stand origin (Tennessee, 2010)

Forest type group	Total (ha)	Stand origin	
		Natural stands	Clear evidence of artificial regeneration
White-red-jack pine	34261	32935	1326
Loblolly-shortleaf pine	372759	174808	197951
Other eastern softwoods	103606	103606	0
Oak-pine	408000	357121	50880
Oak-hickory	4109391	4079080	30311
Oak-gum-cypress	131329	131329	0
Elm-ash-cottonwood	301623	301623	0
Maple-beech-birch	134851	134851	0
Other hardwoods	16220	16220	0
Exotic hardwoods	20310	20310	0
Nonstocked	15085	14510	575
Total	5647436	5366394	281042

Source: adapted from Forest inventory & Analysis Factsheet (Tennessee, 2010 – USDA, Forest Service)

[7] From: http://apbrwww5.apsu.edu/amatlas/INTRO.HTM

[8] Forest inventory & Analysis Factsheet 2010 – USDA, Forest Service- http://www.srs.fs.usda.gov/pubs/su/su_srs051.pdf

2.3. Forest ownership

Approximately 84% of Tennessee's forestland area is privately-owned and the 16% remaining is publicly-owned (federal, state and local public owners). According to the Tennessee Forestry Division, of the privately-owned land in 2004, about 90% was owned by non-industrial private sector and the remaining was owned by forest industries.

Tennessee's timberland and forestland ownership patterns are given in the following table.

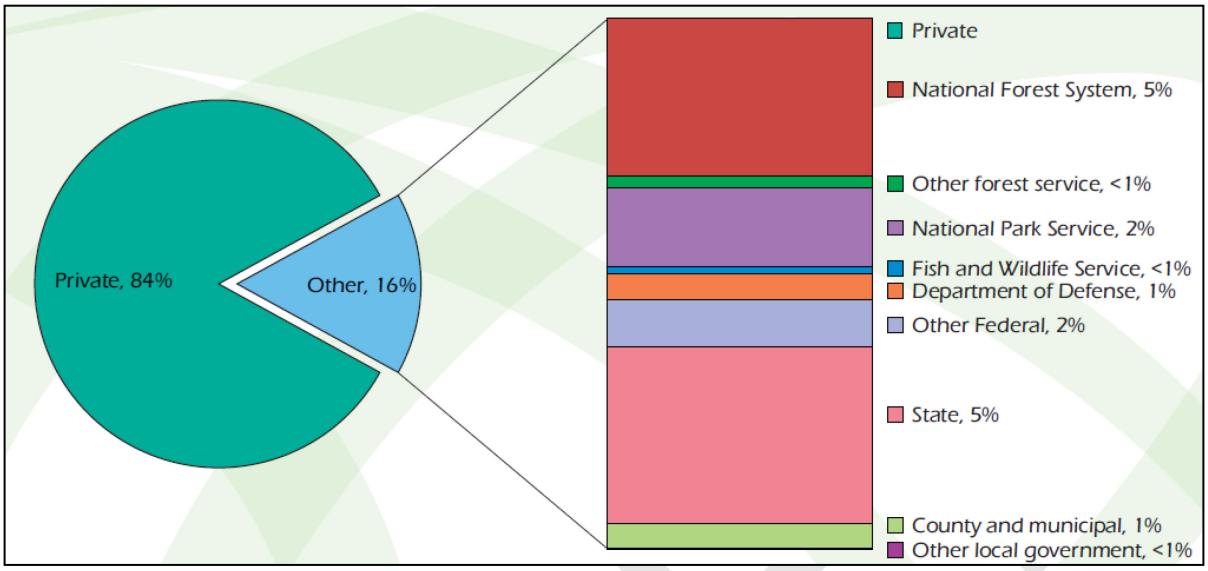
Table 3 : Area of forest land and timberland by ownership groups (2011)

Forest land / Ownership groups		Area (ha)		% of total forestland area
Forest Service	National forest	267 106	288 230	5.1%
	Other national forest	21 124		
Other federal	National Park Service	137 732	274 726	4.9%
	Fish and Wildlife Service	12 989		
	Department of Defense or Energy	68 682		
	Other federal	55 323		
State and local gov't	State	310 708	355 281	6.3%
	Local (county, municipal, etc.)	42 225		
	Other non federal lands	2 348		
Private	Undifferentiated private	47 23 626	4 723 626	83.7%
Total			5641862	
Timberland / Owner ship groups		**Area (ha)**		**% of total timberland area**
Forest Service	National forest	238 935	260 059	4.8%
	Other national forest	21 124		
Other federal	Fish and Wildlife Service	12 989	134 647	2.5%
	Department of Defense or Energy	68 682		
	Other federal	52 976		
State and local gov't	State	308 379	352 952	6.5%
	Local (county, municipal, etc.)	42 225		
	Other non federal lands	2 348		
Private	Undifferentiated private	4 722 332	4 723 626	86.3%
Total			5469989	

Source: adapted from US Forest service, FIA Program (http://apps.fs.fed.us/fido/standardrpt.html)

Tennessee's forest land ownership pattern is given on the following figure.

Figure 6 : Area of forest land by ownership (Tennessee, 2010)



Forest inventory & Analysis Factsheet 2010 – USDA, Forest Service

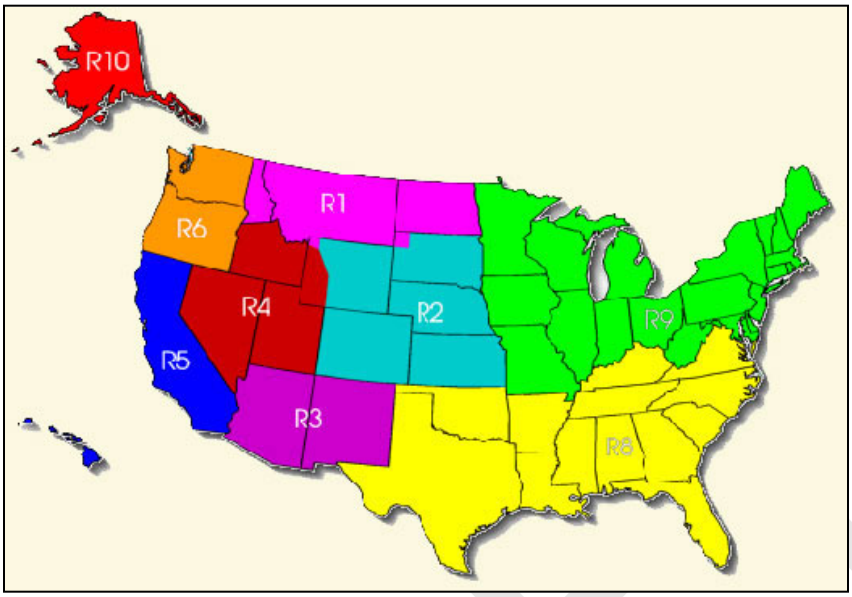
2.4. Competent authorities

Forest management in the United States of America, at the federal level is under the authority of the US Department of Agriculture and more specifically it's agency of the US Forest Service whose mission is to: *"Sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generation"* [9]

Forest management of the territory of the United States is shared in 10 different parts belonging to regional divisions of the Forest Service. As shown on the figure below, Tennessee and other States like Louisiana, Georgia and Florida belongs to the R8 region: Southern Region.

[9] Forest Service Agency Financial report- Fiscal Year 2008

Figure 7 : Regional areas of the Forest Service



Source : http://www.fs.fed.us/

The authority responsible for forest management in Tennessee is split into two levels: federal and state. The Forest Service – an agency of the Department of Agriculture – is responsible at federal level for the coordination of forest policies and the management of federal forests. At state level, the Tennessee Department of Agriculture – Division of Forestry (TDF) is in charge of forest management.

The Tennessee Division of Forestry contains several units in relation with its core missions[10]:

- The Forest Resource Protection Unit: its mission is to reduce losses from wildfires and forest pests, and to prevent water quality degradation from forestry sources.
- The Forest Resource Management: is to promote and advance sustainable forest management on nonindustrial private forestlands for the multiple uses and benefits provided by forested landscapes.
- The Urban Forest Resource Management Unit: its mission is to assist and encourage municipalities and private urban landowners to establish, improve, and maintain urban forest resources.
- The state Forest Management Unit: its mission is to provide for the multiple use management of all resources on State Forest lands such that those resources are protected and utilized in the combination that best meets the long-term needs of the people of Tennessee.

[10] Tennessee Forestry Commission FY 2012 Annual Report - http://www.tn.gov/agriculture/publications/tfc/tfc2012.pdf

- The Reforestation Unit: its mission is to provide quality, affordable seedlings (genetically improved where feasible) to Tennessee landowners and to optimize genetic improvements to increase the productivity of the state's forest resource.

- The Forest Data and Technology Unit: its mission is to facilitate the development and utilization of technology to meet the needs of the Division's core businesses. The Forest Data and Technology Unit has the responsibility to implement state of the art technology, manage and compile data, and administer the Division's Forest Inventory and Analysis, and Geographic Information Systems programs.

- The Forest Business Unit: its mission is to provide support for the Tennessee forest industry and forest-based businesses, and to provide data to characterize Tennessee forest products.

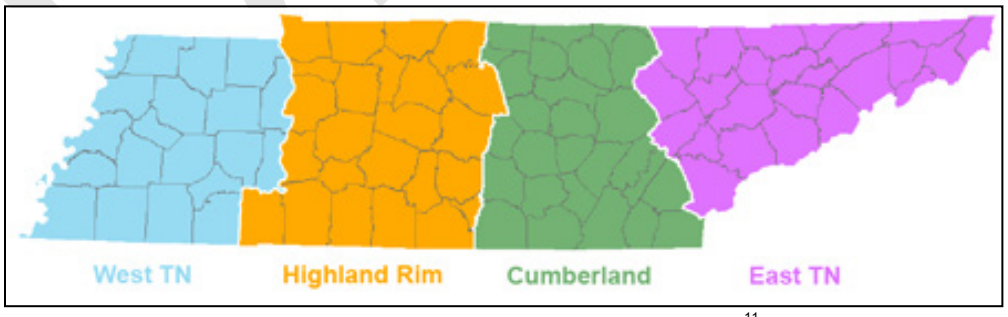
- The Environmental Affairs and Public Outreach Unit: its mission is to communicate clearly and accurately to the Division's public forestry information necessary to accomplish the Division's mission, and to optimize in-house communications.

- The Safety and Training Unit: its mission is to protect the lives and wellbeing of Division employees and the public by reducing or eliminating unsafe acts and/or conditions that may result in personal injury or loss of life and to coordinate training opportunities that will enhance employee career development and the delivery of forestry services to our constituents.

- The administration Unit: its mission is to assist the State Forester in increasing the effectiveness of management, the quality of customer services, the efficiency of operations, and the cost effectiveness of Division programs.

The Tennessee Division of Forestry Administration includes one Headquarters and four Districts as shown on the map below:

Figure 8 : Tennessee Forestry Division Administrative Districts



Source: Department of Agriculture – Division Offices[11]

[11] http://www.tn.gov/agriculture/forestry/directory.shtml

The Tennessee Forestry Commission, established in 1985, serves in an advisory capacity on forestry policy to the Tennessee Department of Agriculture and the governor. The Commission is closely related to the Division of Forestry and has the mission to:

- Nominate candidates for State Forester,
- Review, approve and submit the annual budget of the Forestry Division to the Commissioner of Agriculture,
- Make annual reports,
- Recommend to the General Assembly legislation to protect, conserve and develop the forest resources of the state,
- Approve the Division's comprehensive long-range plan for the state's forest resources,
- Establish state forestry policies that will enable the Division to manage its programs,
- Include in budget recommendations those goals and objectives necessary to implement state forestry policies.

2.5. Overview of wood-related industry

According to a report from the University of Tennessee[12], in 2000, the forest and forest products industrial complex contributed more than $21 billion to the Tennessee economy, accounting for about 6.5% of the economic activity conducted within the state, and employed over 184,000 individuals, or 5.2% percent of the total number of workers. The forest and forest products industrial complex includes the primary industries typically associated with forest operations such as the management and logging of trees, plus the input supplying industries and the value-added sub-sectors, which includes forest products manufacturing.

The information below present a few highlights about Tennessee timber product output (TPO)[13] and the main available figures related to the period 2007-2009. Between 2007 and 2009, TPO from roundwood was reduced by 24%, to 6.4 million m³. Output of softwood roundwood products declined 27%, and output of hardwood roundwood products decreased 23% (Figure 9).

Saw logs and pulpwood were the principal products in 2009. Combined output of these products accounted for 98% (6.26 million m³) of Tennessee's total industrial roundwood processing (Figure 10).

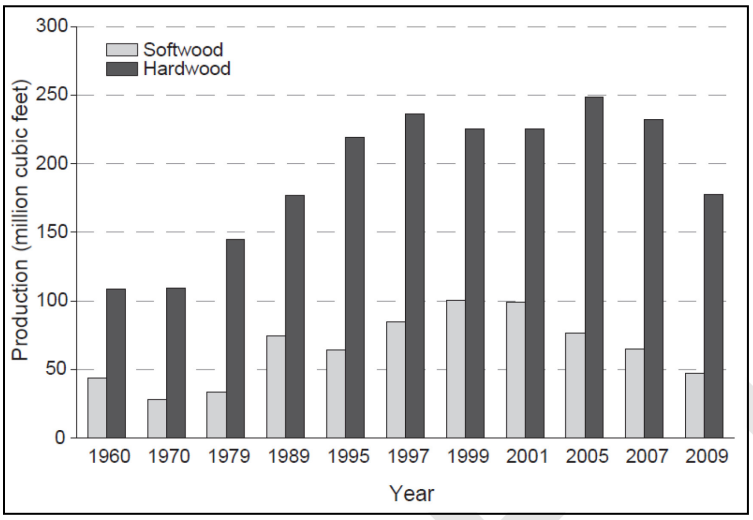
Total receipts at Tennessee mills, which included roundwood harvested and retained in the State as well as roundwood imported from other States, decreased by 23%. At the same time, the number of

[12] Source: Department of Agricultural Economics, University of Tennessee Institute of Agriculture - http://web.utk.edu/~aimag/pubs/Forest%20Main%20Doc.pdf?bcsi_scan_0271f170321d1d0a=0&bcsi_scan_filename=Forest%20Main%20Doc.pdf

[13] USDA - Tennessee's Timber Industry - An Assessment of Timber Product Output and Use, 2009 http://www.srs.fs.usda.gov/pubs/38140

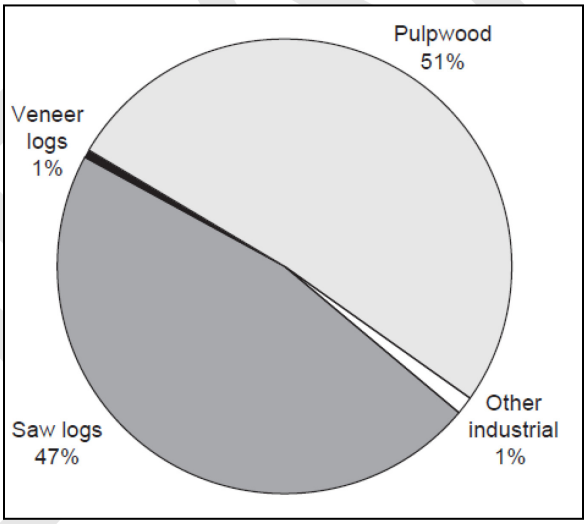
primary roundwood-using plants in Tennessee was down from 329 in 2007 to 267 in 2009 (Figure 11).

Figure 9 : Roundwood production for all products by species group and year



Source: USDA – Forest Service (Assessment of TPO and Use, 2009)

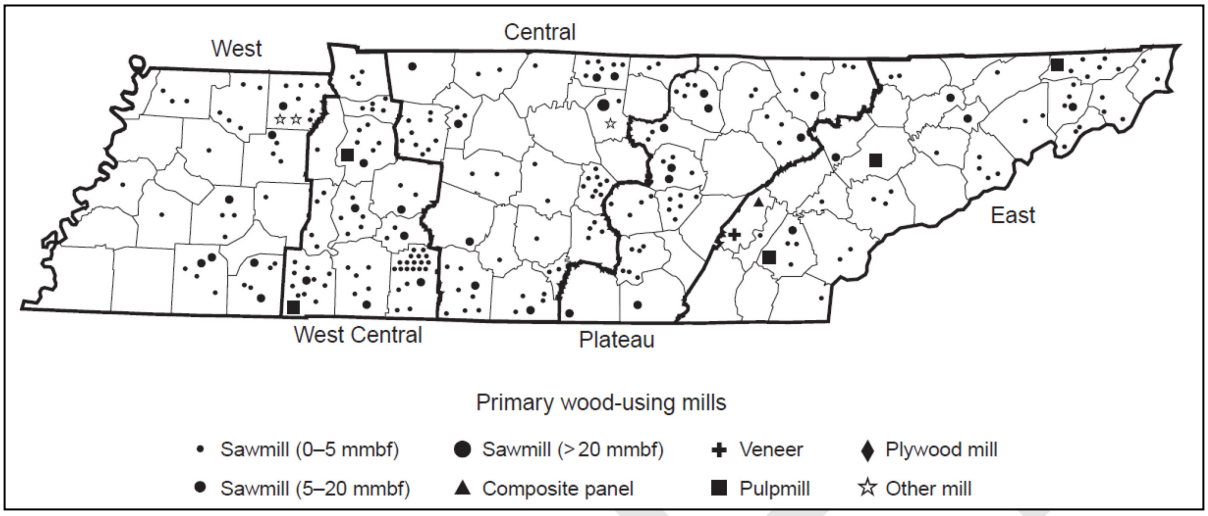
Figure 10 : Roundwood production by type of product (Tennessee, 2009)



Source: USDA – Forest Service (Assessment of TPO and Use, 2009)

Across all products, 71% of roundwood harvested was retained for processing at Tennessee mills. Exports of roundwood to other States amounted to 1.83 million m³, while imports of roundwood amounted to 2.6 million m³ making the State a net importer of roundwood.

Figure 11 : Primary wood-using mills by region (Tennessee, 2009)



mmbf = million board feet

Source: USDA – Forest Service (Assessment of TPO and Use, 2009)

3. Sustainability of Tennessee forest

3.1. Evolution of forest area an risk of conversion

According to the survey[14] conducted in 2010 by the U.S. Department of Agriculture Forest Service, the Tennessee landscape has remained ≥ 50% forested for the past 50 years (Table 4 and related Figure 12). From an estimate in 1961 to the 2010 estimate of 5.65 million ha, forest land has only changed by a positive 2%. Essentially, while small fluctuations have occurred over the last 5 decades, Tennessee forests are very similar to what they used to be in the 1960s.

Tennessee has lost some forests to urbanization. However, at the same time, abandoned agricultural lands, particularly in the West unit of Tennessee, have reverted back to forests and account for increased forest land in that region (Figure 13). The units in Tennessee concerned by the surveys mentioned above are shown in Figure 14.

While urbanization does continue to occur and is the primary contributing factor to forest land loss, more of the development pressure is on agricultural land that is much easier to develop. While there is little change statewide, small-scale forest loss can have significant localized impacts and should not be ignored. For example, localized forest loss can contribute to negative impacts on local water quality and availability.

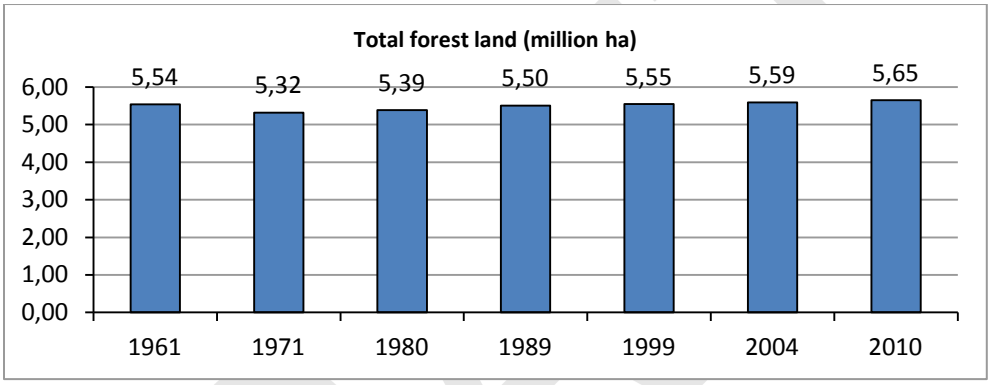
[14] [14] Forest inventory & Analysis Factsheet 2010 – USDA, Forest Service- http://www.srs.fs.usda.gov/pubs/su/su_srs051.pdf

Table 4 : Area by land class and survey year, Tennessee

Land class / year	1961	1971	1980	1989	1999	2004	2010
Timberland	5.44	5.19	5.21	5.37	5.38	5.36	5.48
Other/reserved	0.11	0.13	0.17	0.14	0.16	0.23	0.17
Total forest land	**5.54**	**5.32**	**5.39**	**5.50**	**5.55**	**5.59**	**5.65**
Nonforest land	5.19	5.40	5.32	5.20	5.37	5.32	5.27
Total land area	10.73	10.71	10.70	10.70	10.92	10.92	10.92
Percent forested	**51.6%**	**49.6%**	**50.3%**	**51.4%**	**50.8%**	**51.2%**	**51.7%**

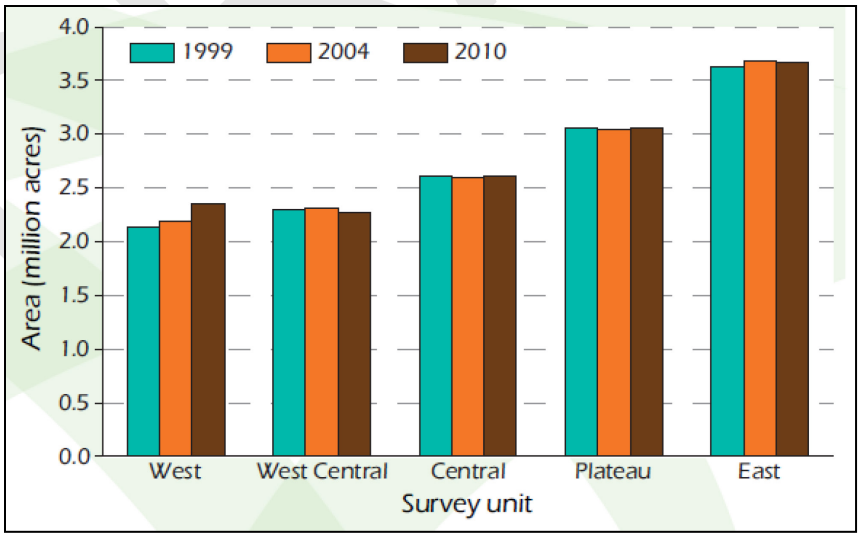
Source: adapted from Forest inventory & Analysis Factsheet - Tennessee, 2010 – USDA, Forest Service

Figure 12 : Change in Forest land over the time, Tennessee



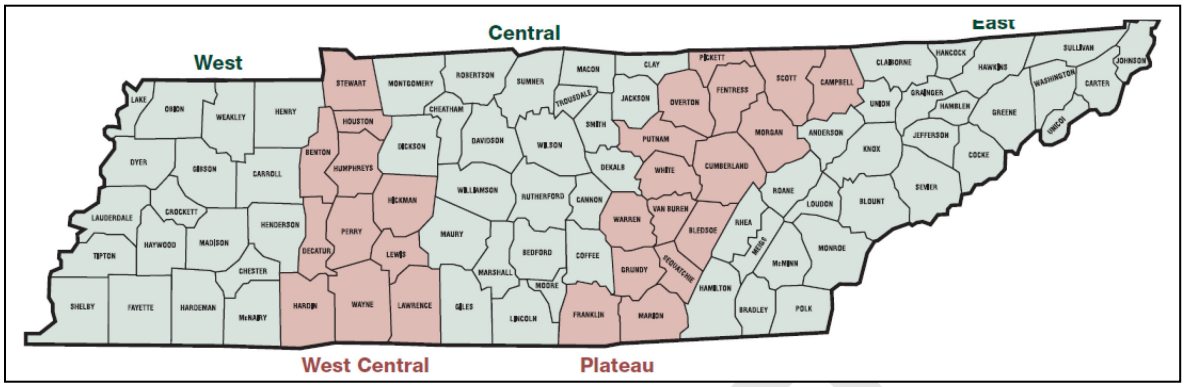
Source: adapted from Forest inventory & Analysis Factsheet - Tennessee, 2010 – USDA, Forest Service

Figure 13 : Area (in acres) of forest land by survey unit and year (Tennessee)



Source: Forest inventory & Analysis Factsheet - Tennessee, 2010 – USDA, Forest Service

Figure 14 : Forest Inventory and Analysis Survey Units in Tennessee



Source: USDA, Forest Service

Table 5 hereafter considers the detailed information available (2011) in the US Forest service database[15]. As we can see (Figure 15), the forest area has been rather stable between 1999 and 2011 with however a slight increase of about 1.7% recorded during this period (i.e. about 0.14% increase yearly on average). If we only consider the last 4 years' trend (period between 2007 and 2011), we can observe a slight decrease of 0.35% in the forest land (i.e. about 0.1% decrease yearly on average).

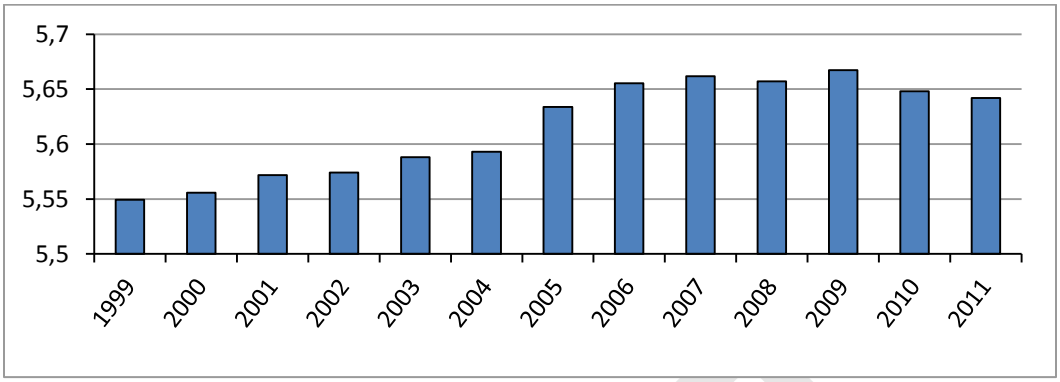
Table 5: Evolution from forested area (1999-2011) and timberland (1980-2011) in Tennessee

Year	Forestland (ha)	Change (ha)	Change %	Timberland (ha)	Change (ha)	Change %
1980	-	-	-	5244464	-	-
1989	-	-	-	5368256	123792	2.36%
1999	5549243	-	-	5386112	17856	0.33%
2000	5555786	6543	0.12%	5394776	8664	0.16%
2001	5571726	15940	0.29%	5410750	15974	0.30%
2002	5574003	2277	0.04%	5407669	-3081	-0.06%
2003	5588133	14130	0.25%	5421479	13810	0.26%
2004	5592981	4848	0.09%	5428698	7219	0.13%
2005	5633735	40754	0.73%	5464568	35870	0.66%
2006	5655212	21477	0.38%	5490300	25732	0.47%
2007	5661714	6502	0.11%	5497693	7393	0.13%
2008	5657153	-4561	-0.08%	5492079	-5614	-0.10%
2009	5667263	10110	0.18%	5502262	10183	0.19%
2010	5648093	-19170	-0.34%	5480141	-22121	-0.40%
2011	5641862	-6231	-0.11%	5469989	-10152	-0.19%

Source: adapted from US Forest service, FIA Program (http://apps.fs.fed.us/fido/standardrpt.html)

[15] http://apps.fs.fed.us/fido/standardrpt.html

Figure 15 : Evolution from forested area in Tennessee (1999-2011)



Source: adapted from US Forest service, FIA Program (http://apps.fs.fed.us/fido/standardrpt.html)

The yearly data of the Forestry Inventory and Analysis (FIA) makes possible to further investigate the recent decrease of the forest areas in Tennessee, through the evolution of forest area by county (see annex 1)[16].

The FSC risk assessment platform www.globalforestregistry.org considers the USA are at unspecified risk in terms of conversion of forest to other land uses, because the following criterion is not verified in the country:

- There is no net loss AND no significant rate of loss (> 0.5% per year) of natural forests and other naturally wooded ecosystems such as savannahs taking place in the eco-region in question.

Indeed, even though at the national level, forested area in the USA increase by 0.1% yearly on average, there are important regional variations and forest extent is are known to be decreasing in different parts of the country. Hence the Global Forest Registry recommends performing an analysis at the state level.

As we have seen above that the most recent trend in Tennessee was the loss of 0.35% of the forested area between 2007 and 2011, we can't exclude a risk of conversion and recommend an analysis at a finer level. The risk can be seen as unspecified at the state level.

At the county level annex 2 makes possible to identify counties where the average annual losses of forest were in excess of 0.5% (which is the threshold the Global Forest Registry refers to in its risk assessment). There are 33 counties where the 0.5% threshold was exceeded as yearly average in the period 2006-2012 (out of the 95 counties in Tennessee). This is a large proportion. Even though the forests have remained rather stable at state level, those statistics show that there have been positive changes and negative changes, with significant increases in some counties and significant decreases in other counties, mostly compensating each other. In total, the loss of forest surfaces in Tennessee between 2006 and 2012 was less than 0.1%.

[16] http://apps.fs.fed.us/fido/standardrpt.html

3.2. *Living wood volumes and removals*

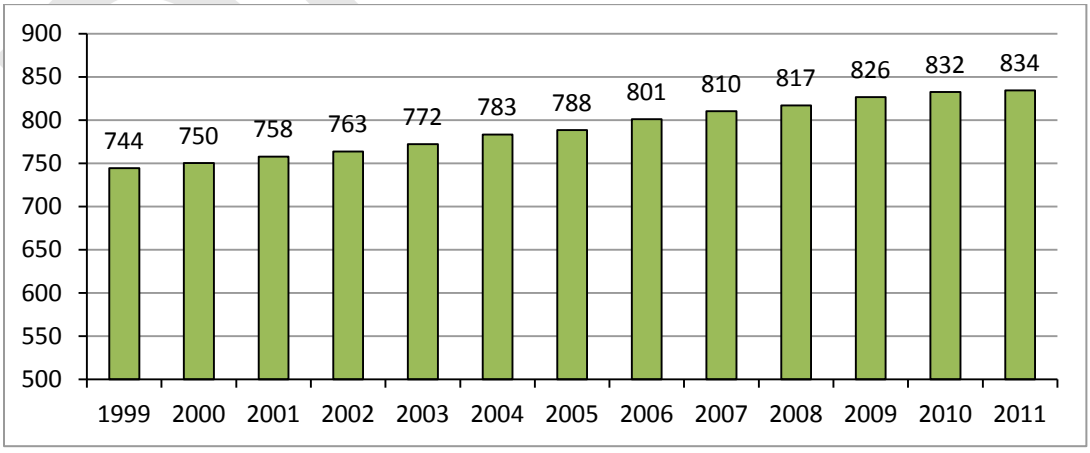
Table 6 shows the net volume, by species group, of live trees in forest land in 2011, according to the more recent available data in the Forestry Inventory and Analysis (FIA) of the USDA – Forest Service[17]. We can see that the Oak/hickory forest-type group accounted for 75% of live-tree volume in Tennessee in 2011, with a total of about 631 million m³. Figure 16 shows the evolution of net volume of live trees between 1999 and 2011. A slight but constant increase is recorded during this period (evolution of about 12% since 1999).

Table 6: Net volume of live trees in forest land (at least 5 inch d.b.h./d.r.c.), in million m³, by forest-type group (Tennessee, 2011)

Forest-type group	Net volume (million m³)	% of total net volume
White / red / jack pine group	9.995	1.20%
Loblolly / shortleaf pine group	40.503	4.85%
Other eastern softwoods group	7.575	0.91%
Oak / pine group	48.110	5.77%
Oak / hickory group	631.333	75.67%
Oak / gum / cypress group	26.556	3.18%
Elm / ash / cottonwood group	39.452	4.73%
Maple / beech / birch group	26.863	3.22%
Other hardwoods group	2.545	0.31%
Exotic hardwoods group	1.286	0.15%
Nonstocked	0.081	0.01%
Total	**8334.298**	

Source: adapted from USDA – Forest Service (http://apps.fs.fed.us/fido/standardrpt.html)

Figure 16 : Evolution of net volume of live trees (at least 5 inch d.b.h./d.r.c.) in million m³ in forest land (Tennessee, 1999-2011)

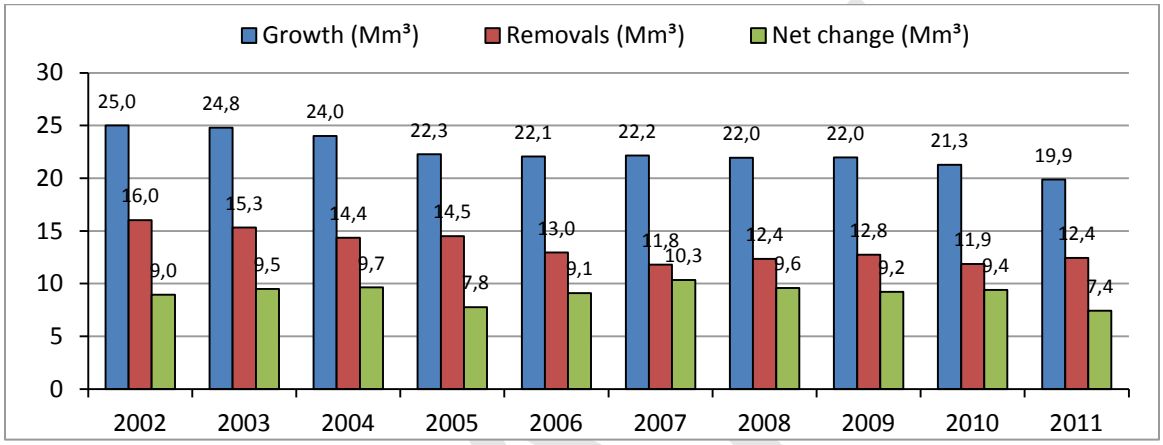


Source: adapted from USDA – Forest Service (http://apps.fs.fed.us/fido/standardrpt.html)

[17] http://apps.fs.fed.us/fido/standardrpt.html

According to the USDA – Forest Service, in 2011, the net annual growth of live trees on forest land averaged 19.9 million m³ and annual removals 12.4 million m³ (including a mortality of 7.8 million m³). The data covering the period between 2002 and 2011 is presented on Figure 18. The net growth of live trees exceeds removals during the entire period. It can be noted that both the annual growth and the removals have been decreasing, but the difference between both remained substantial.

Figure 17 : Average net annual growth VS removals of live trees on forest land (at least 5 inch d.b.h./d.r.c.), in million m³



Net change = net growth - removals

Source: adapted from USDA – Forest Service (http://apps.fs.fed.us/fido/standardrpt.html)

3.3. Protection of ecosystems and biodiversity

As shown on Table 7, the conservation land in Tennessee covers 748517 ha, which is about 6.9% of the state area. This includes both public and private land, under various conservation statuses. Figure 19 shows an overview of all protected areas in Tennessee. Those protected areas are either public (federal, state, county or local) and private lands.

Table 7: Land under protection status in Tennessee (as of 2011)

	Status 1	Status 2	Status 3	Total
Acres	306 362	642 159	901 104	1 849 625
Ha	123 980	259 873	364 664	748 517
Percentage of state area	1.1%	2.4%	3.3%	6.9%

Source: USGS Gap analysis http://gapanalysis.usgs.gov/

Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

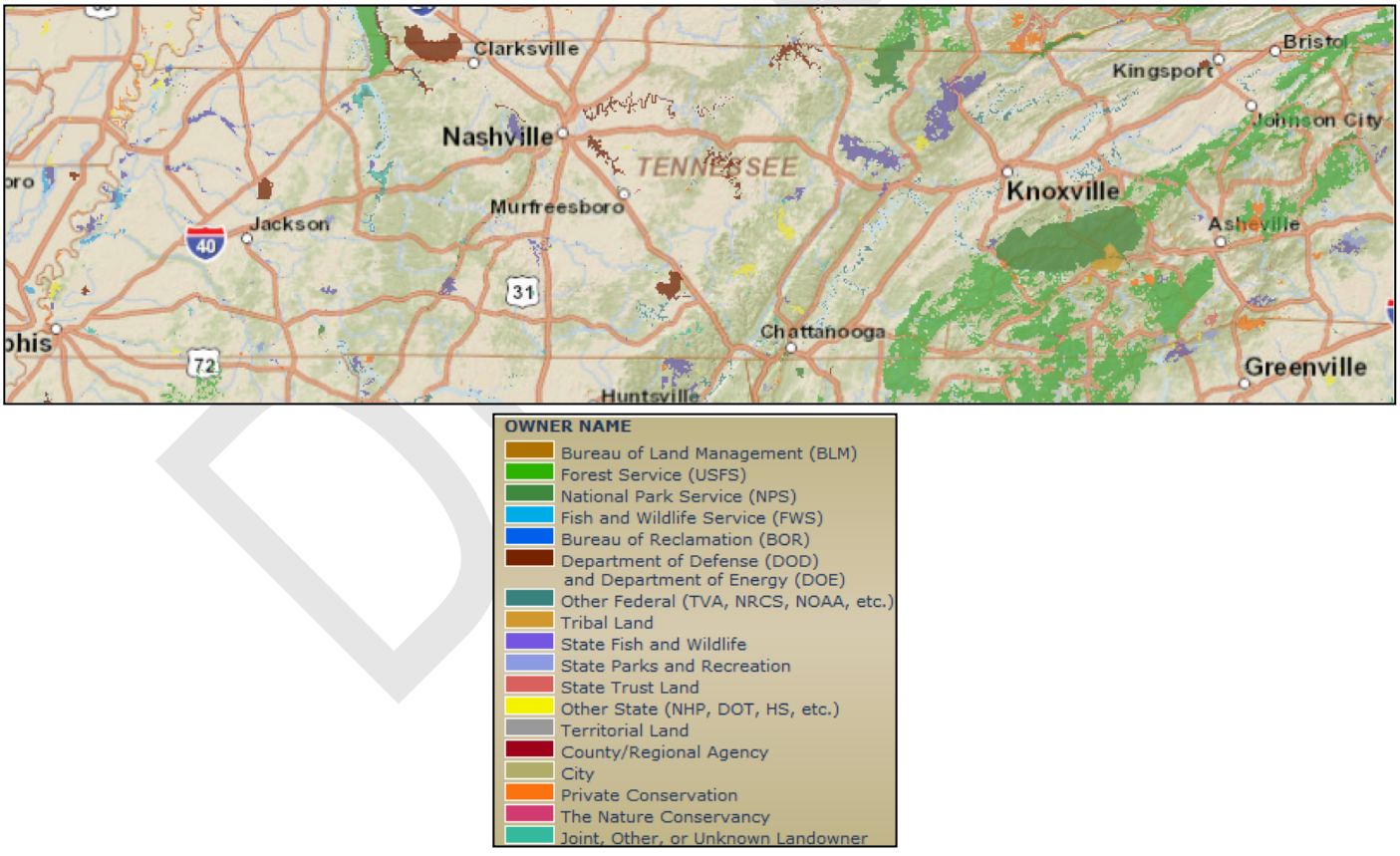
Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

Status 3: Area having permanent protection from conversion of natural land cover for the majority of area. Subject to extractive uses of either broad, low-intensity type (eg. Logging) or localized intense type (eg. Mining). Confers protection to federally listed endangered and threatened species throughout the area.

Note that different figures exist in terms of total conservation area in the State, depending on the categories of protection that are taken into account (particularly in the status 3 as defined above). For example, Figure 19 includes military zones, which are not designated for the purpose of biodiversity and ecosystems protection, even though they might be of considerable interest because the areas are very large and continuous, with most of the time very little human disturbance.

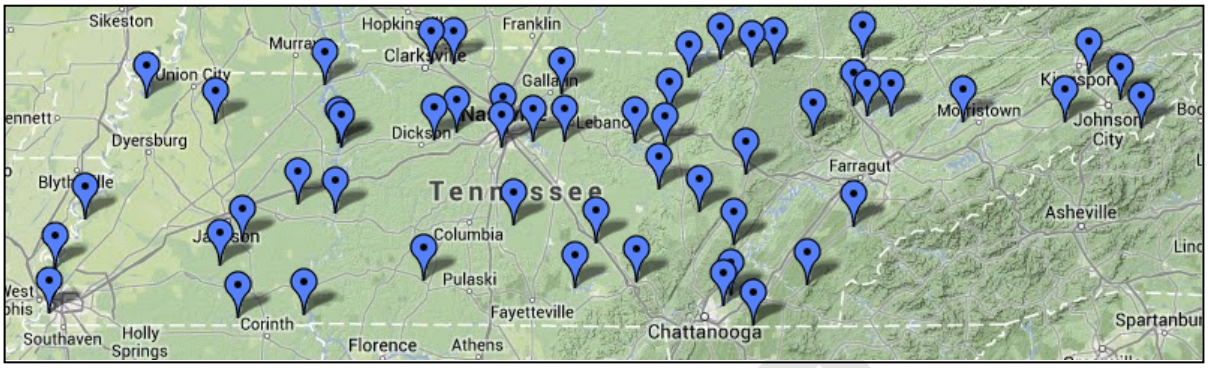
Figure 20 shows the location of State parks in Mississippi. Figure 21 shows the location of national parks in Mississippi.

Figure 18 : Protected areas in Tennessee



Source: National Gap Analysis Program (GAP) – Protected areas data viewer (http://gis1.usgs.gov/csas/gap/viewer/padus/Map.aspx)

Figure 19 : State Parks in Tennessee



Source: Google maps – Tennessee State Parks

Figure 20 : National parks in Tennessee

Source: http://usparks.about.com/cs/usparklocator/l/blpktn.htm

Even though the protected areas in Tennessee are rather limited, there have been recent efforts to improve the situation. Table 8 shows the new surfaces put into conservation between 1998 and 2005. The detailed data are not available in the data source used regarding the Tennessee State for the last years. The increase over 7 years reaches 2.2% (i.e. an average annual growth by 0.3%).

Table 8: New land under conservation status per year in Tennessee (1998-2005)

Year	1998	1999	2000	2001	2002	2003	2004	2005	Total
Acres	6 862.4	7 352.0	2 609.7	7 617.9	2 519.6	8 820.4	586.9	6 833.5	43 202.4
ha	2 777.1	2 975.2	1 056.1	3 082.9	1 019.6	3 569.5	237.5	2 765.4	17 483.4

Source: http://www.conservationalmanac.org

A number of conservation schemes have been introduced recently to increase the conservation land in Tennessee, including initiatives to encourage conservation on private land (which is particularly important given the proportion of private forests in Tennessee).

The most important programs (state and federal) are described hereunder:

- **Tennessee Heritage Conservation Trust Fund[18]:** The Fund provides a mechanism for the state to work with other public and private partners for the preservation and protection of priority tracts across Tennessee. The fund will also be used to promote tourism and outdoor recreational activities such as hiking, hunting and fishing. The first acquisition from this fund was in 2006.

- **Wetlands Acquisition Fund[19]:** The Wetlands Acquisition Fund was the first of the current trust funds established by the General Assembly in 1986. The WAF provides for the acquisition of wetlands and watershed areas.

- **Local Parks and Recreation Fund[20]:** The purpose of the fund is to provide money for the acquisition of land for parks, natural areas, greenways, trails, archaeological sites, and for the purchase of land for recreation facilities. Funds can also be used for trail development and capital projects. This fund requires a 50 percent match from local governments, but allows them to match fund dollars with land, volunteer services, material, or equipment used for project development.

- **Stand Lands Acquisition Fund[21]:** Funds are provided for the acquisition of land or easements for state parks, state forests, state natural areas, boundary areas along state scenic rivers, state trail systems, and for trail development.

- **The Forest Legacy Program (FLP)[22]:** The FLP conserves currently more than 14000 ha across Tennessee. Its mission is to protect environmentally important, working private forestlands threatened with conversion to non-forest uses. This USDA Forest Service Program works to identify and maintain well-managed, working forests on the landscape. Forest Legacy in Tennessee specifically targets and perpetuates traditional forestland values and benefits on environmentally valuable forest lands by requiring each tract to have a detailed forest management plan, known as a Forest Stewardship Plan, to address all resource elements and land management objectives.

- **The Forest Stewardship Program[23]:** The Forest Stewardship program makes forestry assistance available to private forest landowners and increases public awareness about wise

[18] http://www.conservationalmanac.org/secure/almanac/southeast/tn/programs.html
[19] http://www.conservationalmanac.org/secure/almanac/southeast/tn/programs.html
[20] http://www.conservationalmanac.org/secure/almanac/southeast/tn/programs.html
[21] http://www.conservationalmanac.org/secure/almanac/southeast/tn/programs.html
[22] http://www.tn.gov/agriculture/forestry/legacy.shtml
[23] http://www.tn.gov/twra/habitatconserv.html

forest use and management. The program focuses on developing detailed plans for privately owned forestland based on specific objectives of the owner. Free, on-the-ground planning assistance is provided by natural resource specialists under the leadership of the Tennessee Department of Agriculture, Forestry Division. Depending upon landowners' objectives, stewardship plans may contain detailed recommendations for improvement of wildlife habitat and development of recreational opportunities, as well as for timber establishment, stand improvement and harvesting. Guidelines for prevention of soil erosion, protection of water quality, and preservation of visual values are included in all stewardship plans.

- **The Conservation Reserve Program (CRP)[24]:** The Conservation Reserve Program is a land conservation program administered by the Farm Service Agency. In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

- **The Wildlife Habitat Incentives Program (WHIP)[25]:** The purpose of the Wildlife Habitat Incentive Program (WHIP) is to help participants develop fish and wildlife habitat on private agricultural land, nonindustrial private forest land and Indian land. The Natural Resources Conservation Service (NRCS) provides technical and financial assistance to landowners and others to develop or enhance upland, wetland, riparian, and aquatic habitat areas on their property.

- **The Conservation Stewardship Program (CSP)[26]:** The CSP is a voluntary program that provides financial and technical assistance to eligible producers to conserve and enhance soil, water, air, and related natural resources on their land. Eligible lands include cropland, pastureland, and nonindustrial private forest lands.

3.4. Protection of water

In the US, the Clean Water Act (CWA) was introduced in 1972 to regulate the discharge of pollutants in water. In this framework, forestry operations are considered as nonpoint sources and, hence, are generally exempted for permit under CWA as long as Best Management Practices (BMP) are developed and implemented. It is the responsibility of states to develop, implement and assess the Best Management Practices, under the control and funding of the federal Environmental Protection Agency (EPA). Even though the impact on water is the core of the BMP, many states have gone further and used the BMP as a tool for other management purpose (soil, landscape, wildlife etc...).

[24] http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp
[25] http://www.nrcs.usda.gov/wps/portal/nrcs/main/tn/programs/financial/whip/
[26] http://www.nrcs.usda.gov/wps/portal/nrcs/main/tn/programs/financial/csp/

In the State of Tennessee, The Department of Agriculture, Division of Forestry, has published the BMP as required by Public Chapter 680, Acts of the Tennessee General Assembly, 2000. The latest version of BMP for forestry operations was released in 2003[27].

The act requires that such BMP be identified as part of authorizing the Tennessee Department of Environment and Conservation the power to require that a logger "stop work" if the harvesting operation pollutes waters of the state because the logger failed or refused to use BMP.

The topics covered by the BMP:

- Locating, constructing and retiring forest roads
- Drainage from road surfaces
- Establishing streamside management zones
- Stream crossings
- Locating and constructing log landings
- Locating and constructing skid trails
- Debris and hazardous materials in streams and lakes
- Site preparation and tree planting
- Fertilization
- Stabilization and revegetation of disturbed areas
- Sediment control structures
- Wetland management

In Southeast USA, there are specific arrangements for the site preparation before establishing pine plantations on wetlands[28]. Such operations are no exempt of permitting on wetlands and a specific permit under CWA section 404 has to be obtained. This makes possible for the administration to better control the mechanical works in sensitive environment.

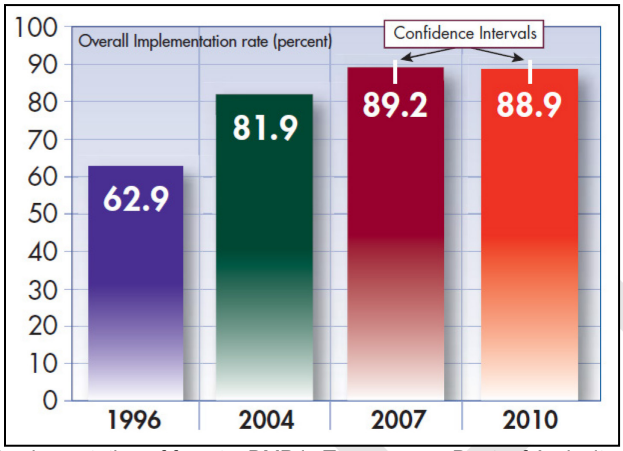
Under the CWA, it is required to regularly evaluate to what extent the BMP are actually implemented in the practice. The last assessments in the state of Tennessee were performed in 2010[29]. A random sample of 205 harvest sites was distributed among Tennessee's Forest Inventory and Analysis (FIA) survey units (Figure 14) based on the amount of timber harvested within each unit. Each site was evaluated for 53 individual BMP that were categorized by haul roads, skid trails, log decks, streamside management zones, stream crossings, debris and hazardous materials, site prep and planting, and applicable BMPs in wetlands.

This last BMP implementation survey showed rather good overall BMP implantation rate (88.9%) and no significant change is observed compared to the overall implementation rate from the 2007 survey

[27] http://www.tn.gov/agriculture/publications/forestry/BMPs.pdf
[28] http://water.epa.gov/lawsregs/guidance/wetlands/silv2.cfm
[29] http://www.tn.gov/agriculture/publications/forestry/BMPimpl2013.pdf?bcsi_scan_0271f170321d1d0a=0&bcsi_scan_filename=BMPimpl2013.pdf

(Figure 23). Substantial improvement in BMP implementation rate is evident when compared to the Division's first BMP implementation survey conducted in 1996.

Figure 21 : Overall forestry BMP Implementation survey results for Tennessee



Source: Voluntary implementation of forestry BMP in Tennessee – Dept. of Agriculture - Div. of Forestry

In 2010, all BMP categories had implementation rates higher than 70%. 'Wetlands' was the BMP category with the lowest implementation rate (70.4%). Site prep and tree planting was the BMP category with the highest implementation rate (97.1%). The FIA East survey unit had the lowest implementation rate (79 percent). The FIA West Central survey unit had the highest implementation rate (92.5 percent).

3.5. Protection of soils

The protection of soil, including soil erosion, soil compaction and soil fertility, is addressed in the Best Management Practice applicable to forestry in Tennessee. It includes considerations of soil in the following topics:

- Forest roads management (road retirement)
- Stream crossings and streamside management zones
- Log landings and skid trails management
- Site preparation and tree planting
- Revegetation of disturbed areas
- Wetland management
- Fertilization

As described under section 3.4, it appears from the BMP Implementation and Compliance Survey (latest report dated 2010) that the BMP are generally well implemented in the State of Tennessee.
Despite some search about this topic, we are not aware of any monitoring programme at the State level exists in order to assess the soils condition (erosion, compaction, fertility) as well as their evolution over time.

3.6. Protection of carbon stocks

In forest land the carbon stocks mainly includes:

- living above ground and below ground woody biomass,
- soil organic carbon,
- carbon in litter.

We have seen in section 3.2 that the volume of live trees has been slightly but consistently increasing in Tennessee over the last decades. In this context, the sequestrated carbon stock in living biomass has increased.

As shown in the Table 9 and related Figure 24 (data from the US Forest service (FIA Program)), we can see a constant increase of carbon stocks regarding the living above/below ground woody biomass and the litter since 1999.

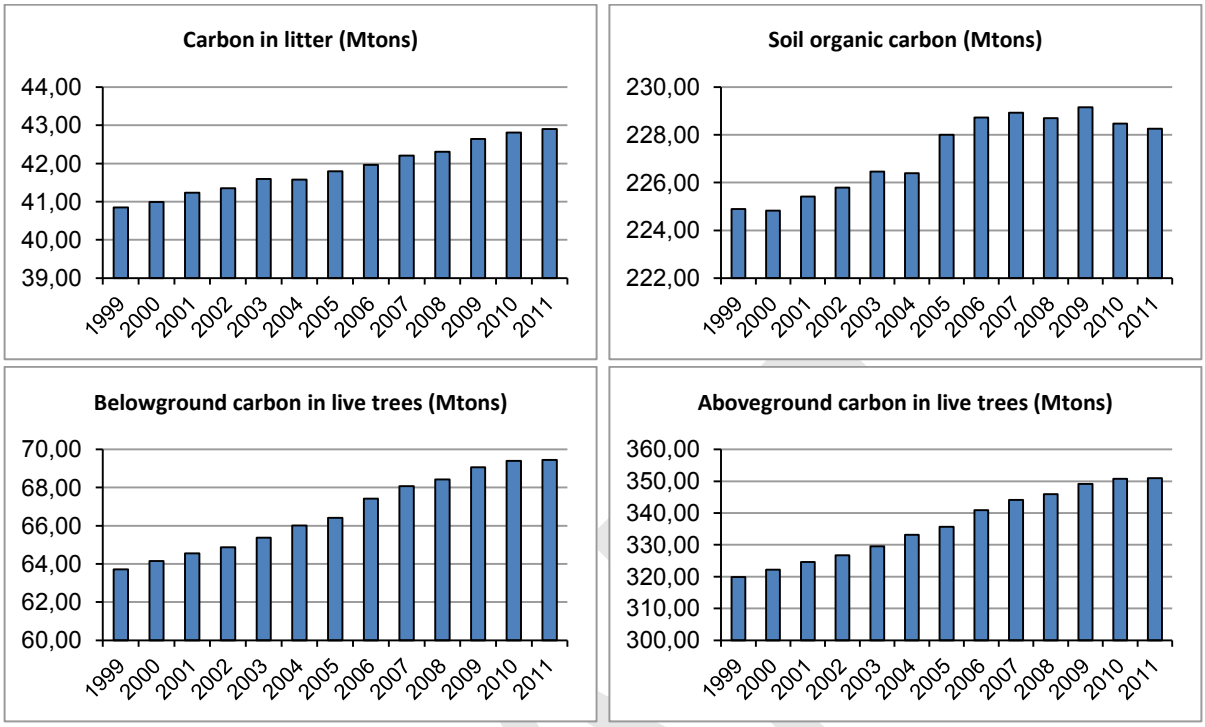
Regarding the soil organic carbon, we can notice a slight overall decrease since 2007, after an increase between 1999 and 2007. Despite this slight decrease, we can see that the sum of the main carbon stocks in forest land has increased since 1999 (more than 6% increase is estimated).

Table 9: Carbon stocks evolution in forestland – (Tennessee 1999-2011)

Year	Carbon in litter (million tons)	Soil organic carbon (million tons)	Belowground carbon in live trees (at least 1 inch d.b.h./d.r.c.) (million tons)	Aboveground carbon in live trees (at least 1 inch d.b.h./d.r.c.) (million tons)
1999	40.85	224.89	63.72	319.89
2000	40.99	224.83	64.15	322.15
2001	41.23	225.41	64.56	324.66
2002	41.35	225.79	64.88	326.70
2003	41.60	226.46	65.37	329.53
2004	41.58	226.40	66.01	333.17
2005	41.80	228.01	66.41	335.64
2006	41.96	228.73	67.42	340.87
2007	42.20	228.92	68.08	344.14
2008	42.31	228.70	68.43	345.90
2009	42.65	229.16	69.06	349.12
2010	42.81	228.48	69.39	350.76
2011	42.91	228.26	69.45	351.02

Source: adapted from US Forest service, FIA Program (http://apps.fs.fed.us/fido/standardrpt.html

Figure 22 : Carbon stocks evolution in forestland (accessible forests) – Tennessee, 1999-2011



Source: adapted from US Forest service, FIA Program (http://apps.fs.fed.us/fido/standardrpt.html

3.7. Protection of air quality

The main impact of forestry on air quality relates to the use of fire. Using fire under controlled conditions is a common practice in Tennessee forestry ("prescribed burning"), and can have different objectives:

- Reduce hazardous fuel
- Prepare sites before seeding and planting
- Wildlife habitat improvement
- Control vegetation and disease

Burning permit must be obtained (during the required season) by the Tennessee Division of Forestry and that burning must be in compliance with Tennessee state air pollution regulations. Many towns and cities have their own burning regulations that supersede the Division's burning permits program.

As burning vegetation has an impact on air quality, open fires are banned from sensitive areas and during some periods of the years to avoid disturbance related to air pollution.

3.8. Illegal logging

The FSC risk assessment platform www.globalforestregistry.org considers the USA are at low risk in terms of illegal logging, because the following criteria are all verified:

1.1 Evidence of enforcement of logging related laws in the district [30]
1.2 There is evidence in the district demonstrating the legality of harvests and wood purchases that includes robust and effective system for granting licenses and harvest permits [31]
1.3 There is little or no evidence or reporting of illegal harvesting in the district of origin[32]
1.4 There is a low perception of corruption related to the granting or issuing of harvesting permits and other areas of law enforcement related to harvesting and wood trade[33]

3.9. Civil rights and traditional rights

The FSC risk assessment platform www.globalforestregistry.org considers the USA are at low risk in terms of violation of civil and traditional rights, because the following criteria are all verified:

- There is no UN Security Council ban on timber exports from the country concerned
- The country or district is not designated a source of conflict timber (e.g. USAID Type 1 conflict)
- There is no evidence of child labor or violation of ILO Fundamental Principles and Rights at work taking place in forest areas in the district concerned
- There are recognized and equitable processes in place to resolve conflicts of substantial magnitude pertaining to traditional rights including use rights, cultural interests or traditional cultural identity in the district concerned
- There is no evidence of violation of the ILO Convention 169 on Indigenous and Tribal Peoples taking place in the forest areas in the district concerned

3.10. Forest certification

The main forest certification schemes used in Tennessee are:

- SFI (Sustainable Forestry Initiative[34]), which is endorsed by PEFC (Programme for the Endorsement of Forest Certification)
- ATFS (American Tree Farm System[35]), which is specifically suitable for small private owners
- FSC (Forest Stewardship Council[36]), which is represented in more than 50 countries.

[30] www.illegal-logging.info ; www.eia-international.org ; http://www.ahec-europe.org/
[31] www.illegal-logging.info ; www.eia-international.org ; http://www.ahec-europe.org/
[32] www.illegal-logging.info ; www.eia-international.org ; http://www.ahec-europe.org/
[33] http://www.transparency.org/cpi2012/results
[34] http://www.sfiprogram.org
[35] https://www.treefarmsystem.org

The certified forest area under each of those schemes as for 2011 is presented in the table hereunder:

Table 10: Certified forest land in Tennessee (2011)

	SFI	FSC	ATFS	Total certified
Acres certified	231 868	42 371	332 166	606 405
Ha certified	93 834	17 147	134 423	245 403
Percentage forests	1.60%	0.29%	2.29%	4.19%

Source: http://www.southernforests.org/resources/publications/SGSF%20Forest%20Certification%20Report%20r1.pdf

4. Conclusions

Tennessee has an important forest that covers about 52% of the State's land area. Most of this forest is privately owned (84%).

The oak-hickory forest-type group occupies very clearly the largest proportion of forest land in Tennessee with 72.4%.

The forest area has been rather stable between 1999 and 2011 with however a slight increase of about 1.7% recorded during this period (i.e. about 0.14% increase yearly on average). If we only consider the trend recorded during the last 4 years (period between 2007 and 2011), we can observe a slight decrease of 0.35% in the forest land (i.e. less than 0.1% decrease yearly on average).

Despite this remarkable stability of forest extent at the state level in terms of forest extent, the situation at county level is very contrasted, with about 30% of the counties have experienced a decrease in excess of 0.5% yearly between 1999 and 2011. As most of those losses were compensated by expansion of forests in other state, the totaldecrease at state level remained as low as 0.1% annually.

Between 1999 and 2011, the net volume of live trees in forestland has increased of about 12%. The annual harvested volume and other losses does not exceed the annual growth since at least 2002.

Because of the increase of the volume of live trees, the carbon stock associated to living woody biomass is growing. Between 1999 and 2011, the augmentation is estimated to be in excess of 6% (0.5% yearly on average).

Tennessee has various types of conservation lands dedicated to the protection of biodiversity and ecosystems, including State parks, National parks, private reserves... The extent of the protected areas is rather limited (6.9%). Even though these areas are rather limited, there have been recent

[36] https://us.fsc.org

efforts to improve the situation and various schemes have been introduced to promote conservation land, in particular on private grounds through tax incentives mechanisms.

Tennessee has developed Best Management Practices (BMP) for forestry to comply with the Clean Water Act. Those BMP address both water and soil conservation. The most recent survey (2010) shows a good level (88.9%) of compliance and implementation of the BMP in the actual forestry operations.

Even though controlled fires are regularly used in forest management practices in Tennessee, the use of fire is regulated and fire is banned from sensitive areas and during some periods of the years to avoid disturbance related to air pollution.

The FSC risk assessment platform www.globalforestregistry.org considers the USA are at low risk in terms of violation of illegal logging and in terms of violation of traditional and civil rights.

The forest certification systems are little developed in Mississippi, with about 4.2% of forest certified under 3 systems SFI, ATFS and FSC.

ANNEX 1:

Forest area in Tennessee by county (forest area in ha) from 2007 to 2011

County	2007	2008	2009	2010	2011
Anderson (1)	53028	52375	52565	52850	52756
Bedford (3)	38746	38781	39003	40510	40175
Benton (5)	70431	68448	68697	68717	68488
Bledsoe (7)	75257	78155	78578	78855	79540
Blount (9)	95525	94855	99404	98222	100868
Bradley (11)	18991	21025	21130	21228	21540
Campbell (13)	88676	87794	86139	85563	85322
Cannon (15)	32390	34532	34543	34965	35763
Carroll (17)	82334	82074	82643	84018	83421
Carter (19)	56731	56604	56455	55894	60109
Cheatam (21)	44388	45002	44982	45423	45509
Chester (23)	48747	48695	48952	48833	48867
Claiborne (25)	53853	53811	55644	55911	55602
Clay (27)	30881	31543	34540	32673	32742
Cocke (29)	78135	78830	75816	77576	75850
Coffee (31)	51700	51148	48536	46599	46689
Crockett (33)	5065	5084	5109	4493	4498
Cumberland (35)	135020	133376	133104	133754	135595
Davidson (37)	50221	50237	50275	49512	51539
Decatur (39)	65626	65173	65128	64352	64156
De Kalb (41)	49703	50834	51976	52707	51865
Dickson (43)	74151	74168	71857	72460	69955
Dyer (45)	17166	17188	18454	17851	17995
Fayette (47)	78638	78540	81174	82765	83506
Fentress (49)	99636	99982	101164	98067	95701
Franklin (51)	79532	77693	79193	76813	77052
Gibson (53)	26331	26262	27587	27590	27622
Giles (55)	89334	88472	87443	86758	89406
Grainger (57)	46693	46751	44954	44498	44219
Greene (59)	70588	70543	69781	67793	65718
Grundy (61)	72059	72311	67674	67887	66253
Hamblen (63)	12215	12681	12509	12573	10713
Hamilton (65)	72347	73891	73784	74237	71623
Hancock (67)	35412	35425	35162	34857	34696
Hardeman (69)	108618	109615	108687	107919	107950
Hardin (71)	112610	110143	110238	110471	110374
Hawkins (73)	75847	73713	73537	74071	73337
Haywood (75)	35053	37701	37652	37590	38097
Henderson (77)	85462	85461	86085	86837	85537
Henry (79)	71193	71016	71569	72473	73864
Hickman (81)	126910	126727	126362	126157	125674
Houston (83)	32375	32500	32471	32450	32431
Humphreys (85)	83991	83851	85113	84998	85428
Jackson (87)	57062	53272	55531	54140	54261
Jefferson (89)	29214	31068	31204	31388	31306
Johnson (91)	60652	60571	60741	58760	58216
Knox (93)	39580	38106	38296	36722	34751
Lake (95)	7400	7389	7388	7388	7391
Lauderdale (97)	37703	37592	39517	39221	39312

County	2007	2008	2009	2010	2011
Lawrence (99)	73463	70710	68866	68800	70399
Lewis (101)	63837	66068	66034	65779	65766
Lincoln (103)	50663	51252	53020	53520	53010
Loudon (105)	23245	21359	20944	21076	21350
McMinn (107)	63675	63624	63052	63489	62649
McNairy (109)	95811	95581	96043	95566	95820
Macon (111)	28370	30393	30423	30728	30775
Madison (113)	64776	64721	65060	65781	65451
Marion (115)	107178	107527	110030	111552	111371
Marshall (117)	51988	52374	52741	50240	50350
Maury (119)	54011	53363	53281	53654	53751
Meigs (121)	24998	25103	25174	25416	25222
Monroe (123)	109477	109683	106886	107294	106942
Montgomery (125)	58669	53840	53307	53972	54765
Moore (127)	14446	14457	13826	13870	13893
Morgan (129)	109465	108738	109526	109907	111229
Obion (131)	38009	37986	38020	38153	38472
Overton (133)	59001	59809	60255	60421	60530
Perry (135)	78594	78470	78153	77082	76652
Pickett (137)	27451	27548	27915	28000	27914
Polk (139)	91033	90938	90507	86831	85418
Putnam (141)	51494	51690	51650	52336	53133
Rhea (143)	50970	51416	49795	48954	48620
Roane (145)	66752	67883	67766	65640	66938
Robertson (147)	12738	12744	12719	10495	11169
Rutherford (149)	63173	65663	66205	64831	63122
Scott (151)	123751	121996	122622	122841	123081
Sequatchie (153)	52124	54076	53608	53769	53371
Sevier (155)	107378	105682	105913	105682	107649
Shelby (157)	57890	57340	58877	59035	58820
Smith (159)	40269	40314	40794	41230	42480
Stewart (161)	73211	75735	76080	76221	75655
Sullivan (163)	46734	46692	46549	46425	46684
Sumner (165)	43763	43037	44183	41917	38481
Tipton (167)	28629	29284	27558	27342	27124
Trousdale (169)	14517	15740	15546	15823	15852
Unicoi (171)	44156	44105	43862	44067	43653
Union (173)	45933	46004	45847	46027	43725
Van Buren (175)	56577	56430	56671	56832	56880
Warren (177)	40863	38599	39220	39308	39475
Washington (179)	28885	27771	27835	27986	28500
Wayne (181)	146912	144134	143409	145144	144953
Weakley (183)	47266	47214	47551	47350	47480
White (185)	53600	54757	56856	56841	54781
Williamson (187)	60718	58413	57819	58512	58642
Wilson (189)	52026	55881	56917	54969	56584
Total	**5661714**	**5657153**	**5667263**	**5648093**	**5641862**

ANNEX 2:

Loss and gain of forestland (in %) by county between 2007 and 2011

County	Total change (ha) 2007-2011	Total change (%) 2007-2011	Yearly average (%) 2007-2011
Robertson (147)	-1569	-12.32%	-3.08%
Hamblen (63)	-1502	-12.30%	-3.07%
Knox (93)	-4829	-12.20%	-3.05%
Sumner (165)	-5282	-12.07%	-3.02%
Crockett (33)	-567	-11.19%	-2.80%
Coffee (31)	-5011	-9.69%	-2.42%
Loudon (105)	-1895	-8.15%	-2.04%
Grundy (61)	-5806	-8.06%	-2.01%
Greene (59)	-4870	-6.90%	-1.72%
Montgomery (125)	-3904	-6.65%	-1.66%
Polk (139)	-5615	-6.17%	-1.54%
Dickson (43)	-4196	-5.66%	-1.41%
Grainger (57)	-2474	-5.30%	-1.32%
Tipton (167)	-1505	-5.26%	-1.31%
Jackson (87)	-2801	-4.91%	-1.23%
Union (173)	-2208	-4.81%	-1.20%
Rhea (143)	-2350	-4.61%	-1.15%
Lawrence (99)	-3064	-4.17%	-1.04%
Johnson (91)	-2436	-4.02%	-1.00%
Fentress (49)	-3935	-3.95%	-0.99%
Moore (127)	-553	-3.83%	-0.96%
Campbell (13)	-3354	-3.78%	-0.95%
Williamson (187)	-2076	-3.42%	-0.85%
Warren (177)	-1388	-3.40%	-0.85%
Hawkins (73)	-2510	-3.31%	-0.83%
Marshall (117)	-1638	-3.15%	-0.79%
Franklin (51)	-2480	-3.12%	-0.78%
Cocke (29)	-2285	-2.92%	-0.73%
Benton (5)	-1943	-2.76%	-0.69%
Perry (135)	-1942	-2.47%	-0.62%
Monroe (123)	-2535	-2.32%	-0.58%
Decatur (39)	-1470	-2.24%	-0.56%
Hancock (67)	-716	-2.02%	-0.51%
Hardin (71)	-2236	-1.99%	-0.50%
McMinn (107)	-1026	-1.61%	-0.40%
Wayne (181)	-1959	-1.33%	-0.33%
Washington (179)	-385	-1.33%	-0.33%
Unicoi (171)	-503	-1.14%	-0.28%
Hamilton (65)	-724	-1.00%	-0.25%
Hickman (81)	-1236	-0.97%	-0.24%
Hardeman (69)	-668	-0.61%	-0.15%
Scott (151)	-670	-0.54%	-0.14%
Anderson (1)	-272	-0.51%	-0.13%
Maury (119)	-260	-0.48%	-0.12%
Lake (95)	-9	-0.12%	-0.03%
Sullivan (163)	-50	-0.11%	-0.03%
Rutherford (149)	-51	-0.08%	-0.02%
McNairy (109)	9	0.01%	0.00%

County	Total change (ha) 2007-2011	Total change (%) 2007-2011	Yearly average (%) 2007-2011
Giles (55)	72	0.08%	0.02%
Henderson (77)	75	0.09%	0.02%
Houston (83)	56	0.17%	0.04%
Chester (23)	120	0.25%	0.06%
Sevier (155)	271	0.25%	0.06%
Roane (145)	186	0.28%	0.07%
Cumberland (35)	575	0.43%	0.11%
Weakley (183)	214	0.45%	0.11%
Van Buren (175)	303	0.54%	0.13%
Meigs (121)	224	0.90%	0.22%
Madison (113)	675	1.04%	0.26%
Obion (131)	463	1.22%	0.30%
Carroll (17)	1087	1.32%	0.33%
Shelby (157)	930	1.61%	0.40%
Morgan (129)	1764	1.61%	0.40%
Pickett (137)	463	1.69%	0.42%
Humphreys (85)	1437	1.71%	0.43%
White (185)	1181	2.20%	0.55%
Sequatchie (153)	1247	2.39%	0.60%
Cheatam (21)	1121	2.53%	0.63%
Overton (133)	1529	2.59%	0.65%
Davidson (37)	1318	2.62%	0.66%
Lewis (101)	1929	3.02%	0.76%
Putnam (141)	1639	3.18%	0.80%
Claiborne (25)	1749	3.25%	0.81%
Stewart (161)	2444	3.34%	0.83%
Bedford (3)	1429	3.69%	0.92%
Henry (79)	2671	3.75%	0.94%
Marion (115)	4193	3.91%	0.98%
Lauderdale (97)	1609	4.27%	1.07%
De Kalb (41)	2162	4.35%	1.09%
Lincoln (103)	2347	4.63%	1.16%
Dyer (45)	829	4.83%	1.21%
Gibson (53)	1291	4.90%	1.23%
Smith (159)	2211	5.49%	1.37%
Blount (9)	5343	5.59%	1.40%
Bledsoe (7)	4283	5.69%	1.42%
Carter (19)	3378	5.95%	1.49%
Clay (27)	1861	6.03%	1.51%
Fayette (47)	4868	6.19%	1.55%
Jefferson (89)	2092	7.16%	1.79%
Macon (111)	2405	8.48%	2.12%
Haywood (75)	3044	8.68%	2.17%
Wilson (189)	4558	8.76%	2.19%
Trousdale (169)	1335	9.20%	2.30%
Cannon (15)	3373	10.41%	2.60%
Bradley (11)	2549	13.42%	3.36%
Total	**-19852**	**-0.35%**	**-0.09%**

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