Forestry Department
Food and Agriculture Organization of the United Nations

GLOBAL FOREST RESOURCES ASSESSMENT

COUNTRY REPORTS

MARSHALL ISLANDS

FRA2010/127
Rome, 2010

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).

The Global Forest Resources Assessment process is coordinated by the Forestry Department at FAO headquarters in Rome. The contact person for matters related to FRA 2010 is:

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Introduction

The Republic of the Marshall Islands is a collection of 29 atolls with over 1000 individual islands spread out over a vast distance in the north-central Pacific Ocean. Climatic data for Majuro indicates little month-to-month fluctuation in temperature and a mean monthly maximum of 30 C and minimum of 25 C. Normal annual precipitation is about 3300 mm. January, February, and March are the driest months of the year.

Much of the native vegetation on the atolls has been replaced with crops of coconut for copra production. While coconut palms provide some cover and erosion protection, they differ markedly from native vegetation.

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
Liu, Z., Fischer, L. In press. The Republic of the Marshall Islands Vegetation Mapping Using Very High Resolution Imagery: Methodology. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, Forest Health Protection. URL: http://www.fs.fed.us/r5/spf/fhp /fhm/landcover/islands/index.shtml	H	Land cover	2008	Data and methods available on the web site. Satellite data spans 2003-6.
Republic of the Marshall Islands Forest Resource Fact Sheet 2001. http://www.fs.fed.us/r5/spf/projects/factsheets/marshall.htm	M	Forest area	2001	
FAOSTAT	H	Land area and country area		

1.2.2 Classification and definitions

National class	Definition
Barren	Nonforest land that has little or no vegetation cover.
Forest	Tropical forest, agroforest, or secondary vegeation with at least 10 percent canopy cover of tree species.
Grassland	Nonforest land with less than 10 percent tree cover that supports grass, shrub, fern, or other vegetation.
Urban	Nonforest land that is urban land use.
Water	Streams, lakes, or other water bodies.

1.2.3 Original data

SELECTED FACTS, U.S. Dept. of Agriculture, Forest Service, Fact Sheet, 2001.	Numbers
Hectares of Forest Land	17992
Hectares of Non-Industrial Private Forest Land	17992

2008 landcover (preliminary) for 10 largest atoll groups in the Marshall Islands (Liu and Fischer, in press).

Atoll Group	Forest	Grassland	Barren	Urban	Water	Grand Total
			hectcres			
Ailinglaplap	1241	13	155	63	0	1472
Arno	1311	22	187	39	0	1558
Jaluit	1092	19	176	57	0	1344
Kwajalein	1023	107	258	599	0	1987
Likiep	866	54	168	41	0	1129
Majuro	481	22	138	640	0	1282
Maloelap	734	103	174	34	0	1045
Mili	1171	33	302	50	0	1557
Rongelap	634	53	208	40	0	935
Wotje	848	31	156	47	0	1082
Total	9401	459	1921	1611	0	13391

FAOSTAT Area of land: 18000 hectares

1.3 Analysis and processing of national data

1.3.1 Calibration

Calibration factor 2008 = (18000/13391) = 1.34418639384661

2008 landcover (preliminary) for 10 largest atoll groups in the Marshall Islands (Liu and Fischer, in press) adjusted for total land area reported by FAO.

Atoll Group	Forest	Grassland	Barren	Urban	Water	Grand Total
			hectcres			
Ailinglaplap	1668	17	208	85	0	1978
Arno	1762	30	251	52	0	2095
Jaluit	1468	26	236	77	0	1806
Kwajalein	1376	144	347	805	0	2671
Likiep	1164	73	225	55	0	1517
Majuro	647	30	186	860	0	1723
Maloelap	986	139	234	46	0	1405
Mili	1574	45	406	68	0	2093
Rongelap	852	71	280	54	0	1257
Wotje	1140	42	209	63	0	1455
Total	12636	617	2582	2165	0	18000

1.3.2 Estimation and forecasting

Due to lack of data, the 2008 figures have been used for all reporting years.

1.3.3 Reclassification into FRA 2010 categories

National class	FAO reclassification
Forest	Forest
Grassland	Other land
Barren	Other land
Urban	Other land
Water	Inland water bodies

1.4 Data for Table T1

FRA 2010 categories	Area (1000 hectares)			
	1990	2000	2005	2010
Forest	12.636	12.636	12.636	12.636
Other wooded land	0	0	0	0
Other land	5.364	5.364	5.364	5.364
...of which with tree cover	n.a.	n.a.	n.a.	n.a.
Inland water bodies	0	0	0	0
TOTAL	**18**	**18**	**18**	**18**

1.5 Comments to Table T1

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Forest		
Other wooded land	No data are available on the occurrence of Other wooded land. If areas of Other wooded land exist, they are included within the figure for Other land.	
Other land		
Other land with tree cover		
Inland water bodies	Original classification work tentatively identified some inland water bodies, however, these were discounted as classification errors.	

Other general comments to the table
No other inventory data exists to establish a trend; the 2008 estimate has been used for all reporting years. Fact sheet data from 2001 erroneously assumed all land was forested.

Expected year for completion of ongoing/planned national forest inventory and/or RS survey / mapping	
Field inventory	2008 2018...
Remote sensing survey / mapping	2008 2018...

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
Liu, Z., Fischer, L. In press. The Republic of the Marshall Islands Vegetation Mapping Using Very High Resolution Imagery: Methodology. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, Forest Health Protection. URL: http://www.fs.fed.us/r5/spf/fhp /fhm/landcover/islands/index.shtml	H	Land cover	2008	Data and methods available on the web site. Satellite data spans 2003-6.

2.2.2 Classification and definitions

Not available.

2.2.3 Original data

Assumes all forest land is multiple use from Table 1, Section 1.

2.3 Analysis and processing of national data

2.3.1 Calibration

Calibration factor 2008 = (18000/13391) = 1.34418639384661

2.3.2 Estimation and forecasting

Due to lack of data, the 2008 figures have been used for all reporting years.

2.3.3 Reclassification into FRA 2010 categories

Not needed.

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	12.636	12.636	12.636	12.636
Other (please specify in comments below the table)	0	0	0	0
No / unknown	0	0	0	0
TOTAL	**12.636**	**12.636**	**12.636**	**12.636**

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	Looking toward the future, the Micronesian challenge is a conservation challenge to protect at least 30 percent of the near-shore marine and 20 percent of the terrestrial resources across Micronesia by 2020.	
Forest area under sustainable forest management		
Forest area with management plan		

Other general comments to the table
No other inventory data exists to establish a trend; the 2008 estimate has been used for all reporting years.

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
Donnegan, J. A., K. Waddell, O. Kuegler, and B. A. Hiserote. 2008. Forest Inventory and Analysis: The Pacific Islands Database for American Samoa, Guam, Palau, the Northern Mariana's, Micronesia, and the Marshall Islands. Database version 2008-1. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	M	Forest type area	2008	Data were collected on 0.067 ha plots spaced at approximately 3 km intervals across the forested landscape.
Liu, Z., Fischer, L. In press. The Republic of the Marshall Islands Vegetation Mapping Using Very High Resolution Imagery:	H	Land cover	2008	Data and methods available on the web site. Satellite data spans 2003-6.

Methodology. U.S. Department of Agriculture, Forest Service, Pacific Southwest Region, Forest Health Protection. URL: http://www.fs.fed.us/r5/spf/fhp /fhm/landcover/islands/index.shtml				

3.2.2 Classification and definitions

National class	Definition
Agroforest	Land where trees, shrubs, and herbs are cultivated for food or medecines among a cover of other forest trees.
Lowland tropical rainforest	Lowland forest of tropical, primarily native and naturalized, tree species.
Mangrove forest	Lowland, tidally inundated forest composed of mangrove tree species.
Strand	Coastal forest vegetation occuring in narrow strips on sandy, rocky coasts. May include interior forest species as this vegetation grades into interior forest.

3.2.3 Original data

RMI forest cover estimated from inventory field plots, 2008	Total	SE
	hectares	
Forest type		
Agroforest	3128	627
Lowland tropical rainforest	3453	768
Mangrove	115	115
Strand	2188	607
All Types	8884	604

3.3 Analysis and processing of national data

3.3.1 Calibration

Calibrate to FAO expanded forested area (12636/8884) = 1.42233228275552

RMI forest cover estimated from inventory field plots, 2008	Total
	hectares
Forest type	
Agroforest	4449
Lowland tropical rainforest	4911
Mangrove	163
Strand	3112
All Types	12636

3.3.2 Estimation and forecasting

Due to lack of data, the 2008 figures have been used for all reporting years.

3.3.3 Reclassification into FRA 2010 categories

National class	FAO FRA 2010 Category
Agroforest	Planted forest
Lowland tropical rainforest	Primary forest
Mangrove forest	Primary forest
Strand	Primary forest

3.4 Data for Table T4

Table 4a

FRA 2010 Categories	Forest area (1000 hectares)			
	1990	2000	2005	2010
Primary forest	8.186	8.186	8.186	8.186
Other naturally regenerated forest	0	0	0	0
...of which of introduced species	n.a.	n.a.	n.a.	n.a.
Planted forest	4.449	4.449	4.449	4.449
...of which of introduced species	n.a.	n.a.	n.a.	n.a.
TOTAL	**12.636**	**12.636**	**12.636**	**12.636**

Table 4b

FRA 2010 Categories	Area (1000 hectares)			
	1990	2000	2005	2010
Rubber plantations (Forest)	0	0	0	0
Mangroves (Forest and OWL)	0.163	0.163	0.163	0.163
Bamboo (Forest and OWL)	0	0	0	0

3.5 Comments to Table T4

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Primary forest	The reported area of primary forest contain an unknown area of Other naturally regenerated forest.	
Other naturally regenerating forest		
Planted forest		
Rubber plantations		
Mangroves		
Bamboo		

Other general comments to the table
The above estimates redistribute the total forest area that was estimated from remotely sensed data (Table 1, Section 1) into categories of forest type based on the field plot area sampled on a systematic grid of plots. No other inventory data exists to establish a trend; the 2008 estimate has been used for all reporting years.

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., K. Waddell, O. Kuegler, and B. A. Hiserote. 2008. Forest Inventory and Analysis: The Pacific Islands Database for American Samoa, Guam, Palau, the Northern Mariana's, Micronesia, and the Marshall Islands. Database version 2008-1. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Forest land volume	2008	Data are collected on 0.067 ha plots spaced at approximately 3 km intervals across the forested landscape.

4.2.2 Classification and definitions

National class	Definition
Net growing stock volume	Volume over bark of all living trees more than 12.5 cm in diameter at breast height (or above buttress and stilted roots if these are higher) minus rotten cull. Includes the stem from ground level to a top diameter of 1 cm. Does not include branches off of the main stem.
Timberland volume	Volume of wood on land that is capable of producing at least 1.4 cubic meters per hectare per year of industrial wood.

4.2.3 Original data

RMI 2008: Net volume (thousand m^3) of live trees ≥ 12.5 cm d.b.h. on all forest land.	Total	
	Total	SE
	cubic meters	
Cocos nucifera	1038742	161062
Pandanus tectorius	94998	22699
Guettarda speciosa	86636	23978
Pisonia grandis	78995	32714
Bruguiera gymnorrhiza	66079	54864
Neisosperma oppositifolia	37305	18665
Cordia subcordata	28429	25557
Tournefortia argentea	38278	24869
Artocarpus mariannensis	19008	19008
Artocarpus altilis	10026	7546
Remaining	28549	10828
Total	1527046	187580

4.3 Analysis and processing of national data

4.3.1 Calibration

Calibration factor 2008 = (18000/13391) = 1.34418639384661

RMI 2008: Net volume (thousand m^3) of live trees ≥ 12.5 cm d.b.h. on all forest land calibrated by FAO area estimate	
Species	**Total**
	cubic meters
Cocos nucifera	1396263
Pandanus tectorius	127695
Guettarda speciosa	116455
Pisonia grandis	106184
Bruguiera gymnorrhiza	88822
Neisosperma oppositifolia	50145
Cordia subcordata	38214
Tournefortia argentea	51453
Artocarpus mariannensis	25550
Artocarpus altilis	13477
Remaining	38375
Total	2052634

4.3.2 Estimation and forecasting

Due to lack of data, the 2008 figures have been used for all reporting years.

4.3.3 Reclassification into FRA 2010 categories

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	2.053	2.053	2.053	2.053				
... of which coniferous	0	0	0	0				
... of which broadleaved	2.053	2.053	2.053	2.053				
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*	nu	n.a.	n.a.	1.396
2nd	*Pandanus tectorius*	bôb	n.a.	n.a.	0.128
3rd	*Guettarda speciosa*	mosor	n.a.	n.a.	0.116
4th	*Pisonia grandis*	mok	n.a.	n.a.	0.106
5th	*Bruguiera gymnorrhiza*	ong	n.a.	n.a.	0.089
6th	*Neisosperma oppositifolia*	umwa	n.a.	n.a.	0.050
7th	*Cordia subcordata*	anno, alau	n.a.	n.a.	0.038
8th	*Tournefortia argentea*	amoneset	n.a.	n.a.	0.051
9th	*Artocarpus mariannensis*	breadfruit	n.a.	n.a.	0.026
10th	*Artocarpus altilis*	mai	n.a.	n.a.	0.013
Remaining			n.a.	n.a.	0.038
TOTAL					2.053

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)	12.5	
Minimum diameter (cm) at the top end of stem for calculation of growing stock (Y)	1	
Minimum diameter (cm) of branches included in growing stock (W)		
Volume refers to "above ground" (AG) or "above stump" (AS)	AS	

[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.

4.5 Comments to Table T6

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Total growing stock		
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; the 2008 estimate has been used for all reporting years.

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., K. Waddell, O. Kuegler, and B. A. Hiserote. 2008. Forest Inventory and Analysis: The Pacific Islands Database for American Samoa, Guam, Palau, the Northern Mariana's, Micronesia, and the Marshall Islands. Database version 2008-1. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Biomass	2008	Data are collected on 0.067 ha plots spaced at approximately 3 km intervals across the forested landscape.
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	

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

2008 stem biomass, RMI						
	Live		Dead		Total	
	Total	SE[1]	Total	SE	Total	SE
	metric tonnes					
Cocos nucifera	520141	80697	17066	6065	537207	82769
Pandanus tectorius	48183	11552	647	445	48829	11613
Guettarda speciosa	48817	12317	1422	977	50238	12736
Pisonia grandis	40841	16846	0	0	40841	16846
Bruguiera gymnorrhiza	35968	30108	3095	3095	39063	33141
Neisosperma oppositifolia	20013	10137	698	578	20711	10448
Cordia subcordata	15041	13585	1381	1381	16422	14962
Tournefortia argentea	19807	12550	220	220	20028	12551
Artocarpus mariannensis	9505	9505	0	0	9505	9505
Artocarpus altilis	10306	7274	0	0	10306	7274
Remaining	25580	6397	882	683	26462	6926
Total	794200	96491	25410	6857	819611	99575

[1]SE = Standard error.

5.3 Analysis and processing of national data

5.3.1 Calibration

Calibration factor 2008 = (18000/13391) = 1.34418639384661
Biomass was calculated using total stem volume and wood density, a biomass expansion factor to estimate branches, leaves, and seeds (3.4; tropical broadleaf), and an aboveground to belowground ratio estimator (0.27; tropical/sub-tropical dry forest).

2008 stem biomass, RMI calibrated by FAO area			
Species	Live Total	Dead Total	All Total
		metric tonnes	
Cocos nucifera	699166	22940	722106
Pandanus tectorius	64767	869	65636
Guettarda speciosa	65618	1911	67529
Pisonia grandis	54897	0	54897
Bruguiera gymnorrhiza	48348	4161	52508
Neisosperma oppositifolia	26902	938	27839
Cordia subcordata	20218	1856	22074
Tournefortia argentea	26625	296	26921
Artocarpus mariannensis	12776	0	12776
Artocarpus altilis	13853	0	13853
Remaining	34384	1185	35569
Total	1067553	34156	1101709

5.3.2 Estimation and forecasting

Due to lack of data, the 2008 figures have been used for all reporting years.

5.3.3 Reclassification into FRA 2010 categories

Live above-ground stem biomass = Above-ground biomass
Dead above-ground stem biomass = Dead wood
Total above-ground stem biomass = TOTAL

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	3.63	3.63	3.63	3.63				
Below-ground biomass	0.98	0.98	0.98	0.98				
Dead wood	0.03	0.03	0.03	0.03				
TOTAL	4.65	4.65	4.65	4.65				

5.5 Comments to Table T7

Variable / category	Comments related to data, definitions, etc.	Comments on the reported trend
Above-ground biomass	Does not include branch, leaf, or root biomass.	
Below-ground biomass		
Dead wood	Does not include branch or root biomass.	

Other general comments to the table
No other inventory data exists to establish a trend; the 2008 estimate has been used for all reporting years.

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., K. Waddell, O. Kuegler, and B. A. Hiserote. 2008. Forest Inventory and Analysis: The Pacific Islands Database for American Samoa, Guam, Palau, the Northern Mariana's, Micronesia, and the Marshall Islands. Database version 2008-1. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.	H	Carbon	2005-6	Data are collected on 0.067 ha plots spaced at approximately 3 km intervals across the forested landscape.
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 breast 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

RMI carbon 2008

	Live		Dead		Total	
	Total	**SE**	**Total**	**SE**	**Total**	**SE**
			metric tonnes			
Cocos nucifera	260070	40349	8533	3032	268603	41385
Pandanus tectorius	24091	5776	323	222	24415	5806
Guettarda speciosa	24409	6159	710	488	25119	6368
Pisonia grandis	20421	8423			20421	8423
Bruguiera gymnorrhiza	17984	15054	1548	1548	19532	16571
Neisosperma oppositifolia	10007	5068	348	289	10356	5224
Cordia subcordata	7521	6793	690	690	8211	7481
Tournefortia argentea	9904	6275	110	110	10014	6276
Artocarpus mariannensis	4752	4752			4752	4752
Artocarpus altilis	5153	3637			5153	3637
Remaining	12789	3199	441	342	13230	3464
Total	**397100**	**48246**	**12705**	**3428**	**409805**	**49788**

[1]SE = Standard error.

6.3 Analysis and processing of national data

6.3.1 Calibration

Calibration factor 2008 = (18000/13391) = 1.34418639384661
Carbon mass was estimated as ½ biomass.

RMI carbon 2008 calibrated by FAO area

	Live Total	Dead Total	All Total
		metric tonnes	
Cocos nucifera	349582	11470	361052
Pandanus tectorius	32383	434	32818
Guettarda speciosa	32810	955	33765
Pisonia grandis	27449		27449
Bruguiera gymnorrhiza	24174	2080	26254
Neisosperma oppositifolia	13451	468	13920
Cordia subcordata	10109	928	11037
Tournefortia argentea	13312	148	13460
Artocarpus mariannensis	6387		6387

Artocarpus altilis	6926		6926
Remaining	17191	593	17784
Total	**533777**	**17078**	**550855**

6.3.2 Estimation and forecasting

Due to lack of data, the 2008 figures have been used for all reporting years.

6.3.3 Reclassification into FRA 2010 categories

Carbon in above-ground tree stem biomass = Carbon in above-ground biomass
Carbon in dead tree stem biomass = Carbon in dead wood

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	1.82	1.82	1.82	1.82				
Carbon in below-ground biomass	0.49	0.49	0.49	0.49				
Sub-total: Living biomass	2.31	2.31	2.31	2.31				
Carbon in dead wood	0.02	0.02	0.02	0.02				
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 standing dead tree stems only. Does not include branches, bark, seeds, and foliage.	

Carbon in litter		
Soil carbon		

Other general comments to the table
No other inventory data exists to establish a trend; the 2008 estimate has been used for all reporting years.

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., K. Waddell, O. Kuegler, and B. A. Hiserote. 2008. Forest Inventory and Analysis: The Pacific Islands Database for American Samoa, Guam, Palau, the Northern Mariana's, Micronesia, and the	H	Damages on trees, presence/absence	2005-6	Data are collected on 0.067 ha plots spaced at approximately 3 km intervals across the forested landscape.

Marshall Islands. Database version 2008-1. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.				

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

RMI, number of trees by species by damaging agent, 2008

	Insects		Disease		Fire		Weather		Vegetation	
Species	**Total**	**SE**	**Total**	**SE**	**Total**	**SE**	**Total**	**SE**	**Total**	**SE**
					thousand trees					
Cocos nucifera	9	7	11	8	20	13	23	17	3	3
Pandanus tectorius	3	3	3	3	7	5	13	6	17	14
Guettarda speciosa	669	436	--	--	--	--	85	85	133	90
Pisonia grandis	--	--	--	--	--	--	381	337	31	27
Bruguiera gymnorrhiza	--	--	24	21	--	--	--	--	--	--
Tournefortia argentea	8	6	3	3	--	--	--	--	5	5
Neisosperma oppositifolia	--	--	--	--	4	4	--	--	--	--
Cordia subcordata	--	--	--	--	--	--	20	20	--	--
Artocarpus mariannensis	--	--	--	--	--	--	--	--	--	--
Pemphis acidula	--	--	--	--	--	--	--	--	--	--
Artocarpus altilis	7	5	3	3	--	--	--	--	--	--
Intsia bijuga	3	3	--	--	--	--	--	--	--	--
Terminalia samoensis	--	--	--	--	--	--	5	5	--	--
Premna serratifolia	181	107	--	--	--	--	--	--	--	--
Allophylus timorensis	--	--	42	42	--	--	--	--	--	--
Scaevola taccada	1462	808	--	--	--	--	--	--	85	59
Morinda citrifolia	--	--	--	--	--	--	4	4	591	456
Total	2343	968	87	52	31	14	532	422	865	484

Continued—RMI, number of trees by species by damaging agent, 2008

			Human caused		Physical		All damaged trees		All trees	
Species	**Total**	**SE**	**Total**	**SE**	**Total**	**SE**	**Total**	**SE**	**Total**	**SE**
Cocos nucifera	39	14	7	5	--	--	105	29	2031	284
Pandanus tectorius	20	12	--	--	--	--	57	19	784	204
Guettarda speciosa	186	55	54	43	--	--	1060	478	1795	551
Pisonia grandis	104	87	--	--	--	--	505	348	574	365
Bruguiera gymnorrhiza	10	10	--	--	--	--	31	27	369	273
Tournefortia argentea	51	26	--	--	--	--	55	26	162	96
Neisosperma oppositifolia	79	63	--	--	--	--	83	64	765	425
Cordia subcordata	66	52	--	--	--	--	83	69	155	129
Artocarpus mariannensis	--	--	--	--	--	--	--	--	20	20
Pemphis acidula	36	36	--	--	--	--	36	36	107	72
Artocarpus altilis	--	--	--	--	--	--	7	5	17	9
Intsia bijuga	7	7	--	--	--	--	10	10	19	15
Terminalia samoensis	21	18	--	--	5	5	30	23	39	23
Premna serratifolia	3	3	--	--	--	--	184	109	402	247
Allophylus timorensis	49	49	--	--	--	--	49	49	184	136
Scaevola taccada	113	113	--	--	--	--	1604	863	4156	1338
Morinda citrifolia	42	42	--	--	--	--	637	457	1415	552
Total	826	188	61	43	5	5	4537	1248	12993	2041

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

None.

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 numbers are recorded on an individual tree basis and expanded to the population as an estimated number of trees affected by damaging agent.