

Forest sustainability in the state of Louisiana, USA

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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 Louisiana, including general condition, management and sustainability assessment.

2. Louisiana forests overview

2.1. Location and distribution

Louisiana is located in the South of the US and covers a total surface area of 134 272 km² (112 835 km² are land areas and 21 437 km² are covered by water). The State of Louisiana is bordered by Arkansas on the north and the Gulf of Mexico on the south. Mississippi borders Louisiana on the east and Texas borders Louisiana on the west. Louisiana is divided into 64 parishes in the same way that 48 of the other states of the US are divided into counties.

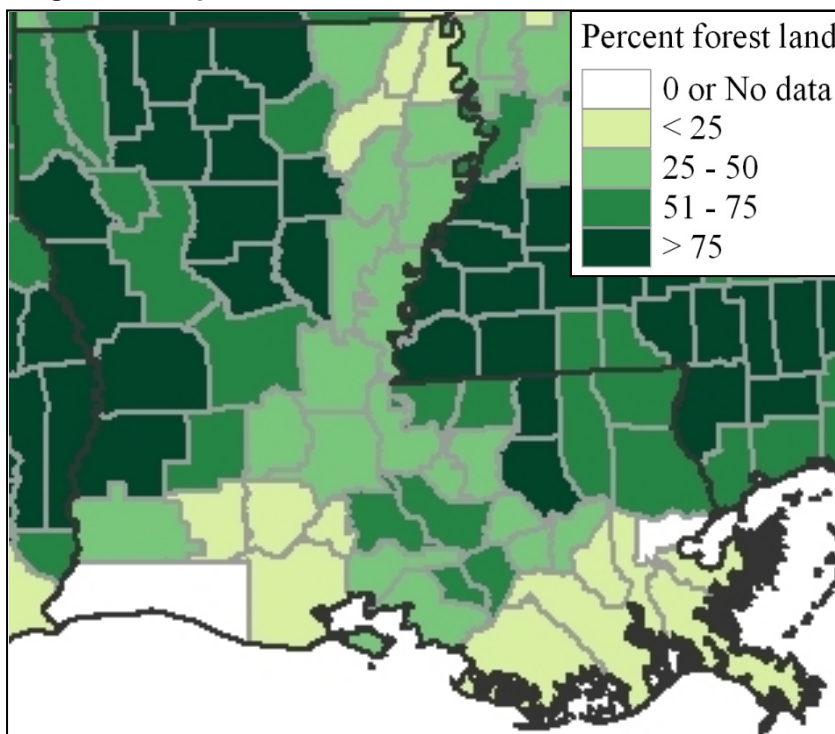
Figure 1: General maps of Louisiana



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

Nowadays, Louisiana's forest covers about 53% of the State's land area with 6.02 million ha¹. Nearly all of the forest land (99.5%) is considered available for timber production (timberland), the rest being reserved or unavailable for production. As seen on the figure below, the most forested areas are located in the western and north-western parts of the state. In 2007, half of the total number of Louisiana's parishes is estimated to be more than 50% forested.

Figure 2 : Proportion of forest land and timberland in Louisiana



Source: USDA Forest Service - Forest Inventory & Analysis (2007)
(<http://www.fia.fs.fed.us/tools-data/maps/2007/default.asp>)

2.1. Ecological zones

Louisiana contains barrier islands and coastal lowlands, large river floodplains, rolling and hilly coastal plains with evergreen and deciduous forests, and a variety of aquatic habitats.

The State is divided by 6 main ecological zones (level III ecoregions) and most of these continue into ecologically similar parts of adjacent states²:

¹ Source : situation as per 2012 Forest Inventory and Analysis, USDA – Forest service

² Source: Primary Distinguishing Characteristics of Level III Ecoregions of the Continental United States
(<http://www.hort.purdue.edu/newcrop/cropmap/ecoreg/descript.html>)

A. Western Gulf Coastal Plain (n°34 on Figure 3)

The principal distinguishing characteristics of the Western Gulf Coastal Plain are its relatively flat coastal plain topography and mainly grassland potential natural vegetation. Inland from this region the plains are older, more irregular, and have mostly forest or savanna-type vegetation potentials. Largely because of these characteristics, a higher percentage of the land is in cropland than in bordering ecological regions. Urban and industrial land uses have expanded greatly in recent decades, and oil and gas production is common.

B. South Central Plains (n°35 on Figure 3)

Locally termed the “piney woods”, this region of mostly irregular plains represents the western edge of the southern coniferous forest belt. Once blanketed by a mix of pine and hardwood forests, much of the region is now in loblolly and shortleaf pine plantations. Only about one sixth of the region is in cropland, primarily within the Red River floodplain, while about two thirds of the region is in forests and woodland. Lumber, pulpwood, oil and gas production are major economic activities.

C. Southeastern Plains (n°65 on Figure 3)

These irregular plains have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation was predominantly longleaf pine, with smaller areas of oak-hickory-pine and Southern mixed forest. The Cretaceous or Tertiary-age sands, silts, and clays of the region contrast geologically with the older metamorphic and igneous rocks of the Piedmont (45), and with the Paleozoic limestone, chert, and shale found in the Interior Plateau (71). Elevations and relief are greater than in the Southern Coastal Plain (75), but generally less than in much of the Piedmont. Streams in this area are relatively low-gradient and sandy-bottomed.

D. 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. Winters are mild and summers are hot, with temperatures and precipitation increasing from north to south. 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.

E. Mississippi Valley Loess 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.

F. Southern Coastal Plain (n° 75 on Figure 3)

The Southern Coastal Plain consists of mostly flat plains with numerous swamps, marshes and lakes. This ecoregion is warmer, more heterogeneous, and has a longer growing season and coarser textured soils than the Middle Atlantic Coastal Plain. Once covered by a forest of beech, sweetgum, southern magnolia, slash pine, loblolly pine, white oak, and laurel oak, land cover in the region is now mostly longleaf-slash pine forest, oak-gum-cypress forest in some low lying areas, pasture for beef cattle, and urban development.

The higher and contiguous hill lands of the north and northwestern part of the state have an area of more than 65 000 km². They consist of prairie and woodlands. The elevations above sea level range from 3 m at the coast and swamp lands to 15 and 18 m at the prairie and alluvial lands. In the uplands and hills, the elevations rise to *Driskill Mountain*, the highest point in the state at only 163 m above sea level.

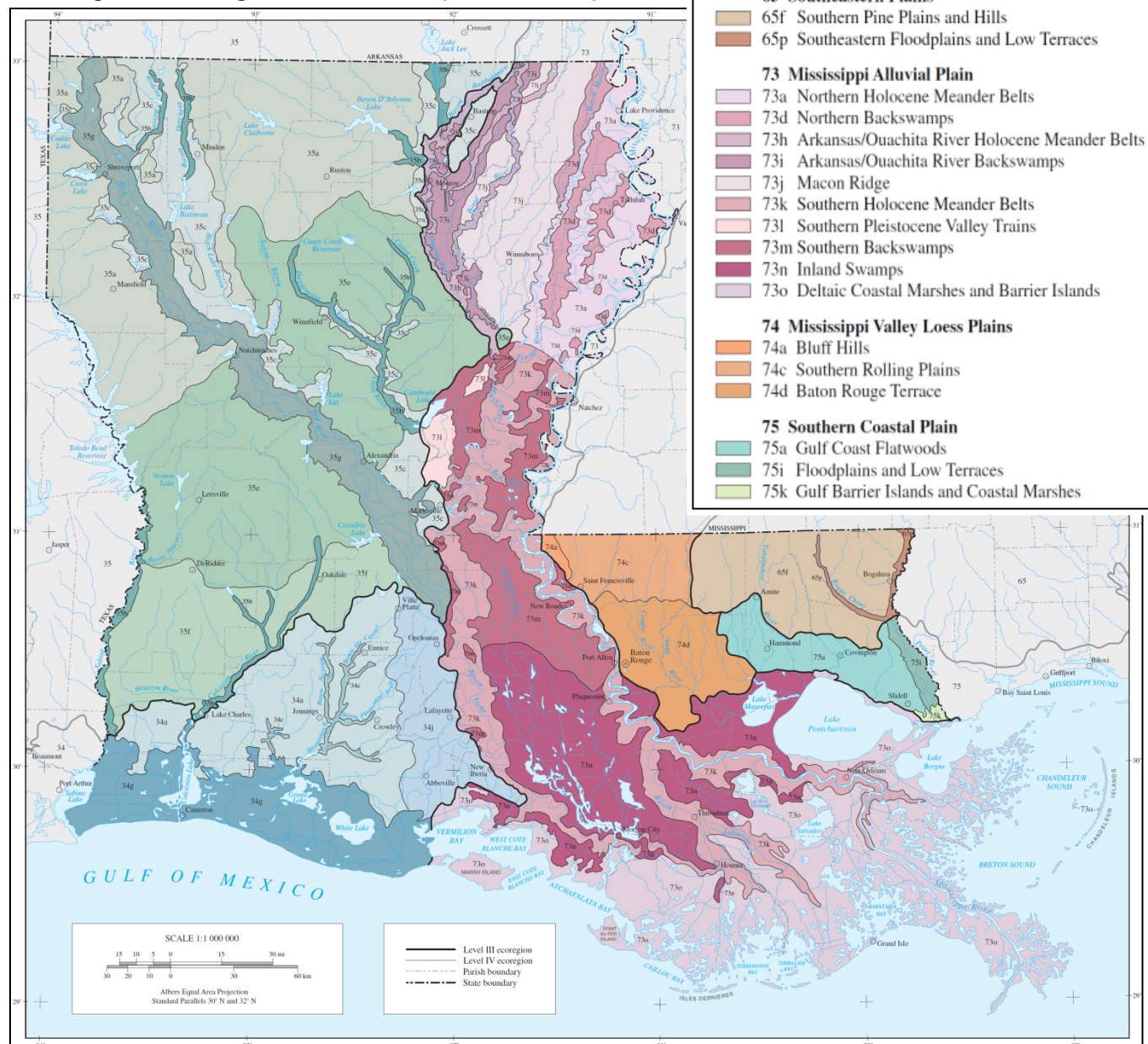
Louisiana has a subtropical humid climate with long, hot, humid summers and short, mild winters. Depending on the place, the typical high temperatures recorded in July and August are in the range 33°C to 34°C while the typical low temperatures recorded in January are in the range 2°C to 4°C³.

Depending on the place, the average precipitations range generally from 1 245 to 1 710 mm per year⁴.

³ Source : <http://www.ustravelweather.com/louisiana/>

⁴ Source : <http://average-rainfall.weatherdb.com/>

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



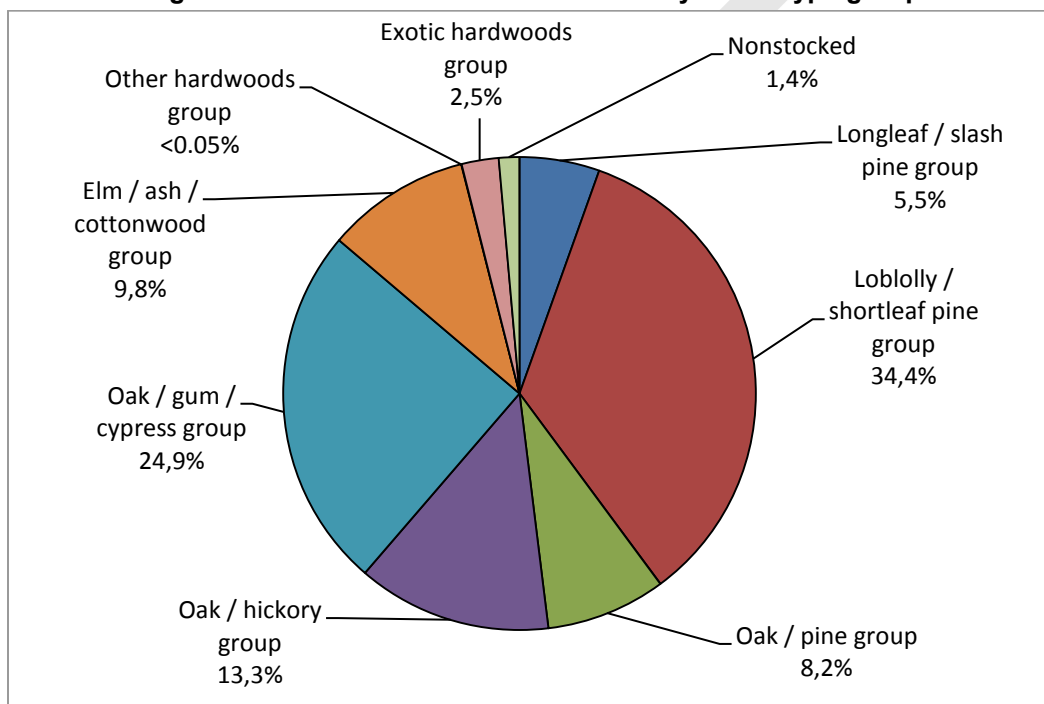
Source: Environmental Protection Agency – Western Ecology Division
(http://www.epa.gov/wed/pages/ecoregions/la_eco.htm)

2.2. Forest species

In 2012, the loblolly-shortleaf pine forest-type group occupies the largest proportion of forest land in Louisiana (34%). The next most common forest-type groups are oak-gum-cypress (25%), oak-hickory (13%), and elm-ash-cottonwood (10%). Over the past 7 years, the proportion of the different forest types has not changed significantly.

The area distribution (2012) occupied by the different species is presented on the figure and table below.

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



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

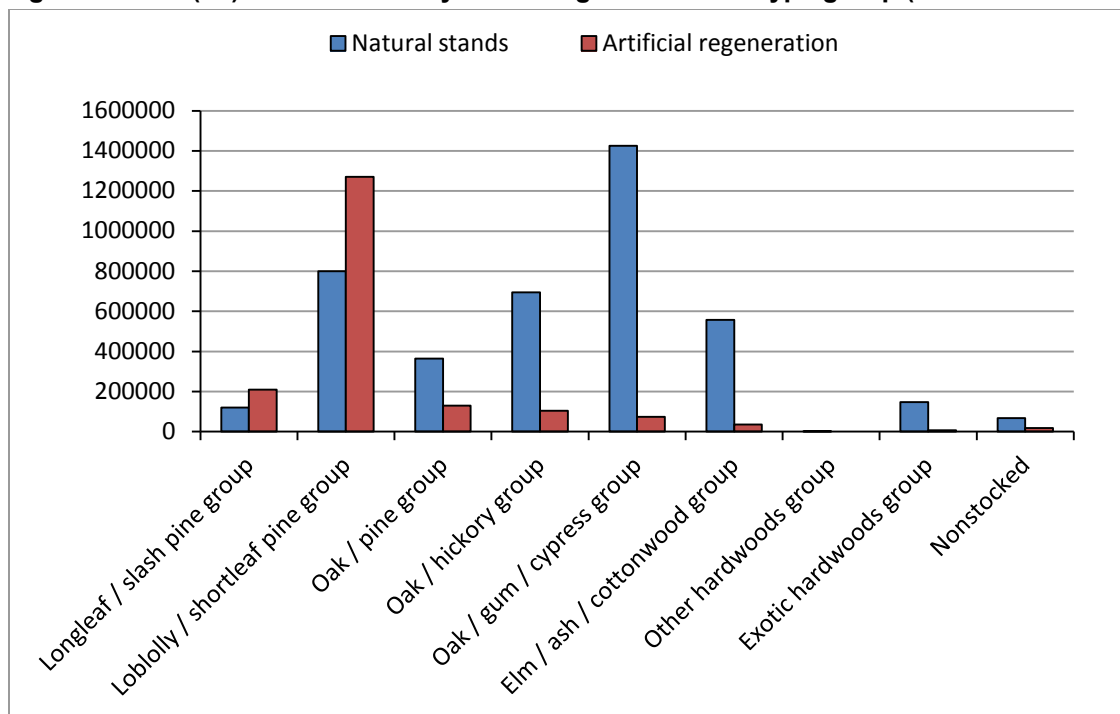
Table 1 : Area of forest land by forest-type group

Forest type group	Area (ha)	% of total forestland area
Loblolly / shortleaf pine group	2069937	34.39%
Oak / gum / cypress group	1497983	24.89%
Oak / hickory group	798462	13.27%
Elm / ash / cottonwood group	592022	9.84%
Oak / pine group	492687	8.19%
Longleaf / slash pine group	328882	5.46%
Exotic hardwoods group	153182	2.55%
Nonstocked	84557	1.40%
Other hardwoods group	682	0.01%
Total	6018394	100.00%

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

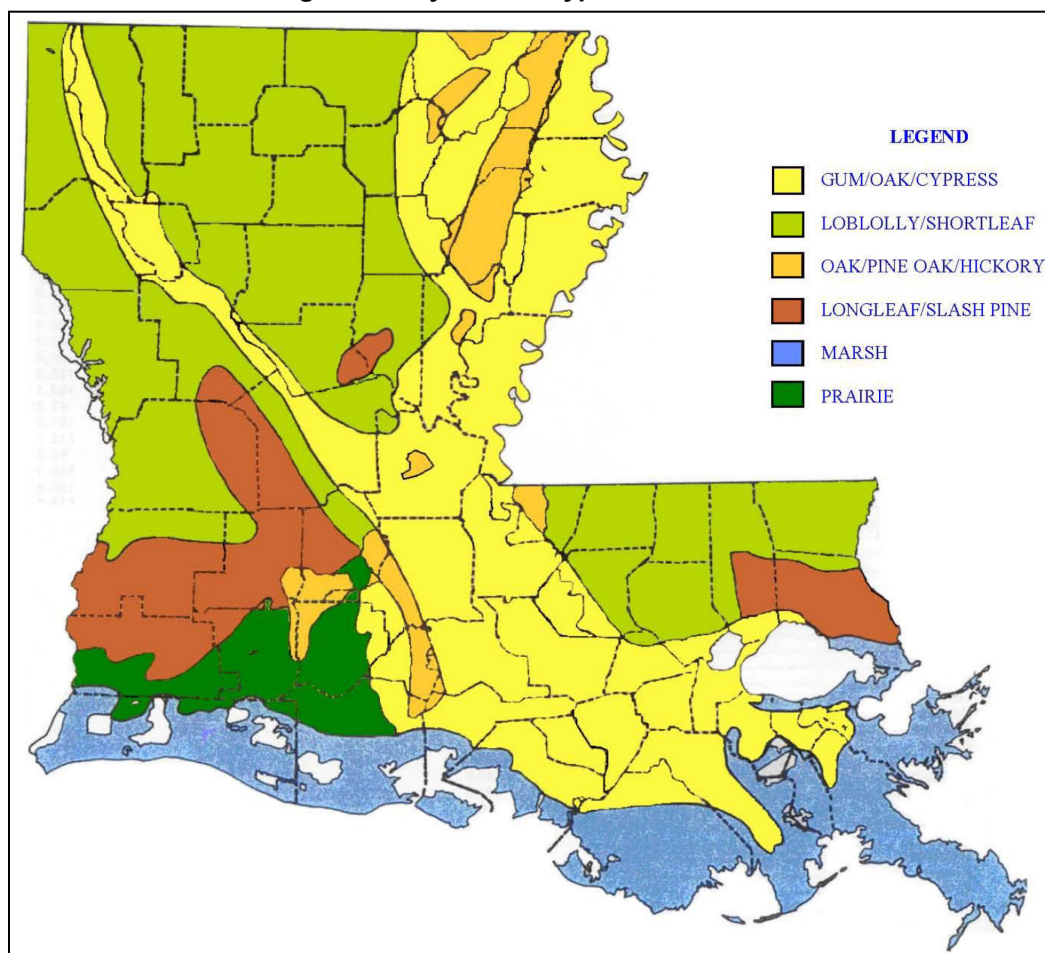
As shown in the figure below, the majority of Louisiana's forest land area is naturally regenerated. In 2012, natural stands represent 4.17 million ha of forest area against 1.84 million ha for the artificial regeneration. Except for the longleaf-slash pine and the loblolly-shortleaf pine groups, all the other forest-type groups present a largest proportion of natural stands.

Figure 5: Area (ha) of forest land by stand origin and forest-type group (Louisiana – 2012)



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

The Figure 6 shows the major forest types of Louisiana.

Figure 6: Major forest types of Louisiana

Source: Louisiana Department of Agriculture & Forestry
<http://www.ladaf.louisiana.gov/portal/Offices/Forestry/Publications/tabid/241/Default.aspx>

2.3. Forest ownership

Approximately 87% of Louisiana's forestland area is privately-owned and the 13% remaining is publicly-owned (federal, state and local public owners). Of the privately-owned land, about 70% is owned by non-industrial private sector and the remaining is owned by forest industries.

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

Table 2 : Area of forest land and timberland by ownership groups (2012)

Forest land / Ownership groups		Area (ha)		% of total forestland area
Forest Service	National forest	279701	279701	4.6%
other federal	National Park Service	5428	174383	2.9%
	Fish and Wildlife Service	88504		
	Department of Defense or Energy	64925		
	Other federal	15526		
State and local gov't	State	208839	304403	5.1%
	Local (county, municipal, etc.)	87192		
	Other non federal lands	8372		
Private	Undifferentiated private	5259909	5259909	87.4%
Total			6018396	100.0%
Timberland / Owner ship groups		Area (ha)		% of total timberland area
Forest Service	National forest	272579	272579	4.5%
Other federal	Fish and Wildlife Service	88504	168955	2.8%
	Department of Defense or Energy	64925		
	Other federal	15526		
State and local gov't	State	207289	302853	5.1%
	Local (county, municipal, etc.)	87192		
	Other non federal lands	8372		
Private	Undifferentiated private	5246759	5246759	87.6%
Total			5991146	100.0%

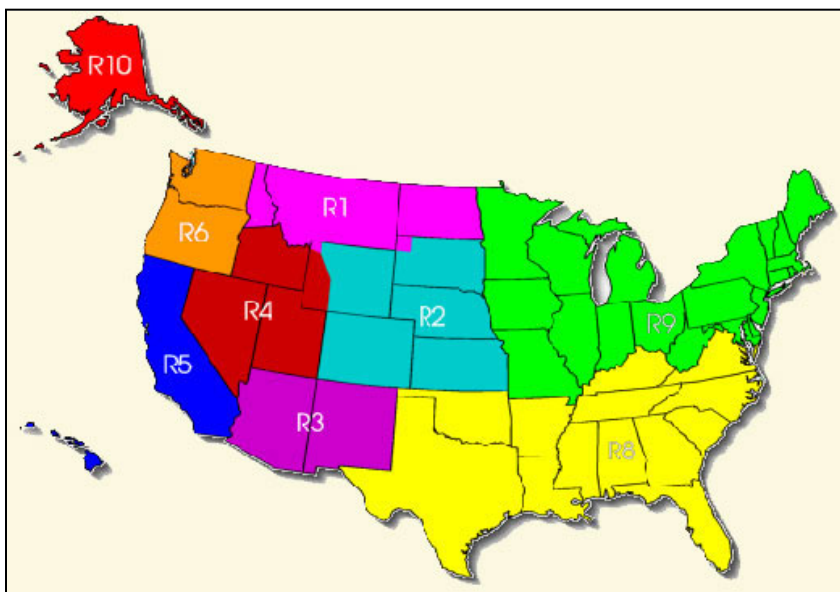
Source: adapted from US Forest service, FIA Program (<http://apps.fs.fed.us/fido/standardrpt.html>)

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"*⁵

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, Louisiana and other States like Alabama and Florida belongs to the R8 region: Southern Region.

⁵ 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 Louisiana 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 Louisiana Office of Forestry⁶ (one of the offices of the Louisiana Department of Agriculture & Forestry) is in charge of forest management. The primary responsibilities of the office are to:

- suppress timberland wildfires,
- promote sound forest management practices,
- disseminate information,
- facilitate educational programs,
- produce reforestation seedlings,
- enforce timber-related laws,
- investigate timber theft,
- assist community urban forestry programs.

The Louisiana Office of Forestry contains several services in relation with her core missions. Among these, the Forestry Enforcement Division is responsible for enforcing criminal laws pertaining to the protection of forest woodlands such as, but not limited to: arson, theft, burglary, simple criminal damage to property, etc.

The Louisiana Office of Forestry is divided in six administrative districts.

⁶ <http://www.ldaf.state.la.us/portal/Offices/Forestry/tabid/63/Default.aspx>

2.5. Overview of wood-related industry

Following the Louisiana office of Forestry, the forest products industry is the Louisiana's second largest manufacturing employment sector, with over 900 firms in 45 parishes directly employing over 25,000 people. An additional 8,000 people are employed in the harvesting and transportation of the resource.

According to a model generated by the *U.S. Department of Agriculture - Forest Service*, the total economic importance of Louisiana's forests in 2001 was calculated to be nearly \$9.4 billion⁷. The \$9.4 billion includes all activities associated with the forest products industry which includes direct, indirect, and induced effects resulting from the industry operation.

In 2002, about 60 sawmills, pulpwood mills, and other primary wood-processing plants distributed across the State directly employed more than 19 800 individuals, with an annual payroll of nearly \$722 million. In 2002, the total value of shipments for the wood products and paper manufacturing sectors combined contributed >\$6.15 billion to the State's economy⁸.

In 2009, saw logs and pulpwood were the primary roundwood products in Louisiana. The combined output of these two products totalled 13.51 million m³ and accounted for nearly 80% of the State's total industrial roundwood output⁹.

Because of the subprime crisis and its depressing effect on the construction sector, the level of activity in the wood sector was significantly reduced in Louisiana after 2005. From 2007 to 2009, timber product output from roundwood in Louisiana decreased 6.06 million m³, or 26% (Table 3). Softwood roundwood product output decreased 25%, while hardwood roundwood products decreased 33% (Figure 8). The number of mills decreased by 27% to 41, continuing a downward trend (USDA Forest service, Louisiana, 2010 – Forest Inventory & Analysis Factsheet).

Table 3 : Output of industrial products by product and species group (Louisiana, 2007 & 2009)

Product and species group	Year		Change	Change
	2007	2009		
	Thousand m ³			%
Saw logs				
Softwood	7500	3817	-3684	-49.1%
Hardwood	1438	563	-875	-60.8%
Total	8938	4379	-4558	-51.0%
Venner logs				
Softwood	3683	2260	-1422	-38.6%
Hardwood	13	19	6	44.7%
Total	3696	2279	-1417	-38.3%

⁷ USDA-Forest Service – Louisiana's Forests, 2005 – <http://www.srs.fs.usda.gov/pubs/43052>

⁸ US Department of Commerce, Bureau of the Census, 2005

⁹ USDA-Forest Service – Louisiana, 2010 – Forest Inventory & Analysis Factsheet (<http://treesearch.fs.fed.us/pubs/40582>)

Product and species group	Year		Change	Change
	2007	2009		
	Thousand m ³			%
Pulpwood ^A				
Softwood	7553	7250	-303	-4.0%
Hardwood	2243	1881	-362	-16.2%
Total	9796	9131	-666	-6.8%
Composite panels ^B				
Softwood	539	999	460	85.3%
Hardwood	3	0	-3	-100.0%
Total	542	999	457	84.2%
Other industrial				
Softwood	91	218	127	140.6%
Hardwood	0	0	0	0.0%
Total	91	218	127	140.6%
All industrial				
Softwood	19366	14544	-4822	-24.9%
Hardwood	3697	2463	-1234	-33.4%
Total	23063	17007	-6056	-26.3%

A: Includes roundwood delivered to nonpulp mills, then chipped and sold to pulpmills (40805 m³ in 2007 and 1019 m³ in 2009)

B: Composite panel volume for 2007 was under reported

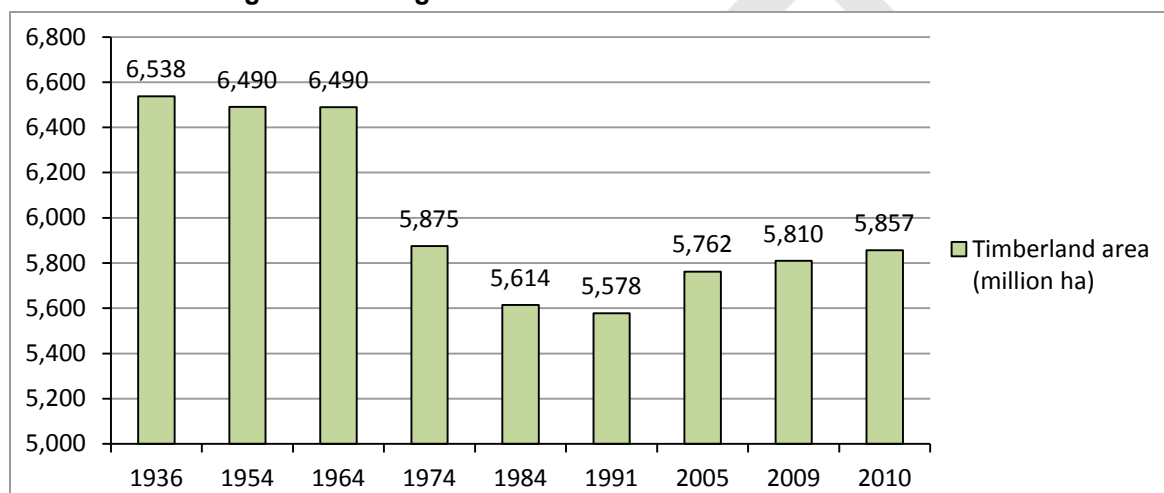
Source: adapted from USDA Forest service, Louisiana, 2010 – Forest Inventory & Analysis Factsheet

3. Sustainability of Louisiana forest

3.1. Evolution of forest area an risk of conversion

According to the inventory¹⁰ conducted in 2010 by the *U.S. Department of Agriculture Forest Service*, timberland area was in the range of 6.5 million ha between the mid-1930s and the late 1960s. From the late 1960s through the early 1980s, a time when soybean prices were peaking and many bottomland forests were being converted to agriculture, timberland area decreased by 13%. Timberland area has been increasing since the late 1990s (Figure 10).

Figure 8 : Change in timberland area over time in Louisiana



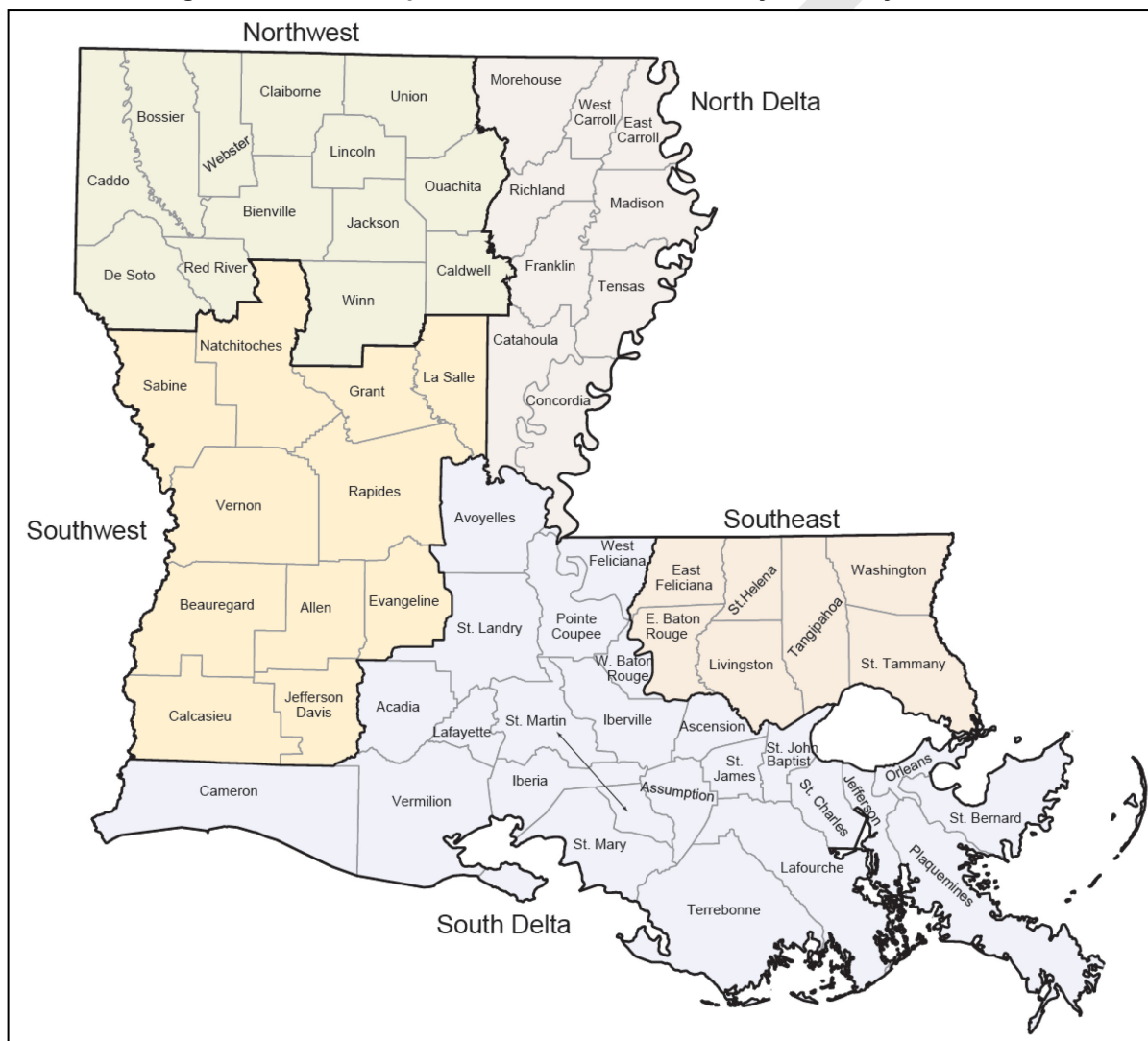
Source: adapted from Forest Inventory & Analysis Factsheet - Louisiana, 2010 – USDA, Forest Service

¹⁰ USDA-Forest Service – Louisiana, 2010 – Forest Inventory & Analysis Factsheet
<http://treesearch.fs.fed.us/pubs/40582>

For the USDA inventories, Louisiana is divided into five survey units: North and South Delta, Southwest, Southeast, and Northwest (Figure 11).

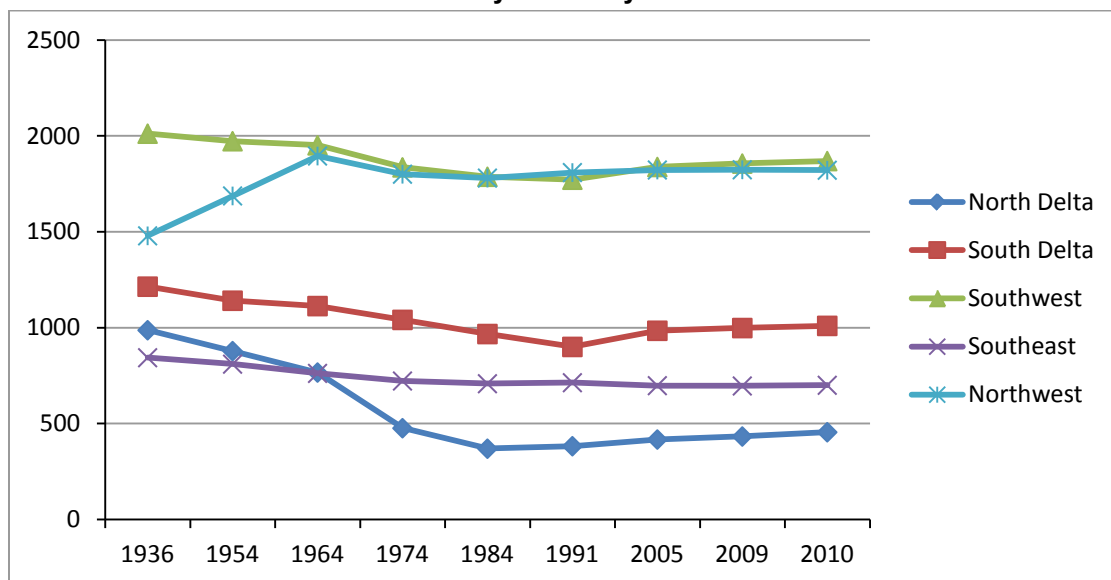
The most noticeable loss of timberland occurred in the North Delta survey unit between the mid-1960s inventory and the mid-1980s inventory. Timberland in the North Delta has either increased or remained stable in the last three inventories (Figure 12).

Figure 9 : Louisiana parishes and Forest Inventory and analysis units



Source: Source: USDA-Forest Service – Louisiana's Forests, 2005

Figure 10 : Timberland area (in thousand ha) change by year and Forest Inventory and Analysis survey unit



Source: adapted from Forest Inventory & Analysis Factsheet - Louisiana, 2010 – USDA, Forest Service

Table 4 hereafter considers the most recent information available (2012) in the *US Forest Service* database¹¹. As we can see, the forest area has been rather stable between 2008 and 2012 with however a slight increase of about 4% during this period (i.e. about 1% increase yearly on average).

Table 4: Evolution from forested area (2008-2012) and timberland (1974-2012) in Louisiana

Year	Forestland (ha)	Change (ha)	Change %	Timberland (ha)	Change (ha)	Change %
1974	-	-	-	5 875 093	-	-
1984	-	-	-	5 614 046	-261 047	-4.44%
1991	-	-	-	5 577 796	-36 250	-0.65%
2008	5 785 397	-	-	5 762 023	184 227	3.30%
2009	5 832 268	46 871	0.81%	5 809 844	47 821	0.83%
2010	5 882 687	50 419	0.86%	5 855 486	45 642	0.79%
2011	5 953 770	71 083	1.21%	5 926 872	71 386	1.22%
2012	6 018 394	64 624	1.09%	5 991 144	64 272	1.08%

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 trend of the forest areas in Louisiana, through the evolution of forest area by parish (see annex 1)¹².

¹¹ <http://apps.fs.fed.us/fido/standardrpt.html>

¹² <http://apps.fs.fed.us/fido/standardrpt.html>

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 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 Louisiana is the increase of 4.0% of the forested area between 2008 and 2012, 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 parish level annex 2 makes possible to identify parishes 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 11 parishes where the 0.5% threshold was exceeded as yearly average in the period 2008-2012 (out of the 64 parishes in Louisiana) :

- Vermilion
- Jeff Davis
- St. Charles
- W. Feliciana
- W. Baton Rouge
- St. Tammany
- Lafayette
- E. Baton Rouge
- De Soto
- E. Feliciana
- Pointe Coupee

Most significant losses of forest land are associated with urbanisation pressure in the surroundings of the most important cities in the south (New Orleans, Lafayette and Baton Rouge areas).

3.2. Living wood volumes and removals

Table 5 and Figure 14 show the evolution of net volume, by forest-type groups, of live trees in forest land for the survey years available (2008-2012) in the Forestry Inventory and Analysis (FIA) of the USDA – Forest Service¹³.

¹³ <http://apps.fs.fed.us/fido/standardrpt.html>

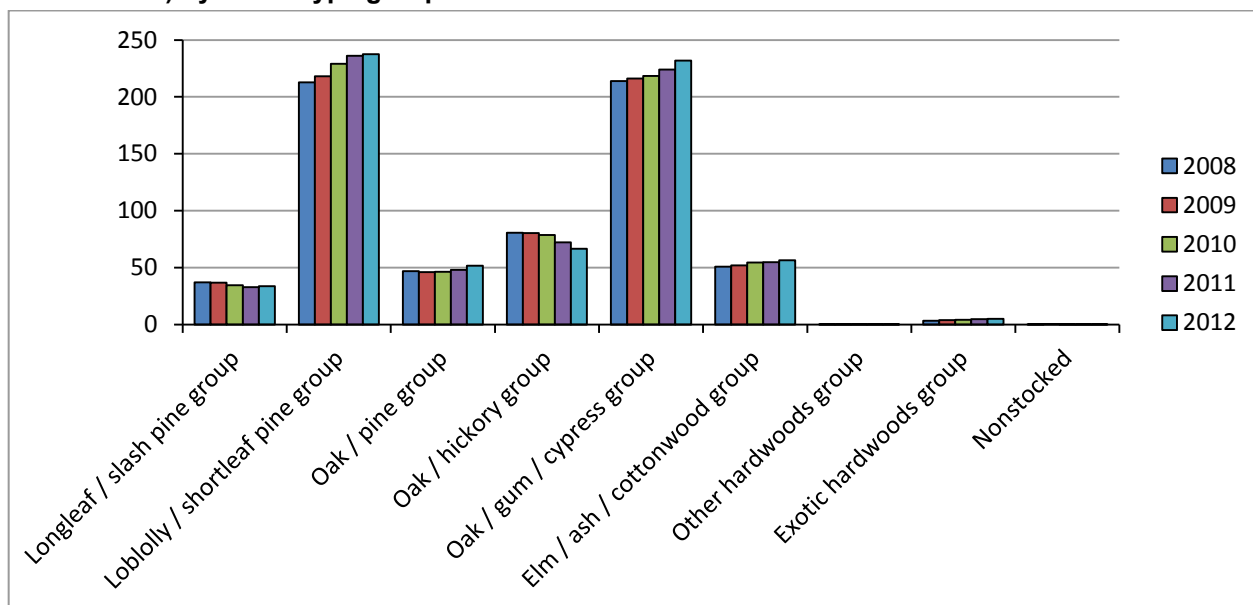
Since 2008, the net volume of live trees has increased by 5.8%. This increase is slightly more intense than the increase of forest surface during the same period (increase by about 4%), which indicates an increase of the maturity of the trees (rate of removals is slower the rate of forest growth). Table 5 also indicates that most of the increase in volume is due to loblolly pine, which is often planted (instead of naturally regenerated) and managed more intensively. Oak/gumtree/cypress group of forest types does also show an clear augmentation in terms of volumes of living trees.

Table 5: Net volume of live trees in forest land (at least 5 inch d.b.h./d.r.c.), in million m³, by forest-type groups and survey years

Forest-type groups	2008	2009	2010	2011	2012	Change 2008-2012	
	Mm m ³	Mm m ³	Mm m ³	Mm m ³	Mm m ³	Mm m ³	%
Longleaf / slash pine group	37	36.8	34.4	32.9	33.8	-3.2	-8.80%
Loblolly / shortleaf pine group	212.7	218	228.9	235.9	237.5	24.7	11.60%
Oak / pine group	46.8	46.1	46.4	48	51.8	5	10.70%
Oak / hickory group	80.7	80.5	78.5	72.1	66.6	-14.1	-17.40%
Oak / gum / cypress group	213.7	216.2	218.2	224	231.9	18.1	8.50%
Elm / ash / cottonwood group	50.7	51.9	54.4	54.8	56.5	5.8	11.50%
Other hardwoods group	0.2	0.2	0.1	0.1	0.01	-0.2	-93.10%
Exotic hardwoods group	3.2	3.7	4	4.7	4.9	1.6	51.00%
Nonstocked	0.3	0.4	0.3	0.2	0.2	-0.1	-32.90%
Total	645.5	653.9	665.4	672.9	683.3	37.8	5.80%

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

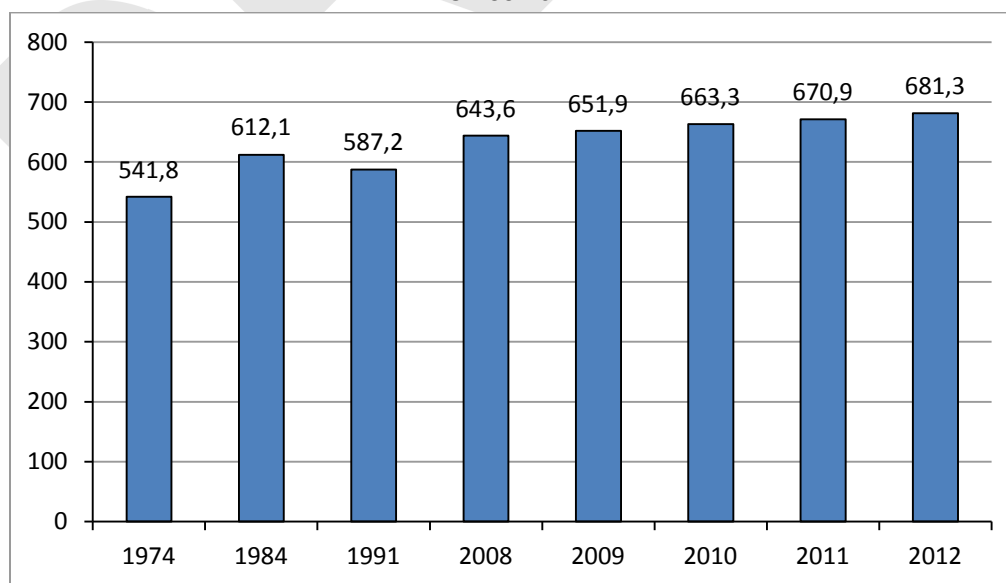
Figure 11 : Evolution (2008-2012) in million m³ of live trees on forest land (at least 5 inch d.b.h./d.r.c.) by forest-type group



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

As oldest data are available regarding timberland in the FIA, figure below show the evolution of net volume of live trees since 1974. Except a slight decrease between 1984 and 1991, we can observe a yearly average in consistent increase over the past 30 years.

Figure 12 : Net volume of live trees in timberland (at least 5 inch d.b.h./d.r.c.), in million m³ since 1974

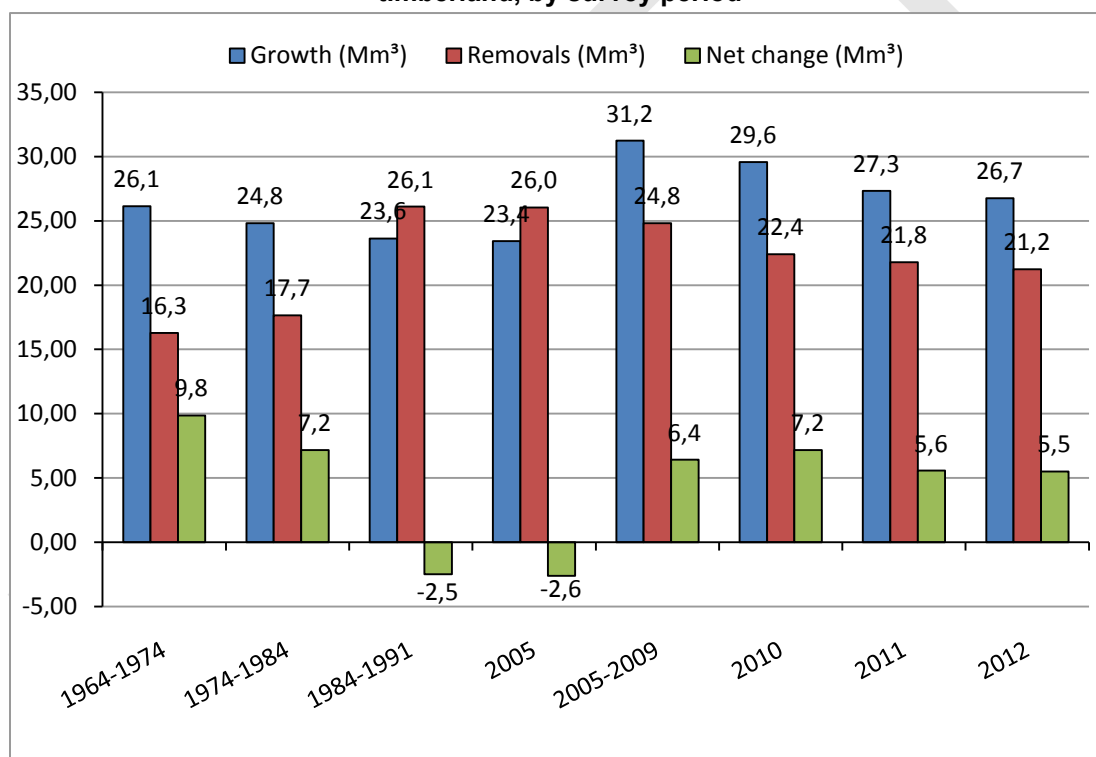


Source: adapted from USDA – Forest Service (<http://apps.fs.fed.us/fido/standardrpt.html>)

According to the USDA – Forest Service, in 2012, the net annual growth of growing-stock volume averaged 26.7 million m³, annual mortality 6.5 million m³ and annual removals 21.4 million m³ on timberland. The data covering the period between 1964 and 2012 is presented on the following figures.

We can see on the Figure 16 that the net growth (for all species combined) has exceeded removals after 2005. Since 2006, the annual balance (net change) has been consistently positive), which is consistent with the above described increase in forest surface and in inventory volumes. The negative trend observed between 1984 and 2005 can be explained by the diversions from timberland to other land uses like urban development or agriculture or reclassification of timberland to reserved forest land.

Figure 13 : Average net annual growth VS Removals (Harvests) of growing stock on timberland, by survey period



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 6, the conservation land in Louisiana covers 1 054 555 ha, which is about 7.8% of the state area. This includes both public and private land, under various conservation statuses.

Figure 17 shows an overview of all protected areas in Louisiana. Those protected areas are either public (federal, state, county or local) and private lands.

Table 6: Land under protection status in Louisiana (as of 2011)

	Status 1	Status 2	Status 3	Total
Acres	117 602	1 123 413	1 364 847	2 605 862
Ha	47 592	454 629	552 334	1 054 555
Percentage of state area	0.3%	3.4%	4.1%	7.8%

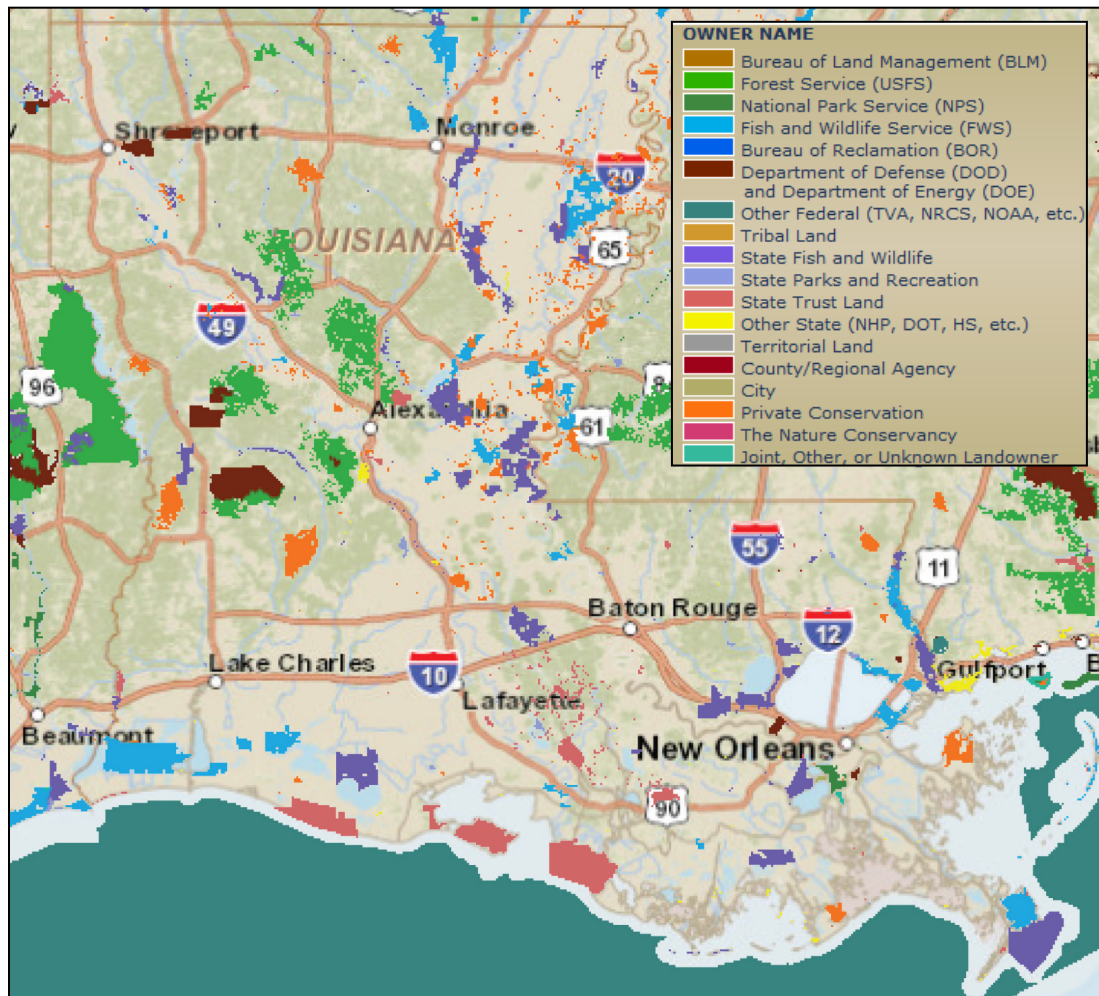
Source: USGS Gap analysis <http://gapanalysis.usgs.gov/>

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 17 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.

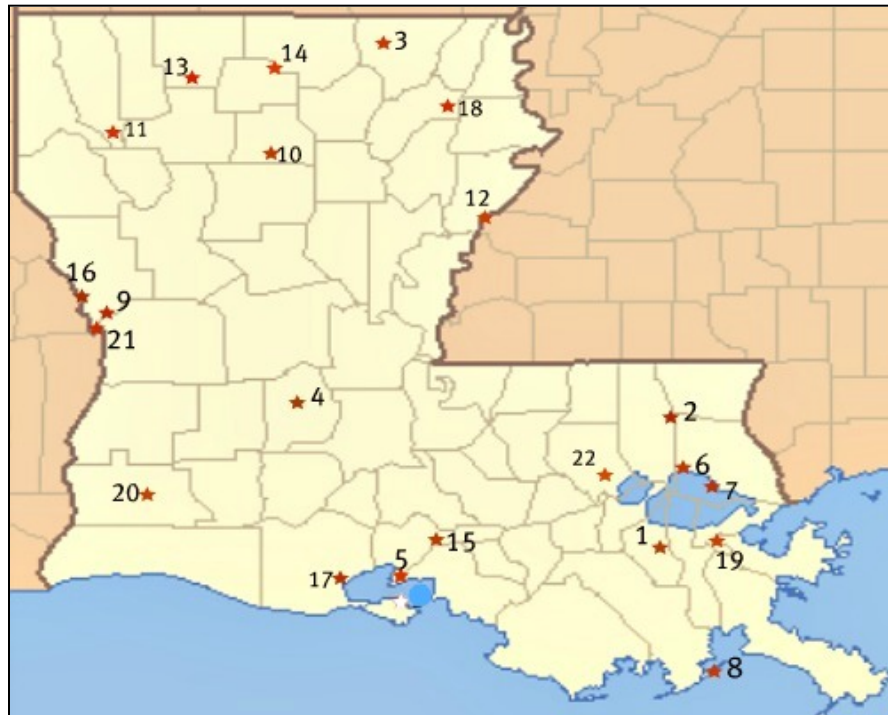
Figure 14 : Protected areas in Louisiana

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

Louisiana has 22 State Parks. Figure 18 shows the location of State parks in Louisiana.

Figure 20 shows the location of national parks in Louisiana.

Figure 15 : State Parks in Louisiana



Source: <http://www.american-state-parks.com/LouisianaStateParks.html>

Figure 16 : National parks in Louisiana



Source: <http://usparklocator.com/blpkla.htm>

Table 7 shows the new surfaces put into conservation between 1998 and 2005. Unfortunately no more recent statistics are available at this time regarding the new land put into conservation.

Table 7: New land under conservation status per year in Louisiana (1998-2005)

Year	1998	1999	2000	2001	2002	2003	2004	2005	Total
Acres	2191.4	1493.8	4905.5	5696.3	3758.5	3651.8	254.7	6042.5	27994.5
ha	886.8	604.5	1985.2	2305.2	1521.0	1477.8	103.1	2445.3	11329.0

Source : <http://www.conservationalmanac.org>

The increase of conserved lands shows a very irregular pattern. The total newly conserved land recorded between 1998 and 2005 accounts for about an increase by 2% of the conserved land in the state.

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

The most important programs are described hereunder¹⁴:

- **The Duck Stamp Fund** provides revenue through the sale of hunting and fishing licenses to acquire land for migratory waterfowl habitat.
- **The Wildlife Habitat and Natural Heritage Trust Fund** was established (In1988), to acquire land in order to conserve critical habitat for wildlife and unique natural areas. These funds are derived from a severance tax on offshore oil drilling in the Gulf of Mexico. The tax also funds the Wetland Conservation and Restoration Trust Fund for the development and implementation of a program to help conserve and restore state coastal vegetated wetlands.
- **The Louisiana Office State Parks** was created (in 1934). Prior to 1975, funding for land acquisition was derived from general appropriations through the state legislature. After 1975, funding has been provided through state general obligation bonds. The office of state parks currently uses user fees for major repairs and improvements to parks.
- **The Forest Legacy Program (FLP)**¹⁵ supports State efforts to protect environmentally sensitive forest lands. Designed to encourage the protection of privately owned forest lands, FLP is an entirely voluntary program. To maximize the public benefits it achieves, the program focuses on the acquisition of partial interests in privately owned forest lands. FLP helps the States develop and carry out their forest conservation plans.

¹⁴ <http://www.conservationalmanac.org/secure/almanac/southeast/la/programs.html>

¹⁵ <http://www.ldaf.state.la.us/portal/Offices/Forestry/ForestManagement/ForestLegacyProgram/tabid/234/Default.aspx>

- **The Coastal and Estuarine Land Conservation Program**¹⁶ provides support to state and local governments to purchase coastal and estuarine lands that are important for their ecological, conservation, recreational, historical or aesthetic values and are under threat of conservation.
- **The Conservation Reserve Program (CRP)**¹⁷ 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 Environmental Quality Incentives Program (EQIP)**¹⁸ is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland.
- **The Wildlife Habitat Incentives Program (WHIP)**¹⁹ is a voluntary program that can assist conservation minded landowners in developing and improving wildlife habitat on private land. In Louisiana, the primary focus of WHIP is to improve early successional grassland and forestland habitats for declining species and other wildlife.
- **The Landowner Incentive Program (LIP)**²⁰, administered by the US Fish and Wildlife Service and implemented through state fish and wildlife agencies, provides an important tool in engaging private landowners in active habitat conservation.

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

¹⁶ <http://coastalmanagement.noaa.gov/land/>

¹⁷ <http://www.nrcs.usda.gov/wps/portal/nrcs/main/la/programs/>

¹⁸ <http://www.nrcs.usda.gov/wps/portal/nrcs/main/la/programs/>

¹⁹ <http://www.nrcs.usda.gov/wps/portal/nrcs/main/la/programs/>

²⁰ <http://www.wlf.louisiana.gov/>

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...).

The Louisiana Office of Forestry and the Louisiana Forestry Association are in charge of implementing Louisiana's forestry best management practices and have developed programs to guide forest landowners, managers and timber harvesters toward voluntary compliance with the CWA.

The Louisiana Forestry Association, Louisiana Department of Agriculture and Forestry (LDAF), Louisiana Department of Environmental Quality and the Louisiana State University Agricultural Center have taken on the task of training landowners, managers and timber harvesters in the use of BMP and conducting surveys on the implementation and effectiveness of forestry BMP.

In Louisiana, the "Recommended Forestry Best Management Practices"²¹ was developed in 1998 (revised in 2000) by the Louisiana Department of Agriculture and Forestry. The topics covered by the BMP:

- Planning for forest operations
- Forest roads
- Timber harvesting
- Site preparation and reforestation
- Silvicultural chemicals
- Fire management
- Forest wetlands
- Natural & scenic rivers

In Southeast USA, there are specific arrangements for the site preparation before establishing pine plantations on wetlands²². 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 assessment in the state of Louisiana was performed in 2009 (Forestry Best Management Practice-2009-Results²³). This 2009 survey found that only 73.5% of 151 surveyed forestry operations fully implement Louisiana BMP, which was lower than the reported 96% in the 2002 survey and calculated 96% in the 2000 survey.

The 2009 survey data suggest most problems with BMP implementation occurred on private, non-industrial mixed pine/hardwood forests with regard to 'erosion control' and 'Streamside Management

²¹ <http://www.ldaf.state.la.us/portal/Portals/0/FOR/for%20mgmt/BMP.pdf>

²² <http://water.epa.gov/lawsregs/guidance/wetlands/silv2.cfm>

²³ <http://www.ldaf.state.la.us/portal/Portals/0/FOR/for%20mgmt/BMPsummary2009.pdf>

zones', specifically for these 2 guidelines (other types of BMP guidelines were consistently highly implemented across sites) :

- Seeding and/or mulching performed when necessary,
- Skid trails, temporary road crossing, or landings conditioned to minimize erosion by seeding and/or installing waterbars.

These 2 guidelines also were problematic in the 2000 survey. Potentially several factors could be influencing these data :

- Economic downturns in 2000 and 2009 could have led to cost cutting and profit maximizing measures,
- The 2009 survey could have been strongly influenced by salvage logging following the 2005 and 2008 hurricanes.

A new question was added to the survey in 2009 questioning whether a site had significant water quality risk. Only 2.6% (4 of 150 surveyed sites) were deemed by LDAF foresters to have significant water quality risk.

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 Louisiana. It includes considerations of soil in the following topics:

- forest roads (location, construction, maintenance, planning and water crossings)
- timber harvesting (streamside management, skidding, landings, revegetation)
- site preparation & reforestation
- silvicultural chemicals (pesticides and fertilizers)
- fire management (prescribed burning, fireline, wildfire)
- forest wetlands (mandatory roads, site preparation, reforestation, forest chemicals)
- natural & scenic rivers (permit requirements)

As described under section 3.4, it appears that the BMP implementation's rate is not at an optimal level based on the 2009 compliance survey, specifically for a guideline related to erosion control, with only 73.5% of compliance in the operations surveyed in 2009.

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 consistently increasing in Louisiana over the last three decades. Forest land and timberland areas have been increasing as well since the 1990s. In this context, the sequestered carbon stock in living biomass has increased.

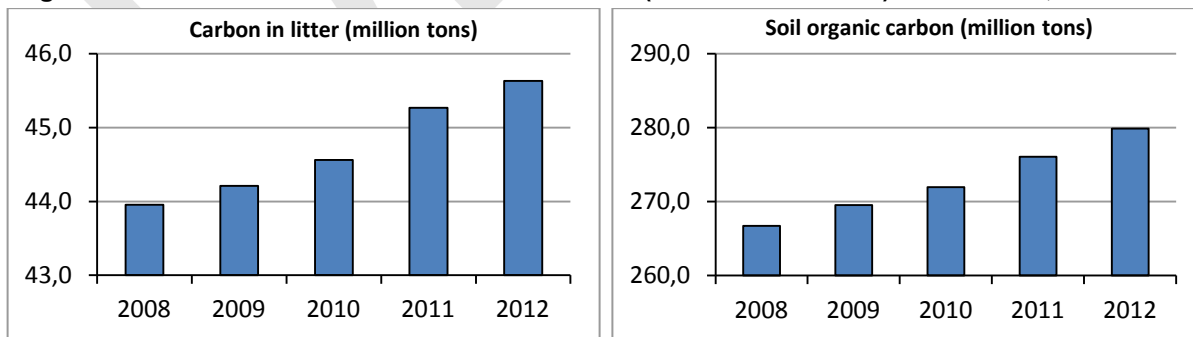
As shown in the Table 8 and related Figure 21 (data from the US Forest service (FIA Program)), we can see a constant increase of carbon stocks regarding the living above/below ground woody biomass, the litter and the soil organic carbon since 2008.

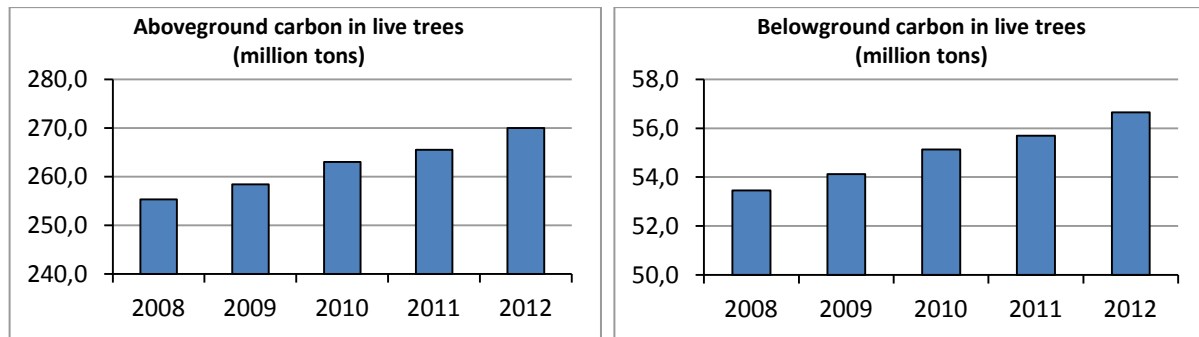
Table 8: Carbon stocks evolution in forestland – (Louisiana 2008-2012)

Year	Carbon in litter (short tons)	Soil organic carbon (short tons)	Belowground carbon in live trees (at least 1 inch d.b.h./d.r.c.) (short tons)	Aboveground carbon in live trees (at least 1 inch d.b.h./d.r.c.) (short tons)
2008	43 956 460	266 740 494	255 354 783	53 460 289
2009	44 209 505	269 552 041	258 434 195	54 125 683
2010	44 564 616	271 950 596	262 984 784	55 134 062
2011	45 268 577	276 090 722	265 538 732	55 695 632
2012	45 633 445	279 866 887	269 976 509	56 652 499

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

Figure 17 : Carbon stocks evolution in forestland (accessible forests) – Louisiana, 2008-2012





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 Louisiana forestry ("prescribed burning"), and can have different objectives:

- Prepare sites before seeding and planting
- Reduce hazardous fuels under tree stands to prevent wildfires
- Improve wildlife habitat
- Manage competing vegetation
- Control insects and disease
- ...

The BMP describes appropriate use of fire and prevention of wildfires, including appropriate implementation of fireline construction and maintenance.

The use of fire is subject to permit issued by the Louisiana Department of Agriculture and Forestry which coordinates all forestry burning with the division of Air Quality (Department of Environmental Quality).

In order to assure adherence to air quality regulations and manage smoke from prescribed burning operations, the State of Louisiana developed the "Louisiana Smoke Management Program (SMP)" and "Voluntary smoke management guidelines"²⁴.

The basic framework of a SMP consists of six elements that must be addressed: authorization, minimizing air pollutant emissions, smoke management components, air quality monitoring, public education and awareness, surveillance and enforcement, and program evaluation.

²⁴ <http://www.idaf.state.la.us/portal/Offices/Forestry/ForestProtection/tabid/135/Default.aspx>

Occasionally, during periods of relatively stagnant air, the Environmental Protection Agency and/or the Louisiana Department of Environmental Quality can forecast or issue an 'Ozone Action Day'. When an 'Ozone Action Day' is forecasted, burn managers are asked not to ignite any new fires and to complete any fires burning at the time the 'Ozone Action Day' is declared.

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 ²⁵
- 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 ²⁶
- 1.3 There is little or no evidence or reporting of illegal harvesting in the district of origin ²⁷
- 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 ²⁸

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 Louisiana are:

²⁵ www.illegal-logging.info ; www.eia-international.org ; <http://www.ahec-europe.org/>

²⁶ www.illegal-logging.info ; www.eia-international.org ; <http://www.ahec-europe.org/>

²⁷ www.illegal-logging.info ; www.eia-international.org ; <http://www.ahec-europe.org/>

²⁸ <http://www.transparency.org/cpi2012/results>

- SFI (Sustainable Forestry Initiative²⁹), which is endorsed by PEFC (Programme for the Endorsement of Forest Certification)
- ATFS (American Tree Farm System³⁰), which is specifically suitable for small private owners
- FSC (Forest Stewardship Council³¹), which is represented in more than 50 countries.

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

Table 9: Certified forest land in Louisiana (2011)

	SFI	FSC	ATFS	Total certified
Acres certified	3 129 004	603 584	1 805 888	5 538 476
Ha certified	88604	17092	51137	156833
Percentage forests	22.00 %	4.24 %	12.70%	38.94%

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

4. Conclusions

Louisiana has an important forest that covers about 53% of the state. Most of this forest is privately owned (87%).

The loblolly-shortleaf pine forest-type group occupies the largest proportion of forest land in Louisiana (34%). The next most common forest-type groups are oak-gum-cypress (25%), oak-hickory (13%), and elm-ash-cottonwood (10%).

From the late 1960s through the early 1980s, many bottomland forests were being converted to agriculture and timberland area decreased by 13%. Since the late 1990s, timberland area has been consistently increasing. Between 2008 and 2012, an increase of about 4% of forest area has been recorded (i.e. about 1% increase yearly on average).

Regarding the net volume of live trees in timberland, except a slight decrease between 1984 and 1991, we can observe a yearly average in constant increase over the past 30 years. The trend observed between 2008 and 2012 corresponds to an increase of 5.8% during this period. A large share of the increase in living wood volumes concerns the loblolly pine.

²⁹ <http://www.sfiprogram.org>

³⁰ <https://www.treefarmssystem.org>

³¹ <https://www.us.fsc.org>

Because of the increase of the volume of standing trees, the carbon stocks associated to living above ground and below ground woody biomass also shows an increase over the last decade. The litter and the soil organic matter also show the same trend.

Louisiana 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 good compared to other states in the South East (7.8%) and the recent trend shows an increase at a very slow pace (only 2% increase between 1998 and 2005). A number of conservation schemes have been introduced recently to increase the conservation land in Louisiana, including initiatives to encourage conservation on private land (which is particularly important given the proportion of private forests in Louisiana).

Louisiana has developed Best Management Practices (BMP) for forestry to comply with the Clean Water Act. Those BMP address both water and soil conservation. The Louisiana Office of Forestry and the Louisiana Forestry Association are the leaders in implementing Louisiana's BMP. The most recent survey (2009) found 73.5% of 151 surveyed forestry operations fully implement Louisiana BMP. The survey data suggest most problems with BMP implementation occurred on private, non-industrial mixed pine/hardwood forests with regard to 'erosion control' and 'Streamside Management zones'.

Even though controlled fires are often used in forest management practices in Louisiana, the use of fire is strongly regulated and fire is banned from specific places during periods of relatively stagnant air in order to respect the air quality standards.

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 rather developed in Louisiana, with just under 40% of forest certified under one of the 3 systems SFI, ATFS and FSC.

ANNEX 1:**Forest area in Louisiana by parish (forest area in ha) from 2008 to 2012**

Parish	2008	2009	2010	2011	2012
Acadia	44053	45361	48903	46950	47515
Allen	163466	163381	163231	161087	162793
Ascension	31318	31995	31832	30318	31717
Assumption	42013	43840	43250	44840	45506
Avoyelles	101452	108901	108396	106301	108592
Beauregard	243604	245822	244021	247402	247927
Bienville	181907	180912	180800	184447	183738
Bossier	150033	153245	155334	156547	158440
Caddo	111660	114730	113506	115488	122164
Calcasieu	101000	103654	110020	116563	112481
Caldwell	111538	113956	111713	111275	110055
Cameron	0	1795	1828	4261	4246
Catahoula	69451	71951	74406	74406	73343
Claiborne	163298	160606	161450	162741	164919
Concordia	75186	75154	79261	88465	96641
De Soto	168063	165058	167486	168146	163090
E. Baton Rouge	48388	47130	44988	44724	46661
E. Carroll	18700	18724	23592	24852	26518
E. Feliciana	82621	81857	82205	81849	80411
Evangeline	85970	85744	88188	89393	89821
Franklin	30998	33461	35824	36292	39094
Grant	125400	125268	126460	126246	125260
Iberia	36456	38489	38854	40692	44666
Iberville	114628	117939	118382	118963	124704
Jackson	150912	150386	149063	152760	152753
Jefferson	6037	5949	7956	7805	8513
Jeff Davis	22786	20192	20417	18160	18125
Lafayette	9079	8533	8682	8596	8560
Lafourche	39086	38417	34673	37324	40863
La Salle	140118	140085	143209	143610	142574
Lincoln	98610	99480	99207	97908	100694
Livingston	119628	121545	123415	124471	127034
Madison	48361	53176	56955	56955	63835
Morehouse	85249	86666	87755	92755	90008
Natchitoches	247232	252428	252552	252906	252952
Orleans	0	0	0	2767	2590

Parish	2008	2009	2010	2011	2012
Ouachita	88828	88455	91021	93440	92346
Plaquemines	9503	9471	9330	12254	12525
Pointe Coupee	76613	74872	71934	72135	74916
Rapides	228428	236224	235481	236229	234288
Red River	66784	67193	66589	70185	72887
Richland	25348	27765	27446	25961	26781
Sabine	189338	193296	192196	190289	194757
St. Bernard	5832	6263	6224	5670	5745
St. Charles	36391	32943	33093	31984	32034
St. Helena	71785	74805	77243	78895	77900
St. James	30769	30104	32363	32117	34776
St. John Bapt.	24867	24371	24152	26293	25370
St. Landry	89700	89148	91170	91885	89878
St. Martin	99085	100859	102292	106849	113394
St. Mary	60113	64349	68245	66854	67436
St. Tammany	128921	123954	122363	120061	121319
Tangipahoa	124994	127665	127581	127843	129021
Tensas	50846	53238	54213	61326	71942
Terrebonne	36275	32798	32320	36936	39193
Union	187871	186598	186036	189280	189909
Vermilion	10249	8754	10553	10094	6477
Vernon	297390	296541	299588	305297	311907
Washington	123850	123663	126167	126271	123567
Webster	108097	108758	110030	111733	113465
W. Baton Rouge	22407	21934	20366	19287	19895
W. Carroll	13620	13479	16368	15173	19488
W. Feliciana	71789	71878	74014	73946	63328
Winn	237404	237063	236493	237217	235048
Totals :	5785397	5832268	5882687	5953770	6018394

ANNEX 2:**Loss and gain of forestland (in %) by county between 2008 and 2012**

Parish	Total change (ha) 2008-2012	Total change (%) 2008-2012	Yearly average (%) 2008-2012
Vermilion	-3772	-36.80%	-9.20%
Jeff Davis	-4661	-20.46%	-5.11%
St. Charles	-4357	-11.97%	-2.99%
W. Feliciana	-8461	-11.79%	-2.95%
W. Baton Rouge	-2512	-11.21%	-2.80%
St. Tammany	-7602	-5.90%	-1.47%
Lafayette	-519	-5.72%	-1.43%
E. Baton Rouge	-1727	-3.57%	-0.89%
De Soto	-4973	-2.96%	-0.74%
E. Feliciana	-2210	-2.67%	-0.67%
Pointe Coupee	-1697	-2.22%	-0.55%
St. Bernard	-87	-1.49%	-0.37%
Caldwell	-1483	-1.33%	-0.33%
Winn	-2356	-0.99%	-0.25%
Allen	-673	-0.41%	-0.10%
Washington	-283	-0.23%	-0.06%
Grant	-140	-0.11%	-0.03%
St. Landry	178	0.20%	0.05%
Claiborne	1621	0.99%	0.25%
Bienville	1831	1.01%	0.25%
Union	2038	1.08%	0.27%
Jackson	1841	1.22%	0.30%
Ascension	399	1.27%	0.32%
La Salle	2456	1.75%	0.44%
Beauregard	4323	1.77%	0.44%
St. John Bapt.	503	2.02%	0.51%
Lincoln	2084	2.11%	0.53%
Natchitoches	5720	2.31%	0.58%
Rapides	5860	2.57%	0.64%
Sabine	5419	2.86%	0.72%
Tangipahoa	4027	3.22%	0.81%
Ouachita	3518	3.96%	0.99%
Evangeline	3851	4.48%	1.12%
Lafourche	1777	4.55%	1.14%
Vernon	14517	4.88%	1.22%
Webster	5368	4.97%	1.24%

Parish	Total change (ha)	Total change (%)	Yearly average
Morehouse	4759	5.58%	1.40%
Bossier	8407	5.60%	1.40%
Catahoula	3892	5.60%	1.40%
Richland	1433	5.65%	1.41%
Livingston	7406	6.19%	1.55%
Avoyelles	7140	7.04%	1.76%
Acadia	3462	7.86%	1.96%
Terrebonne	2918	8.04%	2.01%
Assumption	3493	8.31%	2.08%
St. Helena	6115	8.52%	2.13%
Iberville	10076	8.79%	2.20%
Red River	6103	9.14%	2.28%
Caddo	10504	9.41%	2.35%
Calcasieu	11481	11.37%	2.84%
St. Mary	7323	12.18%	3.05%
St. James	4007	13.02%	3.26%
St. Martin	14309	14.44%	3.61%
Iberia	8210	22.52%	5.63%
Franklin	8096	26.12%	6.53%
Concordia	21455	28.54%	7.13%
Plaquemines	3022	31.80%	7.95%
Madison	15474	32.00%	8.00%
Jefferson	2476	41.01%	10.25%
Tensas	21096	41.49%	10.37%
E. Carroll	7818	41.81%	10.45%
W. Carroll	5868	43.08%	10.77%
Cameron	-	-	-
Orleans	-	-	-
Total:	232997	4.03%	1.01%

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