

The background of the slide features a light green, semi-transparent lotus flower pattern. There are three distinct lotus flowers: one in the upper left, a larger one in the center, and one in the lower right. The overall color scheme is a soft, pale green.

# **Forest ecosystem services assessment in China**

**Research Project Group**

# Outline

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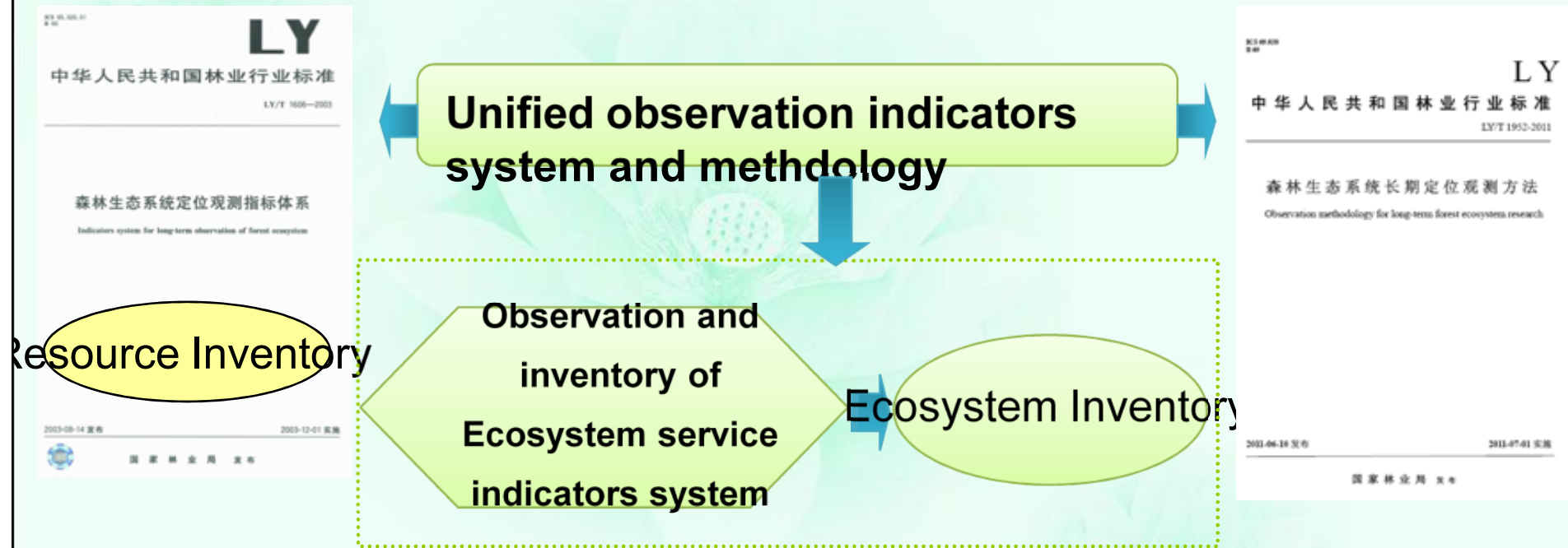
**1. Research base of assessment**

**2. Methodology of assessment**

**3. Outcome and conclusions**



# Forest ecosystem inventory framework



Observation coupled with the forest resources inventory

## 2. Assessment indicators system

Principle of indicator selection

representativeness

Comprehensiveness

Adaptability

simplicity

Practicality

Indicators system of forest ecosystem services assessment in China

Water conservation

调节水量

净化水质

Soil conservation

固土

保肥

Carbon fixation, oxygen released

固碳

释氧

Nutrient accumulation

林木积累营养物质

Atmosphere environmental purification

提供负离子

吸收污染物

滞尘

Actions of forest against natural calamities

农田防护

防风固沙

Biodiversity protection

物种保育

Forest recreation

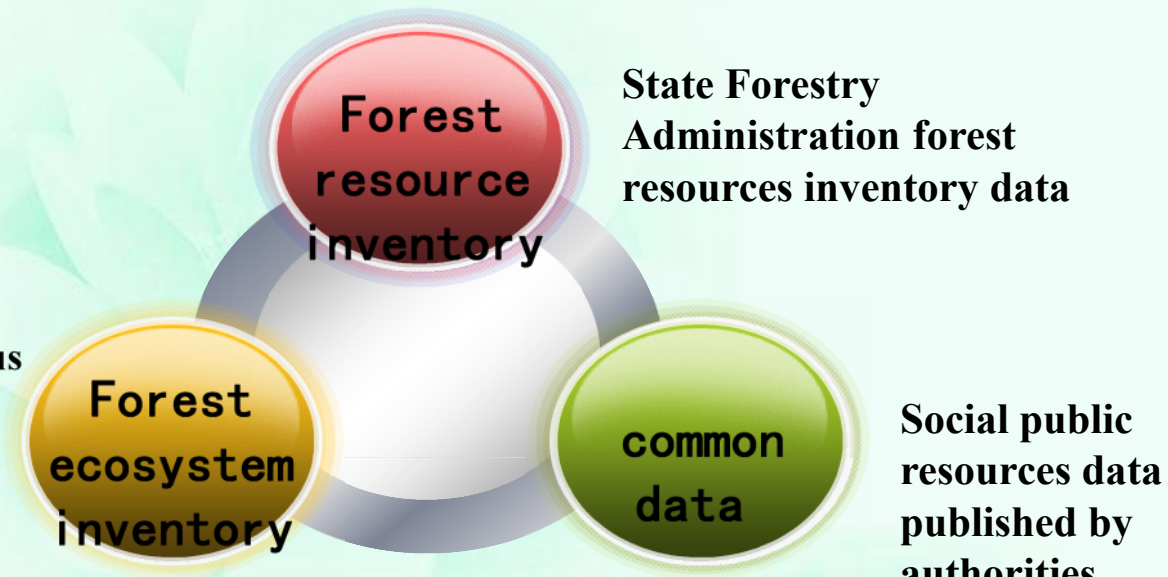
森林游憩





### 3. Data coupling and integration

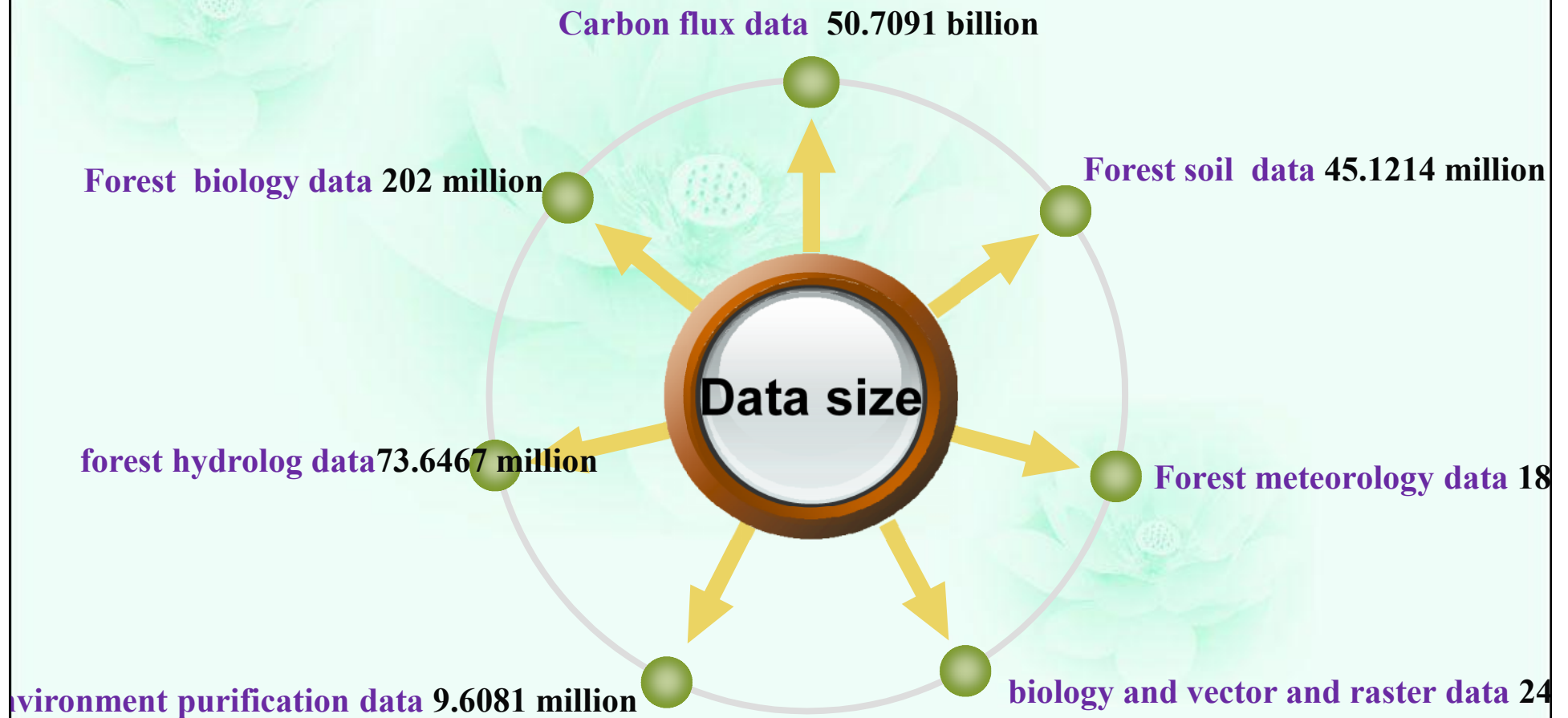
Long-term fixed-site continuous data set accumulated from 100 forest ecological observation stations, 600 auxiliary observation sites and about 10,000 fixed sample areas.



<b>Forest resource data</b>	<ul style="list-style-type: none"> <li>林分面积 林分蓄积年增长率 林分采伐消耗量</li> </ul>
<b>Ecosystem services parameter</b>	<ul style="list-style-type: none"> <li>年降水量 林分蒸散量 非林区降水量 无林地蒸发散 森林土壤侵蚀模数 无林地土壤侵蚀模数 土壤容重 土壤含氮量 土壤有机质含量 土层厚度 土壤含钾量 泥沙容重 生物多样性指数 蓄积/生物量 吸收二氧化硫能力 吸收氟化物能力 吸收氮氧化物能力 滞尘能力 木材密度</li> </ul>
<b>Common data</b>	<ul style="list-style-type: none"> <li>水库库容造价 水质净化费用 林地转让价格 磷酸二铵含氮量 磷酸二铵含磷量 氯化钾含钾量 磷酸二铵价格 氯化钾价格 有机质价格 二氧化碳含碳比例 二氧化碳价格 氧气价格 二氧化硫治理费用 燃煤污染收费标准 大气污染收费标准 排污收费标准</li> </ul>



### 3. Data coupling and integration



### 3. Data coupling and integration



China vegetation remote sensing images, China soil texture remote sensing images, China land use remote sensing images



ARC GIS 9: geographic information system



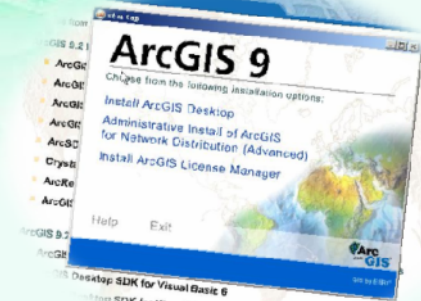
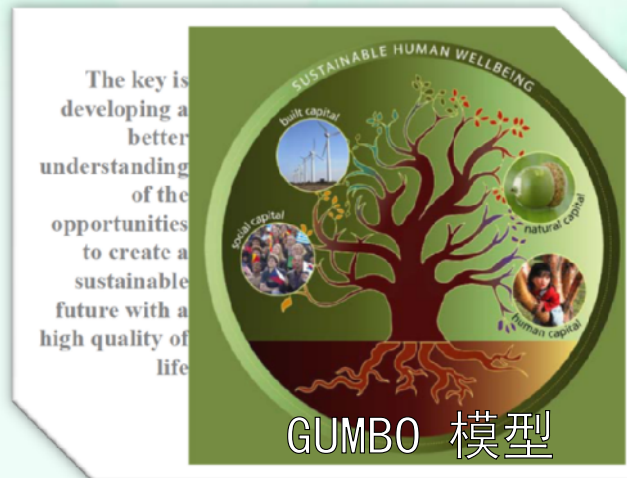
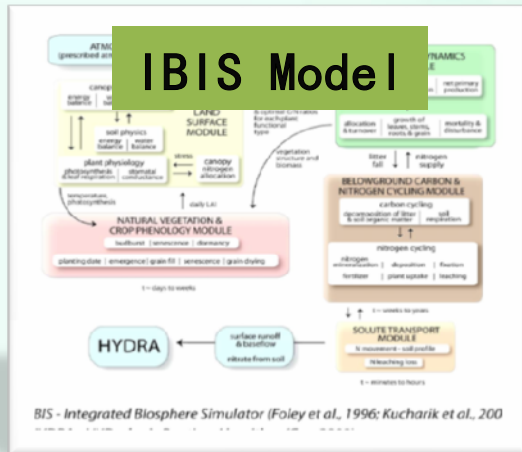
IBIS: Integrated Biosphere Simulator  
GUMBO: Global Unified Metamodel of the Biosphere



中华人民共和国  
植被图



InVEST模型



## 6. Formula and model

### Index of the endangered, ancient tree, endemic species

Endangered index	Index of the endangered	degree	species
	4	CR	参见《中国物种红色名录》第一卷：红色名录
	3	EN	
	2	VU	
	1	NT	

Ancient tree age index	age	index	species
	100~299 years	1	参见全国绿化委员会、国家林业局文件《关于开展古树名木普查建档工作的通知》
	300~499 years	2	
	≥500 years	3	

Endemic species index	distribution
4	仅限于范围不大的山峰或特殊的自然地理环境下分布
3	仅限于某些较大的自然地理环境下分布的类群，如仅分布于较大的海岛(岛屿)、高原、若干个山脉等
2	仅限于某个大陆分布的分类群
1	至少在2个大陆都有分布的分类群
0	世界广布的分类群



## 6. Formula and model

farmland conservation and sand fixing

forest against natural calamities	index	physical	monetary
formula	Sand-fixing		$U_f = A_f \times K_f$
	Farmland conservation		$U_a = KV_a \times m_a$
parameters	<p> <math>U_f</math> 为森林防风固沙生态服务功能价值量（元）；  <math>A_f</math> 为防风固沙林面积（<math>\text{hm}^{-2}</math>）；  <math>K_f</math> 为认治沙漠出资额度；  <math>U_a</math> 为农田防护功能的价值量（元）；  <math>K</math> 为19，表示平均<math>1\text{hm}^{-2}</math>农田防护林能够实现农田防护面积为<math>19\text{hm}^{-2}</math>；  <math>V_a</math> 为农作物、牧草的价格，元·<math>\text{kg}^{-1}</math>；  <math>m_a</math> 为农作物、牧草平均增产量（<math>\text{kg}\cdot\text{a}^{-1}</math>）。         </p>		

## 6. Formula and model

forest recreation

Forest recreation	index	physical	monetary
Evaluation formula	<b>Forest recreation</b>		$U_r = \sum U_i$
parameters	<p><math>U_r</math>为森林游憩功能的价值量； <math>U_i</math>为各省、直辖市森林公园的直接收入， <math>i</math>指北京、天津、河北等中国<b>31</b>个省、直辖市、自治区（不包含港、澳、台地区）。</p>		

## 6. Formulate and model

function	index	physical	monetary
Water conservation	调节水量	$G_{\text{调}} = 10A (P-E-C)$	$U_{\text{调}} = 10C_{\text{库}} A(P-E-C)$
	净化水质	$G_{\text{调}} = 10A (P-E-C)$	$U_{\text{水质}} = 10KA(P-E-C)$
Soil conservation	固土	$G_{\text{固土}} = A (X_2 - X_1)$	$U_{\text{固土}} = AC_{\pm}(X_2 - X_1)/\rho$
	保肥	$G_N = AN (X_2 - X_1)$	$U_{\text{肥}} =$
		$G_p = AP (X_2 - X_1)$	$A(X_2 - X_1)(NC_1/R_1 + PC_1/R_2 + KC_2/R_3 + MC_3)$
$G_K = AK (X_2 - X_1)$			
Carbon fixation, oxygen released	固碳	$G_{\text{碳}} = A(1.63R_{\text{碳}}B_{\text{年}} + F_{\text{土壤碳}})$	$U_{\text{碳}} = AC_{\text{碳}}(1.63R_{\text{碳}}B_{\text{年}} + F_{\text{土壤碳}})$
	释氧	$G_{\text{氧气}} = 1.19AB_{\text{年}}$	$U_{\text{氧}} = 1.19C_{\text{氧}}AB_{\text{年}}$
Nutrient accumulation	林木营养积累	$G_{\text{氮}} = AN_{\text{营养}}B_{\text{年}}$ $G_{\text{磷}} = AP_{\text{营养}}B_{\text{年}}$ $G_{\text{钾}} = AK_{\text{营养}}B_{\text{年}}$	$U_{\text{营养}} = AB_{\text{年}}(N_{\text{营养}}C_1/R_1 + P_{\text{营养}}C_1/R_2 + K_{\text{营养}}C_2/R_3)$
Atmosphere environmental purification	提供负离子	$G_{\text{负离子}} = 5.256 \times 10^{15} \times Q_{\text{负离子}}AH/L$	$U_{\text{负离子}} = 5.256 \times 10^{15} \times AHK_{\text{负离子}}(Q_{\text{负离子}} - 600)/L$
	吸纳污染物	$G_{\text{二氧化硫}} = Q_{\text{二氧化硫}}A$	$U_{\text{二氧化硫}} = K_{\text{二氧化硫}}Q_{\text{二氧化硫}}A$
		$G_{\text{氟化物}} = Q_{\text{氟化物}}A$	$U_{\text{氟}} = K_{\text{氟化物}}Q_{\text{氟化物}}A$
		$G_{\text{氮氧化物}} = Q_{\text{氮氧化物}}A$	$U_{\text{氮氧化物}} = K_{\text{氮氧化物}}Q_{\text{氮氧化物}}A$
滞尘	$G_{\text{滞尘}} = Q_{\text{滞尘}}A$	$U_{\text{滞尘}} = K_{\text{滞尘}}Q_{\text{滞尘}}A$	
Actions of forest against natural calamities	防风固沙		$U_f = A_f \times K_f$
	农田防护		$U_d = KV_d \times m_d$
Biodiversity protection	物种保育		$U_{\text{总}} = (1 + 0.1 \sum_{m=1}^x E_m + 0.1 \sum_{n=1}^y B_n + 0.1 \sum_{r=1}^z O_r) S_{\text{生}} A$
Forest	森林游憩		$U_r = \sum II.$

## Forest ecosystem service value in China

function	value (亿元)	%	function	value (亿元)	%
Water conservation	62774.65	40.54	Atmosphere environmental purification	11773.57	7.60
Soil conservation	20036.85	12.94	Biodiversity protection	36776.73	23.75
Carbon fixation, oxygen released	10735.90	6.93	Farmland conservation and sand fixing	548.81	0.35
Nutrient accumulation	3715.80	2.40	Forest recreation	8498.79	5.49



**Forest ecosystem service value = 15490 billion yuan**



Forest area growth



Forest quality growth



Assessment indicators  
and formula more perfect



Forest age structure  
more reasonable





## Water conservation

During the 8<sup>th</sup> national forest resources inventory, national forest ecosystem conserved water 580.709 billion cubic meters annually.

It increased by 85.943 billion cubic meters annually during the 8<sup>th</sup> national forest resources inventory than during the 7<sup>th</sup>.

15

↑

2

↑



三峡水库蓄水深度达175m时，库容为393亿立方米

## Soil conservation

During the 8<sup>th</sup> national forest resources inventory, national forest ecosystem conserved soil 8.191 billion tonnes per year.

It increased by 1.156 billion tonnes per year during the 8<sup>th</sup> national forest resources inventory than during the 7<sup>th</sup>.

11

倍

1.5

倍



我国11大河流（长江、黄河、海河、淮河、珠江、松花江、辽河、钱塘江、塔里木河、黑河和闽江）2011年土壤侵蚀总量为7.37亿吨（2011年中国水土保持公报）

## Fertilizer conservation

During the 8<sup>th</sup> national forest resources inventory, national forest ecosystem conserved fertilizer 430 million tonnes per year.

It increased by 66 million tonnes annually during the 8<sup>th</sup> national forest resources inventory than during the 7<sup>th</sup>.



China consumes 3.48 billion tonnes of standard coal, equivalent to 9.048 billion tonnes of CO<sub>2</sub> (China Statistics Year Book 2012)

## Atmosphere environmental purification

During the 8<sup>th</sup> national forest resources inventory, national forest ecosystem absorbed sulfur dioxide 34.594 billion kilograms per year, absorbed nitrogen oxides 1.787 billion kilograms per year, and absorbed dust 5845.044 billion kilograms per year



Among total exhaust emissions in 2011, carbon dioxide emissions are 22.179 billion kilograms, nitrogen oxides emissions are 24.043 billion kilograms, and the dust emissions are 12.788 billion kilograms. (China Statistics Year Book 2012)

7.5倍

约等于



Fertilizer use in 2011 is 57 million tonnes. (China Statistics Year Book 2012)

## Carbon fixation

During the 8<sup>th</sup> national forest resources inventory, national forest ecosystem fixed carbon 402 million tonnes (1.474 billion tonnes of carbon dioxide), and it increased by 430 million tonnes per year (equivalent to 161 million tonnes of carbon dioxide).

It increased by 4.849 billion kilograms of sulfur dioxide, 274 million kilograms of nitrogen oxides and 843.631 billion kilograms of dust per year during the 8<sup>th</sup> national forest resources inventory than during the 7<sup>th</sup>.