5th Workshop on GHG Inventory in Asia

Overview of present GHG Inventory on LULUCF Sector in Korea

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Contents

Background

Land Use and Forestry

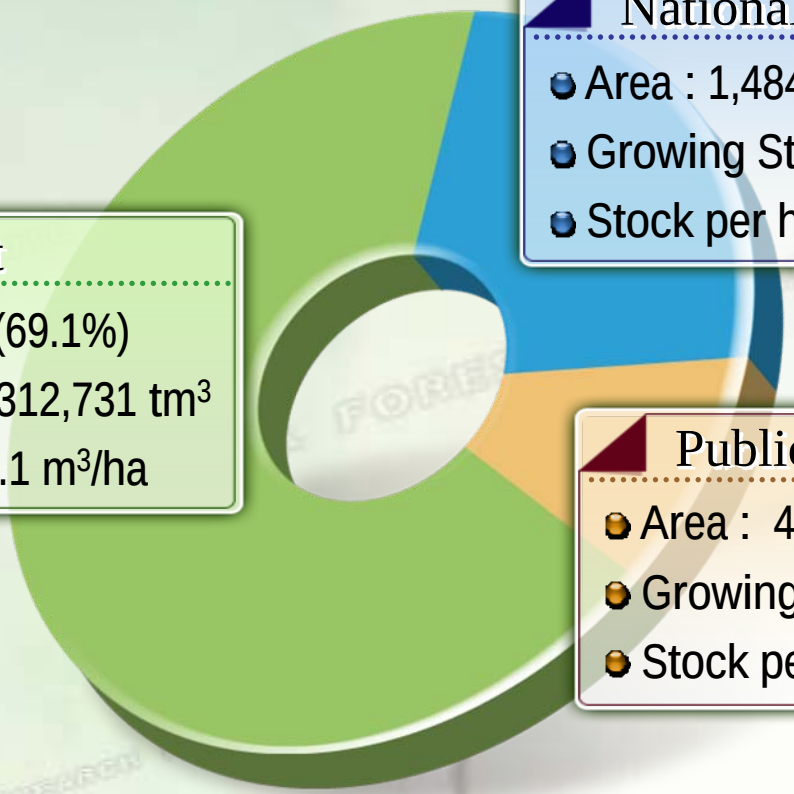
- Major land use : 65% of total land area
- Location in warm temperate zone
- Heterogeneity in site, species, ownership and function
- Slow decrease of forest land : 0.1% annually
- Rapid increase of growing stock : 3% annually
- Immature stage
- Low economic efficiency of timber production
- Increasing demands for environmental services

Statistics

Trend in Land Use Pattern

Land Use	1965	1975	1985	1995	2005
Total (kha)	9,843	9,880	9,922	9,927	9,965
Forest	67.2%	67.2%	65.8%	65.0%	64.2%
Agriculture	22.9%	22.7%	21.6%	20.0%	20.2%
Other	9.9%	10.2%	12.6%	15.0%	15.6%

Status of Forest Lands by Ownership(2005)



National Forest
- Area : 1,484 kha (23.2%)
- Growing Stock : 153,434 tm^3
- Stock per ha : 103.4 m^3/ha

Private Forest
- Area : 4,420 kha (69.1%)
- Growing Stock : 312,731 tm^3
- Stock per ha : 70.1 m^3/ha

Public Forest
- Area : 489 kha (7.6%)
- Growing Stock : 40,212 tm^3
- Stock per ha : 82.1 m^3/ha

Status of Forest Lands by Forest Type (2005)

Coniferous Forest

- Area : 2,698 kha (43.3%)
- Growing Stock : 216,660tm^3
- Stock per ha : 80.3 m^3/ha

Broad-leaved Forest

- Area : 1,659 kha (26,6%)
- Growing Stock : 136,451 tm^3
- Stock per ha : 82.2 m^3/ha

Mixed Forest

- Area : 1,874 kha (30.1%)
- Growing Stock : 153,264 tm^3
- Stock per ha : 81.8 m^3/ha

GHG Inventory (2nd NC)

GHG Inventory (2nd NC)

Major Indicators of Greenhouse Gas

- Average annual GHG growth rate('90~'03) : about 5%

Classification		1990	1995	2000	2002	2003	Average Annual Growth Rate(%)
Category	Unit						
Total GHG Emissions	$MtCO_2$	**310.6**	**452.8**	**528.6**	**569.3**	**582.2**	**5.0**
GDP	Billion Won	320,696	467,099	578,665	642,748	662,655	5.7
GHG/GDP	tCO_2 per Million Won	0.968	0.969	0.964	0.886	0.879	-0.7

GHG Emissions & Removals Trend by Source

Classification	1990	1995	2000	2002	2003	Average Annual Growth Rate(%)
Total Emissions	310.6 (100%)	452.8 (100%)	528.6 (100%)	569.3 (100%)	582.2 (100%)	5.0
Energy	247.7 (79.8%)	372.1 (82.2%)	438.5 (83.0%)	473.0 (83.1%)	481.4 (82.7%)	5.2
Industry	19.9 (6.4%)	47.1 (10.4%)	58.3 (11.0%)	64.5 (11.3%)	69.6 (12.0%)	10.1
Agriculture	17.5 (5.6%)	17.8 (3.9%)	16.2 (3.1%)	15.8 (2.8%)	15.5 (2.7%)	-0.9
Waste	25.5 (8.2%)	15.7 (3.5%)	15.6 (3.0%)	16.0 (2.8%)	15.6 (2.7%)	-3.7
Land-Use Change & Forestry (Sinks)	**-23.7**	**-21.2**	**-37.2**	**-33.4**	**-33.3**	2.6
Net Emissions	286.8	431.5	491.4	535.9	548.9	5.1

GHG Inventory on LUCF

Introduction

Based on 1996 Guideline

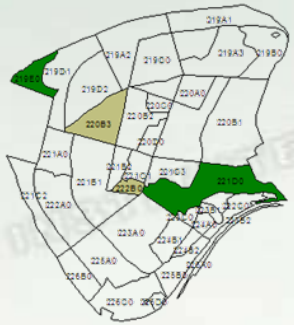
Categories

- Changes in Forest & Woody Biomass Stocks
- Forest & Grassland Conversion – CO_2 from Biomass
- Change in Soil Carbon for Mineral Soils
- On-Sire Burning of Forest
- Abandonment of Managed Lands

Methodology

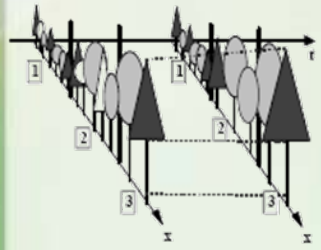
National Forest Inventory (KFRI)

Forest practice survey (each district)



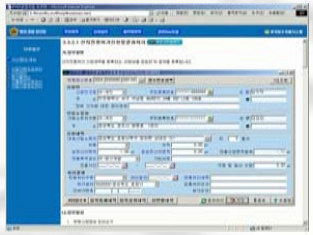
Statistical Yearbook on Forestry

(KFS)



Growth rate by forest type & age class (KFRI)

Cutting, Planting, Land conversion (KFS)



Process


Inventory
(previous)
Statistical
Yearbook
on Forestry
(KFS)
Inventory
(this year)

CO_2 Emissions on LUCF(2005, 3rd NC)

Net CO_2 Removals in Forests

Forest Type	Net * increment of stem volume (km^3)	Oven** dried specific gravity (tdm/m^3)	Net increment of stem biomass (ktdm)	Ratio *** of above ground biomass to stem biomass	Ratio *** of total biomass to above ground biomass	Net increment of total biomass (ktdm)	**** Carbon conversion factor	Net carbon removals (GgC)
	A	B	C=AxB	D	E	F=CxDxE	G	H=FxG
Coniferous	11,152	0.47	5,241	1.29	1.28	8,654	0.5	4,327
Broadleaf	8,486	0.80	6,789	1.22	1.41	11,678	0.5	5,839
Total	19,638		12,030					10,166

* Statistical Yearbook on Forestry, FA, 2006
** Wood properties and uses of major tree species growing in Korea, Forestry Research Institute, 1994
*** "Analysis of studies on production of forest biomass in Korea", Journal of KFE 8(2), 1988
**** Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook, IPCC, 1996

CO_2 Emissions from Harvest

Forest Type	* Commer-cial harvest (km3)	** Above ground biomass expansion factor (tdm/m3)	Above ground biomass removed in commer-cial harvest (ktdm)	* Fuel wood consum-ption (ktdm)	Above ground biomass consum-ption (ktdm)	*** Ratio of total biomass to above ground biomass	Total biomass consum-ption (ktdm)	**** Carbon conver-sion factor	Total carbon emissions (GgC)
	A	B	C=AxB	D	E=C+D	F	G=ExF	H	I=GxH
Conif.	1,660	0.71	1,179		1,179	1.28	1,509	0.5	755
Brd.	690	1.15	793	150	943	1.41	1,330	0.5	665
Total	2,350		1,972		2,122		2,839		1,420

* Statistical Yearbook on Forestry, FA, 2006
** B = Conversion factor of log to stem volume (1/0.85) x Oven dried specific gravity x Ratio of aboveground biomass to stem biomass
*** "Analysis of studies on production of forest biomass in Korea", Journal of KFE 8(2), 1988
**** Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Workbook, IPCC, 1996

Forest Conversion - CO_2 emissions from Woody biomass

Before Conversion	After Conversion (kha)	Conversion area (kha)	Density change (t/ha)	Biomass loss (kt)	Portion of on-site	Biomass decayed (kt)	Carbon emissions (kt)
Coniferous	Cropland	0.261	36	9	0.6	6	3
	Grassland	0.080	41	3		2	1
	Others	2.423	51	124		74	37
Broadleaf	Cropland	0.110	78	9		5	3
	Grassland	0.034	83	3		2	1
	Others	1.020	93	95		57	28
Mixed	Cropland	0.124	57	7		4	2
	Grassland	0.038	62	2		1	1
	Others	1.148	72	83		50	25
Non-stocked	Cropland	0.185	-12	-2		-1	-1
	Grassland	0.057	-7	0		0	0
	Others	1.722	3	5		3	2
Total				337		202	101

Change in Soil Carbon from Mineral Soil

Land Use	Soil Carbon (MgC/ha)	Land Area (1981) (Mha)	Land Area (2001) (Mha)	Soil Carbon (1981) (Tg)	Soil Carbon (2001) (Tg)	Annual Net Emissions (Mg/y)
Cropland	106.4	2.144	1.824	117.8	99.9	896
Forest	67.9	6.531	6.394	443.5	434.2	465
Others	11.5	1.239	1.744	14.2	20.1	-890
Total		9.914	9.962	575.5	554.2	1,071

Carbon Emissions from Liming of Agricultural Soils

Type of lime	Total annual amount of Lime (Mg)	Carbon Conversion Factor	Carbon Emissions from Liming (MgC)
Limestone $Ca(CO_3)$	293	0.120	35

Carbon Flux in Forests

Categories of GHG emissions/removals	Emissions	Removals	Net emissions/ removals
	(Mg)		
Total	**2,625**	**(-)11,586**	**(-)8,960**
A. Changes in Forest & other Woody Biomass Stocks	1,420	(-)11,856	(-)10,166
B. Forest & Grassland Conversion	101	0	101
C. Abandonment of managed Lands	NE	NE	NE
D. Changes in Soil Carbon for Mineral Soil	1,105	0	1,105
E. others	NE	NE	NE

IPCC GPG 2003 (LULUCF)

IPCC GPG Implementation in LULUCF

GPG2003 : expert review

- Korean edition publication & preliminary applicability analysis

Definitions : ???

- "Forest", "Managed forests" → various definitions

Identification of Lands

- Relevant digital thematic maps and records

  - Maps : forest type, compartment, forest function, land-use register, *and so on*

  - Records(DB): practices, reforestation, deforestation, forest fire

- Land-use categorization, Land-use matrix : ???

Estimation of Emissions and Removals

- Inaction of New National Forest Inventory System (2006)
  - ***Systematic sampling (4 x 4km grid) : total 4,000 sample plots***
  - ***Every 5 year : 800 sample plots per year***
- Biomass Expansion Factors and Other Coefficients
  - ***more data needed for precision and subdivision***

Cross-Checking

- Satellite image, LiDAR (?)

→ *Related researches on National Forest GHG Inventory System and Emission Factors are being carried out (2006~)*

5th National Forest Inventory

Overview of National Forest Inventory

The NFI began from 1972 with 10 year interval

- 1st NFI (1972-1974), 2nd NFI (1978-1980), 3rd NFI (1986-1992), 4th NFI (1996-2005)
- 5th NFI (2006-2010) : turning point to change inventory system

Rationale for change the Inventory System

- Increasing demands of reliable forest statistics

  - SFM, FAO, KP under UNFCCC etc.

5th National Forest Inventory

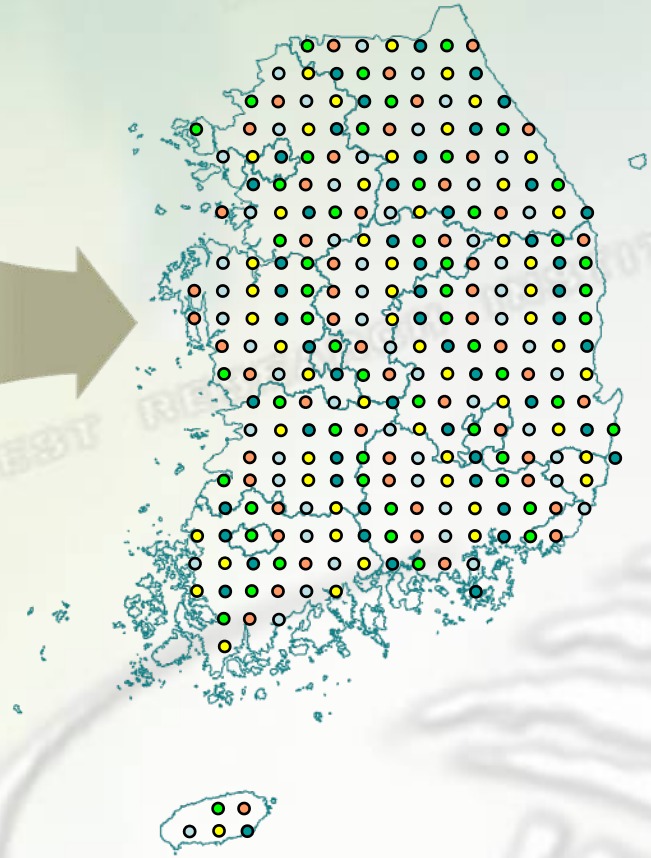
Summary of changes

- Survey cycle is 5 years (10 years in past NFI)
- Re-measurements for ground plots every 5 years
- New systematic layout of 4,000 permanent plots(4x4km)
- Cluster sampling with 4 subplots
- New measurement variable
  - ➡ biodiversity, forest health, biomass, carbon stock, etc
- Interagency collaboration
  - ➡ KFS, KFRI & Forest Cooperatives Federation

Inventory cycle

- Periodic Inventory

- Annual Inventory



5 Panel System

Researches of KRFI

Overview of researches

- **Development of Forest Carbon Inventory System on UNFCCC (2002~2005)**
- **Research for Development of Forest Biomass Map (2006)**
- **Analysis of Forest Management Effect on Forest Carbon Stock (2007~2009)**
- **Study on the Basis of Forest Carbon Accounting in Korea (2007~2010)**
  - Integration of Forest Carbon Accounting System
  - Development of BEF & CCF for Korean 12 Tree Species
  - Analysis of the Potential Carbon Credit of Korea
  - Analyze new Guideline : AFOLU 2006

Current Results of KFRI on UNFCCC & KP

- **CarbonTree Calculator (2006)**
  - Purpose : the PR of research results & importance of forest
- **CarbonTree Calculator educational version (2006)**
  - Purpose : Application as a study material at science class
- **Biomass Expansion Factor for Korean 8 Tree Species (2005)**
- **Development of Equations to Estimate Forest Biomass (2005)**
- **Forest Carbon Inventory System on UNFCCC (2005)**

Lessons

Uncertainty & Complexity (vs. Energy)

Constraints for policy makers to take action

- **Role of Forest Carbon Sinks**
  - Dynamic and heterogeneous ecosystem
  - Potential reversibility with global warming (?)
- **Negotiation**
  - At present, only for 1st CP, ? for Post-2012
- **GHG Inventory and Carbon Accounting**
  - GPG2003, many decisions and documents only for LULUCF
- **Relationships with Relevant International Organizations/ Agreements**
  - UNFCCC, CBD, UNCCD, …

Lack of Resources for GPG2003(vs.1996GL)

Constraints to prepare an accurate and complete reporting

- **Land-Use Matrix with 6 Categories**
- **All Carbon Pools and Non-CO_2 Gases**
- **Linkage of Biomass and Soil Carbon Pools**
- **Definitions and Geographical Information**
- **Harvested Wood Products (potentially)**
- **Uncertainty and QA/QC**

Need additional significant efforts
(data, information, technology, capacity building, etc)

Thank you for your attention