Forestry Department
Food and Agriculture Organization of the United Nations

GLOBAL FOREST RESOURCES ASSESSMENT

COUNTRY REPORTS

GUAM

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The Forest Resources Assessment Programme

Sustainably managed forests have multiple environmental and socio-economic functions important at the global, national and local scales, and play a vital part in sustainable development. Reliable and up-to-date information on the state of forest resources - not only on area and area change, but also on such variables as growing stock, wood and non-wood products, carbon, protected areas, use of forests for recreation and other services, biological diversity and forests' contribution to national economies - is crucial to support decision-making for policies and programmes in forestry and sustainable development at all levels.

FAO, at the request of its member countries, regularly monitors the world's forests and their management and uses through the Forest Resources Assessment Programme. This country report forms part of the Global Forest Resources Assessment 2010 (FRA 2010).

The reporting framework for FRA 2010 is based on the thematic elements of sustainable forest management acknowledged in intergovernmental forest-related fora and includes variables related to the extent, condition, uses and values of forest resources, as well as the policy, legal and institutional framework related to forests. More information on the FRA 2010 process and the results - including all the country reports - is available on the FRA Web site (www.fao.org/forestry/fra).

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Introduction

The island of Guam is the largest and farthest south in the north-south sweeping Marianas archipelago. The climate is tropical marine with little annual variation in temperature, but a pronounced dry season from January to June. The northern half of the island is generally flat limestone plateau with abrupt drop-offs and cliffs toward the ocean. Locally the limestone can be strongly weathered into rugged karstic terrain. Soils are related to vegetation communities in Guam. The limestone soils in the north are covered with forest in areas not cultivated or urbanized. The southern part of the island features rolling to mountainous terrain in the deeply weathered volcanic soils. The volcanic soils on the southern half of Guam are covered primarily by grassland, with some ravine forest occurring in sheltered and leeward sites. Significant disturbance agents have shaped vegetation in Guam, including frequent tropical storms and typhoons, human-introduced grassland and forest fires, animal rooting, browsing and trampling, mass soil movements and erosion, nonnative insects and pathogens, invasive weeds, historical military actions, and historical timber harvest.

1 Table T1 – Extent of Forest and Other wooded land

1.1 FRA 2010 Categories and definitions

Category	Definition
Forest	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use.
Other wooded land	Land not classified as "Forest", spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds *in situ*; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
Other land	All land that is not classified as "Forest" or "Other wooded land".
Other land with tree cover (Subordinated to "Other land")	Land classified as "Other land", spanning more than 0.5 hectares with a canopy cover of more than 10 percent of trees able to reach a height of 5 meters at maturity.
Inland water bodies	Inland water bodies generally include major rivers, lakes and water reservoirs.

1.2 National data

1.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
Donnegan, J. A., S. L. Butler, W. Graboweicki, B. A. Hiserote, and D. Limtiaco. 2004. Guam's Forest Resources, 2002. Resource Bulletin PNW-RB-243, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Forest land area	2002	A five class land cover map was derived from IKONOS satellite data (1m resolution). Classes included: forest, nonforest vegetation, barren land, urban, and inland water.

1.2.2 Classification and definitions

National class	Definition
Forest land	Land spanning more than 0.5 hectares and a tree canopy cover of more than 10 percent.
Unreserved forest land	Forest land available for wood removals.
Protected forest land	Forest land that is not available for wood removals.
Limestone forest	Forest occurring on limestone substrate, generally in northern Guam
Volcanic forest	Forest occurring on volcanic soils, generally in southern Guam
Nonforest urban	Land used primarily for urban purposes.
Nonforest vegetation	Land characterized primarily by non-tree species or <10% canopy cover of trees.
Barren lands	Lands with exposed soil, rock, or sand, devoid of vegetation.
Water	Inland water bodies generally include major rivers, lakes and water reservoirs.

1.2.3 Original data

Landcover	Acres	Hectares
Limestone forest	44,704	18,091
Volcanic forest	19,129	7,741
Total unreserved	63,833	25,832
Reserved forest land	0	0
All forest land	63,833	25,832
Nonforest and other area:		
Nonforest urban	23,956	9,695
Nonforest vegetation	44,455	17,990
Barren lands	1,539	623
Area not classified	1,622	656
Water	255	103
All nonforest and other	71,827	29,067
Total area	135,660	54,900

1.3 Analysis and processing of national data

1.3.1 Calibration

FAOSTAT total area = 55,000 ha
Calibration factor 2002 = (55,000/54,900) = 1.00182379604469

Landcover	Acres	Hectares	Recalibration Hectares
Limestone forest	44,704	18,091	18,124
Volcanic forest	19,129	7,741	7,755
Total unreserved	63,833	25,832	25,880
Reserved forest land	0	0	0
All forest land	63,833	25,832	25,880
Nonforest and other area:			
Nonforest urban	23,956	9,695	9,712
Nonforest savanna or fernland	44,455	17,990	18,023
Barren lands	1,539	623	624
Area not classified	1,622	656	658
Water	255	103	103
All nonforest and other	71,827	29,067	29,120
Total area	135,660	54,900	55,000

1.3.2 Estimation and forecasting

Only one point in time, 2002, is provided for the forest inventory data, thus no estimation and forecasting was used.

1.3.3 Reclassification into FRA 2010 categories

1.4 Data for Table T1

FRA 2010 categories	Area (1000 hectares)			
	1990	2000	2005	2010
Forest	25.88	25.88	25.88	25.88
Other wooded land	0	0	0	0
Other land	29.12	29.12	29.12	29.12
...of which with tree cover	n.a.	n.a.	n.a.	n.a.
Inland water bodies	0	0	0	0
TOTAL	**55.00**	**55.00**	**55.00**	**55.00**

1.5 Comments to Table T1

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Forest	Forest land area in Guam includes minor components of agroforest and secondary forest.	Data reported in FRA 2010 for the years: 1990, 2000, 2005, and 2010 was collected in 2002. No other inventory data exists to establish a trend. The 2002 data was collected prior to the two major typhoons that struck Guam later in that year. The 2002 data was placed in the 2000 column as the best fit for this reason. The FRA 2000 estimate for forest land in Guam was 21,000 ha.
Other wooded land		
Other land		
Other land with tree cover		
Inland water bodies		

Other general comments to the table
Data is not available to determine a trend; the 2002 figures has been used for all reporting years.

Expected year for completion of ongoing/planned national forest inventory and/or RS survey / mapping	
Field inventory	2002 2012...
Remote sensing survey / mapping	2003 2013...

2 Table T3 – Forest designation and management

2.1 FRA 2010 Categories and definitions

Term	Definition
Primary designated function	The primary function or management objective assigned to a management unit either by legal prescription, documented decision of the landowner/manager, or evidence provided by documented studies of forest management practices and customary use.
Protected areas	Areas especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means.
Categories of primary designated functions	
Production	Forest area designated primarily for production of wood, fibre, bio-energy and/or non-wood forest products.
Protection of soil and water	Forest area designated primarily for protection of soil and water.
Conservation of biodiversity	Forest area designated primarily for conservation of biological diversity. Includes but is not limited to areas designated for biodiversity conservation within the protected areas.
Social services	Forest area designated primarily for social services.
Multiple use	Forest area designated primarily for more than one purpose and where none of these alone is considered as the predominant designated function.
Other	Forest areas designated primarily for a function other than production, protection, conservation, social services or multiple use.
No / unknown	No or unknown designation.
Special designation and management categories	
Area of permanent forest estate (PFE)	Forest area that is designated to be retained as forest and may not be converted to other land use.
Forest area within protected areas	Forest area within formally established protected areas independently of the purpose for which the protected areas were established.
Forest area under sustainable forest management	To be defined and documented by the country.
Forest area with management plan	Forest area that has a long-term (ten years or more) documented management plan, aiming at defined management goals, which is periodically revised.

2.2 National data

2.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
Fosberg, F. R. 1960. The vegetation of Micronesia: 1. General descriptions, the vegetation of the Marianas Islands, and a detailed consideration of the vegetation of Guam. Bulletin of the American Museum of Natural History 119:1-76.	M	Descriptive comments on forest land use.	1960	
Stone, B. C. 1971. The flora of Guam. Micronesica 6:657 pp.	M	Descriptive comments on forest land use.	1971	
Morton, J. M., F. A. Amidon, and L. R. Quinata. 2000. Structure of a limestone forest on Northern Guam. Micronesica 32:299-244.	M	Descriptive comments on forest land use.	2000	

2.2.2 Classification and definitions

No national classification for designated function exists on Guam.

2.3 Analysis and processing of national data

Same as T1, all forest land is assumed to be multiple purpose use.

2.4 Data for Table T3

Table 3a – Primary designated function

FRA 2010 Categories	Forest area (1000 hectares)			
	1990	2000	2005	2010
Production	0	0	0	0
Protection of soil and water	0	0	0	0
Conservation of biodiversity	0	0	0	0
Social services	0	0	0	0
Multiple use	25.880	25.880	25.880	25.880
Other (please specify in comments below the table)	0	0	0	0
No / unknown	0	0	0	0
TOTAL	25.880	25.880	25.880	25.880

Table 3b – Special designation and management categories

FRA 2010 Categories	Forest area (1000 hectares)			
	1990	2000	2005	2010
Area of permanent forest estate				
Forest area within protected areas				
Forest area under sustainable forest management				
Forest area with management plan				

2.5 Comments to Table T3

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Production		
Protection of soil and water		
Conservation of biodiversity		
Social services		
Multiple use		
Other		
No / unknown designation		
Area of permanent forest estate		
Forest area within protected areas		
Forest area under sustainable forest management		
Forest area with management plan		

Other general comments to the table
Forests on Guam provide cover for protection of soil and water, conservation of biodiversity, and social services, such as recreation, hunting, and non-wood forest products. Some wood is gathered for cooking, but wood production is a very low priority on Guam. No other inventory data exists to establish a trend.

3 Table T4 – Forest characteristics

3.1 FRA 2010 Categories and definitions

Term / category	Definition
Naturally regenerated forest	Forest predominantly composed of trees established through natural regeneration.
Introduced species	A species, subspecies or lower taxon, occurring outside its natural range (past or present) and dispersal potential (i.e. outside the range it occupies naturally or could occupy without direct or indirect introduction or care by humans).
Characteristics categories	
Primary forest	Naturally regenerated forest of native species, where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed.
Other naturally regenerated forest	Naturally regenerated forest where there are clearly visible indications of human activities.
Other naturally regenerated forest of introduced species *(sub-category)*	Other naturally regenerated forest where the trees are predominantly of introduced species.
Planted forest	Forest predominantly composed of trees established through planting and/or deliberate seeding.
Planted forest of introduced species *(sub-category)*	Planted forest, where the planted/seeded trees are predominantly of introduced species.
Special categories	
Rubber plantations	Forest area with rubber tree plantations.
Mangroves	Area of forest and other wooded land with mangrove vegetation.
Bamboo	Area of forest and other wooded land with predominant bamboo vegetation.

3.2 National data

3.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
FAO, 2007. Mangroves of Oceania 1980-2005. Working paper 138.	M	Area of mangroves	all	The FAO thematic study, The world's mangroves 1980-2005 was used to establish the reported trend

3.2.2 Classification and definitions

3.2.3 Original data

3.3 Analysis and processing of national data

3.4 Data for Table T4

Table 4a

FRA 2010 Categories	Forest area (1000 hectares)			
	1990	2000	2005	2010
Primary forest				
Other naturally regenerated forest				
...of which of introduced species				
Planted forest				
...of which of introduced species				
TOTAL				

Table 4b

FRA 2010 Categories	Area (1000 hectares)			
	1990	2000	2005	2010
Rubber plantations (Forest)	0	0	0	0
Mangroves (Forest and OWL)	0.074	0.060	0.055	0.050
Bamboo (Forest and OWL)	0	0	0	0

4 Table T6 – Growing stock

4.1 FRA 2010 Categories and definitions

Category	Definition
Growing stock	Volume over bark of all living trees more than X cm in diameter at breast height (or above buttress if these are higher). Includes the stem from ground level or stump height up to a top diameter of Y cm, and may also include branches to a minimum diameter of W cm.
Growing stock of commercial species	Growing stock (see def. above) of commercial species.

4.2 National data

4.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
Donnegan, J. A., S. L. Butler, W. Graboweicki, B. A. Hiserote, and D. Limtiaco. 2004. Guam's Forest Resources, 2002. Resource Bulletin PNW-RB-243, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Tree stem volume.	2002	Data derived from 46 - 670 sq. m field plots where tree diameters and heights were measured.

4.2.2 Classification and definitions

National class	Definition
Gross volume	Wood volume of the tree stem, from the ground to a height where the diameter equals 2.5 cm.
Net volume	Wood volume of the tree stem, from the ground to a height where the diameter equals 2.5 cm, minus portions of the stem that are rotten or missing.

4.2.3 Original data

Estimated gross volume of all live trees on forest land by forest type-group and diameter class

	Diameter class				
Forest type group	**<12.7 cm**	**12.7 – 28 cm**	**28.1 - 51 cm**	**51.1+ cm**	**All sizes**
			Cubic meters		
Limestone forest type	707,922	628,488	234,418	111,497	1,682,325
Volcanic/ravine forest type	182,293	398,406	324,433	0	905,132
Total	890,215	1,026,895	558,851	111,497	2,587,458

Estimated net volume of all live trees greater than or equal to 5 inches in diameter on forest land by forest-type group and diameter class

Forest type group	Diameter class (inches)			All sizes
	12.7 – 28 cm	28.1 - 51 cm	51.1+ cm	
	Cubic meters			
Limestone forest type	607,899	233,571	106,385	947,855
Volcanic/ravine forest type	397,820	320,495	0	718,315
Total	1,005,719	554,066	106,385	1,666,170

4.3 Analysis and processing of national data

4.3.1 Calibration

Conversion to metric units.

4.3.2 Estimation and forecasting

None, 2002 data were used for all reporting years.

4.3.3 Reclassification into FRA 2010 categories

Total net volume was used for FRA growing stock category.

4.4 Data for Table T6

Table 6a – Growing stock

FRA 2010 category	Volume (million cubic meters over bark)							
	Forest				Other wooded land			
	1990	2000	2005	2010	1990	2000	2005	2010
Total growing stock	1.66617	1.66617	1.66617	1.66617				
... of which coniferous	0	0	0	0				
... of which broadleaved	1.66617	1.66617	1.666170	1.66617				
Growing stock of commercial species	n.a.	n.a.	n.a.	n.a.				

Table 6b – Growing stock of the 10 most common species

FRA 2010 category / Species name			Growing stock in forest (million cubic meters)		
Rank	Scientific name	Common name	1990	2000	2005
1st	*Cocos nucifera*	niyok, coconut palm	n.a.	0.3857	0.3857
2nd	*Vitex parviflora*		n.a.	0.2182	0.2182
3rd	*Cycas micronesica*	fandan	n.a.	0.1312	0.1312
4th	*Mangifera indica*	mango	n.a.	0.1210	0.1210
5th	*Ficus prolixa*	nunu	n.a.	0.1014	0.1014
6th	*Heterospathe elata*	palma brava	n.a.	0.1009	0.1009
7th	*Premna obtusifolia*	ahgao	n.a.	0.0886	0.0886
8th	*Pandanus tectorius*	aggag	n.a.	0.0793	0.0793

9th	*Leucaena leucocephala*	tangantangan	n.a.	0.0790	0.0790
10th	*Hibiscus tiliaceus*	sea-hibiscus, pago	n.a.	0.0500	0.0500
Remaining			n.a.	0.3110	0.3110
TOTAL				**1.6662**	**1.6662**

Note: Rank refers to the order of importance in terms of growing stock, i.e. 1st is the species with the highest growing stock. Year 2000 is the reference year for defining the species list and the order of the species.

Table 6c – Specification of threshold values

Item	Value	Complementary information
Minimum diameter (cm) at breast height[1] of trees included in growing stock (X)	12.7	
Minimum diameter (cm) at the top end of stem for calculation of growing stock (Y)	2.5	
Minimum diameter (cm) of branches included in growing stock (W)		
Volume refers to "above ground" (AG) or "above stump" (AS)	AG	

4.5 Comments to Table T6

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Total growing stock		Two major typhoon struck Guam within a year of the 2001 inventory. Volume, biomass, and carbon mass estimates for 2005, 2010 cannot be reliably projected from 2001 data.
Growing stock of broadleaved / coniferous		
Growing stock of commercial species		
Growing stock composition		

Other general comments to the table
No other inventory data exists to establish a trend.

[1] Diameter at breast height (DBH) refers to diameter over bark measured at a height of 1.30 m above ground level or 30 cm above buttresses if these are higher than 1 m.

5 Table T7 – Biomass stock

5.1 FRA 2010 Categories and definitions

Category	Definition
Above-ground biomass	All living biomass above the soil including stem, stump, branches, bark, seeds, and foliage.
Below-ground biomass	All biomass of live roots. Fine roots of less than 2mm diameter are excluded because these often cannot be distinguished empirically from soil organic matter or litter.
Dead wood	All non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.

5.2 National data

5.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
Donnegan, J. A., S. L. Butler, W. Graboweicki, B. A. Hiserote, and D. Limtiaco. 2004. Guam's Forest Resources, 2002. Resource Bulletin PNW-RB-243, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Biomass from tree stem volume.	2002	Cited publication provides species level aboveground biomass data. For the FRA 2005 report, averages were used derived from stem volumes.
Penman, J., M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe, and F. Wagner, editors. 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Intergovernmental Panel on Climate Change, National Greenhouse Gas Inventories Programme, Institute for Global Environmental Strategies (IGES), Hayama, Kanagawa, Japan,.	M	Biomass expansion factors and ratio of aboveground to belowground biomass.	2003	

5.2.2 Classification and definitions

National class	Definition
Live above-ground stem biomass	Biomass of live standing tree stems ≥2.5 cm at breast height from ground to 1 cm top. Does not include branch, leaf, or root biomass.
Dead above-ground stem biomass	Biomass of dead standing tree stems ≥2.5 cm at breast height from ground to 1 cm top. Does not include branch, leaf, or root biomass.
Total above-ground stem biomass	Biomass of live and dead standing tree stems ≥2.5 cm at breast height from ground to 1 cm top. Does not include branch, leaf, or root biomass.

5.2.3 Original data

Wood volume on forest land was used to estimate biomass using expansion factors in section 7.3.1, from Penman et al. (2003).

Ranked top 10 species biomass estimate for live tree stems ≥ 2.5 cm d.b.h. from 2002 forest inventory. Wood density for individual species was used to estimate stem biomass only.

Scientific Name	DEAD	LIVE	Grand Total
Cocos nucifera	1955	192261	194216
Vitex parviflora	1890	168280	170170
Ficus prolixa	0	139323	139323
Mangifera indica	869	132517	133386
Cycas micronesica	0	74342	74342
Heterospathe elata	0	72610	72610
Premna obtusifolia	3838	59769	63608
Pandanus tectorius	1775	56997	58772
Leucaena leucocephala	1101	55247	56348
Hibiscus tiliaceus	0	52372	52372
Remaining	12860	351254	364114
Grand Total	24288	1354972	1379259

5.3 Analysis and processing of national data

5.3.1 Calibration

Biomass was calculated using total stem volumes and an average wood density (0.5), biomass expansion factor (3.4; tropical broadleaf), and aboveground to belowground ratio estimator (0.27; tropical/sub-tropical dry forest).

5.3.2 Estimation and forecasting

None.

5.3.3 Reclassification into FRA 2010 categories

5.4 Data for Table T7

FRA 2010 category	Biomass (million metric tonnes oven-dry weight)							
	Forest				Other wooded land			
	1990	2000	2005	2010	1990	2000	2005	2010
Above-ground biomass	2.832	2.832	2.832	2.832				
Below-ground biomass	0.765	0.765	0.765	0.765				
Dead wood	n.a.	n.a.	n.a.	n.a.				
TOTAL	**n.a.**	**n.a.**	**n.a.**	**n.a.**				

5.5 Comments to Table T7

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Above-ground biomass	Original data used species specific wood density. The data presented in Table 7 estimates biomass from the volume figures using expansion factors from Penman et al. (2003).	
Below-ground biomass		
Dead wood		

Other general comments to the table
No other inventory data exists to establish a trend.

6 Table T8 – Carbon stock

6.1 FRA 2010 Categories and definitions

Category	Definition
Carbon in above-ground biomass	Carbon in all living biomass above the soil, including stem, stump, branches, bark, seeds, and foliage.
Carbon in below-ground biomass	Carbon in all biomass of live roots. Fine roots of less than 2 mm diameter are excluded, because these often cannot be distinguished empirically from soil organic matter or litter.
Carbon in dead wood	Carbon in all non-living woody biomass not contained in the litter, either standing, lying on the ground, or in the soil. Dead wood includes wood lying on the surface, dead roots, and stumps larger than or equal to 10 cm in diameter or any other diameter used by the country.
Carbon in litter	Carbon in all non-living biomass with a diameter less than the minimum diameter for dead wood (e.g. 10 cm), lying dead in various states of decomposition above the mineral or organic soil.
Soil carbon	Organic carbon in mineral and organic soils (including peat) to a specified depth chosen by the country and applied consistently through the time series.

6.2 National data

6.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
Donnegan, J. A., S. L. Butler, W. Graboweicki, B. A. Hiserote, and D. Limtiaco. 2004. Guam's Forest Resources, 2002. Resource Bulletin PNW-RB-243, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Carbon mass from tree stem volume.	2002	Cited publication provides species level aboveground carbon mass data. For the FRA 2005 report, averages were used derived from stem volumes.
Penman, J., M. Gytarsky, T. Hiraishi, T. Krug, D. Kruger, R. Pipatti, L. Buendia, K. Miwa, T. Ngara, K. Tanabe, and F. Wagner, editors. 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Intergovernmental Panel on Climate Change, National Greenhouse Gas Inventories Programme, Institute for Global Environmental Strategies (IGES), Hayama, Kanagawa, Japan,.	M	Carbon mass conversion factors, biomass expansion factors and ratio of aboveground to belowground biomass.	2003	

6.2.2 Classification and definitions

National class	Definition
Carbon in above-ground tree stem biomass	Carbon in living tree stems ≥ 2.5 cm in diameter at breat height from ground to 1 cm top. Does not include branches, bark, seeds, and foliage.
Carbon in dead tree stem biomass	Carbon in standing dead tree stems ≥ 2.5 cm in diameter at breat height from ground to 1 cm top. Does not include branches, bark, seeds, and foliage.

6.2.3 Original data

Volume data was used in carbon mass estimation.

6.3 Analysis and processing of national data

Not needed.

6.4 Data for Table T8

FRA 2010 Category	Carbon (Million metric tonnes)							
	Forest				Other wooded land			
	1990	2000	2005	2010	1990	2000	2005	2010
Carbon in above-ground biomass	1.41624	1.41624	1.41624	1.41624				
Carbon in below-ground biomass	0.38239	0.38239	0.38239	0.38239				
Sub-total: Living biomass	***1.79863***	***1.79863***	***1.79863***	***1.79863***				
Carbon in dead wood	n.a.	n.a.	n.a.	n.a.				
Carbon in litter	n.a.	n.a.	n.a.	n.a.				
Sub-total: Dead wood and litter	***n.a.***	***n.a.***	***n.a.***	***n.a.***				
Soil carbon	n.a.	n.a.	n.a.	n.a.				
TOTAL	**n.a.**	**n.a.**	**n.a.**	**n.a.**				

Soil depth (cm) used for soil carbon estimates	

6.5 Comments to Table T8

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Carbon in above-ground biomass		
Carbon in below-ground biomass		
Carbon in dead wood		
Carbon in litter		
Soil carbon		

Other general comments to the table
No other inventory data exists to establish a trend.

7 Table T10 – Other disturbances affecting forest health and vitality

7.1 FRA 2010 Categories and definitions

Term	Definition
Disturbance	Damage caused by any factor (biotic or abiotic) that adversely affects the vigour and productivity of the forest and which is not a direct result of human activities.
Invasive species	Species that are non-native to a particular ecosystem and whose introduction and spread cause, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health.
Category	**Definition**
Disturbance by insects	Disturbance caused by insect pests.
Disturbance by diseases	Disturbance caused by diseases attributable to pathogens, such as bacteria, fungi, phytoplasma or virus.
Disturbance by other biotic agents	Disturbance caused by biotic agents other than insects or diseases, such as wildlife browsing, grazing, physical damage by animals, etc.
Disturbance caused by abiotic factors	Disturbances caused by abiotic factors, such as air pollution, snow, storm, drought, etc.

7.2 National data

7.2.1 Data sources

References to sources of information	Quality (H/M/L)	Variable(s)	Year(s)	Additional comments
Donnegan, J. A., S. L. Butler, W. Graboweicki, B. A. Hiserote, and D. Limtiaco. 2004. Guam's Forest Resources, 2002. Resource Bulletin PNW-RB-243, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Carbon mass from tree stem volume.	2002	Cited publication provides species level aboveground carbon mass data. For the FRA 2005 report, averages were used derived from stem volumes.

7.2.2 Classification and definitions

National class	Definition
Insect	Disturbance caused by insect pests.
Disease	Disturbance caused by diseases attributable to pathogens, such as bacteria, fungi, phytoplasma or virus.
Fire	Damage to a tree from fire.
Animal	Damage caused by grazing, browsing, rooting, or toppling.

Weather	Damage related to storms, e.g., wind, flood, lightning.
Vegetation (e.g., competition or vines)	Damage caused by other vegetation.
Unknown	Unknown damage agent.
Silvicultural or cutting	Damage caused by humans.
Physical	Damage caused by one tree hitting another or from undermining of roots.

7.2.3 Original data

Estimated number of trees ≥ 12.7 cm d.b.h. by damage agent.

Scientific Name	None	Disease	Insect	Physical	Silvicultural	Unknown	Vegetation	Weather	Animal	Grand Total
Adenanthera pavonina	14447		14447					28894		57788
Aglaia mariannensis	231153					14447		14447		260047
Annona reticulata	72235			14447						86682
Areca catechu	44197									44197
Artocarpus altilis	73091							43626		116718
Artocarpus mariannensis	14447									14447
Averrhoa bilimbi	57788									57788
Barringtonia asiatica	14447							14447		28894
Barringtonia racemosa								29465		29465
Calophyllum inophyllum	58930									58930
Cananga odorata	14447									14447
Carica papaya	28894									28894
Casuarina equisetifolia	115576									115576
Ceiba pentandra	14447									14447
Cerbera dilatata	144470							43341		187812
Cocos nucifera	1071755	43912	29179		28894					1173741
Cyathea lunulata	29465									29465
Cycas micronesica	1103682	14447	28894	43341		86682	58359	43626		1379032
Eugenia thompsonii	29465									29465
Ficus prolixa	130879							14447		145326
Ficus tinctoria	14447							14447		28894
Guamia mariannae	86682	14447		14447						115576
Hernandia ovigera	115576							14447		130023
Hernandia sonora		28894								28894
Heterospathe elata	1042861	29465								1072326
Hibiscus tiliaceus	219274	43341	144470	14447	14732			173650		609915
Intsia bijuga	57788			14447						72235
Kleinhovia hospita	57788									57788
Leucaena leucocephala	770259	28894			29465			58930		887547
Macaranga thompsonii	144470				14447			28894		187812
Mangifera indica	176789					14732		44197	29465	265183
Morinda citrifolia	29179							29465		58644
Neisosperma oppositifolia	14447									14447
Pandanus tectorius	686716						44197	87253		818166
Premna obtusifolia	375623		14447				57788	202259		650117
Spathodea campanulata	57788									57788
Vitex parviflora	740794		28894				14447	145041		929176
Xylosma nelsonii	14447									14447
Grand Total	7868747	203400	260332	101129	87538	115862	174791	1030876	29465	9872140

7.3 Analysis and processing of national data

7.3.1 Calibration

National data is recorded as presence/absence on individual trees. Presence/absence point count cannot be expanded to area estimates.

7.3.2 Estimation and forecasting

7.3.3 Reclassification into FRA 2010 categories

Insect = Disturbance by insects
Disease = Disturbance by diseases
Fire = Disturbance caused by abiotic factors
Animal = Disturbance by other biotic agents
Weather = Disturbance caused by abiotic factors
Vegetation (e.g., competition or vines) = Disturbance by other biotic agents
Unknown = Unknown
Silvicultural or cutting = Disturbance by other biotic agents

7.4 Data for Table T10

Table 10a – Disturbances

FRA 2010 category	Affected forest area (1000 hectares)		
	1990	2000	2005
Disturbance by insects			
Disturbance by diseases			
Disturbance by other biotic agents			
Disturbance caused by abiotic factors			
Total area affected by disturbances			

Notes: The figures for the reporting years refer to the averages of annually affected areas for the 5-year periods 1988-1992, 1998-2002 and 2003-2007 respectively.

The total area affected by disturbances is not necessarily the sum of the individual disturbances as these may be overlapping.

Table 10b – Major outbreaks of insects and diseases affecting forest health and vitality

Description / name	Tree species or genera affected (scientific name)	Year(s) of latest outbreak	Area affected (1000 hectares)	If cyclic, approx. cycle (years)

Note: Area affected refers to the total area affected during the outbreak.

Table 10c – Area of forest affected by woody invasive species

Scientific name of woody invasive species	Forest area affected 2005 (1000 hectares)
Total forest area affected by woody invasive species	

Note: The total forest area affected by woody invasive species is not necessary the sum of the values above, as these may be overlapping.

7.5 Comments to Table T10

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Disturbance by insects		
Disturbance by diseases		
Disturbance by other biotic agents		
Disturbance caused by abiotic factors		
Major outbreaks		
Invasive species		

Other general comments to the table
National data is recorded as presence/absence on individual trees. Presence/absence point count cannot be expanded to area estimates.