

## **Accountability of afforestation, reforestation and deforestation**

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### **1. INTRODUCTION**

Ohayo gozaimasu! Good morning - it is a great honor and pleasure to be here at your very timely meeting on Global Environmental Issues and World Forests.

For several years, scientists have been saying that the world's climate is warming up. According to the World Meteorological Organization (WMO) the year 1998 proved to be one of the hottest years on record (WMO 1998). If unchecked, global warming may have two affects that are of interest to us - changing of vegetation and the possible raising of sea levels and the inundation of coastal towns and cities. Sweda (1993) concludes that the magnitude of change in vegetation will surpass what has taken nature 10000 to tens of millions of years to accomplish. Both the vegetation change and flooding could spell economic and social disaster for the countries involved. Scientists attribute the increased emissions of gases (carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride) to the atmosphere as the primary cause of global warming. These gases - known as greenhouse gases--tend to trap the sun's heat. Major sources of greenhouse gases include the burning of fossil fuels (gas, oil, and coal), forest destruction, and agriculture. With increasing human populations and development, increased emissions to the atmosphere are probable thus increasing the risks of global warming. Whether or not global warming is a reality, nations are reacting in a positive manner.

In 1992, at the United Nations Conference on Environment and Development (UNCED), world leaders adopted the United Nations Framework Convention on Climate Change (UNFCCC). The UNFCCC aims at stabilizing the concentration of greenhouse gases in the atmosphere in an effort to prevent human-caused disturbances to the global climatic system. The Convention commits the Parties to carry out national inventories of greenhouse gas emissions and sinks, and to work toward meeting their voluntary emissions reduction goals (FAO 1999). However, the UNFCCC was not legally binding. To put some meaning into the Convention, the Conference of Parties (COP) met in Kyoto, Japan in December 1997. The COP developed the Kyoto Protocol to which some 160 countries agreed.

The Protocol established legally-binding commitments from developed countries and countries with economies in transition (Annex I countries) to reduce their overall emissions of the six greenhouse gases to at least 5% below 1990 levels between 2008 and 2012 (first commitment period). The U.S. agreed to 7% reductions, the European Union 8%, and Japan 6%.

There are many ways emissions may be reduced among which are reducing the use of fossil fuels and the planting of more forests. According to FAO (1999) *"Forests play a significant role in moderating the net flux of greenhouse gases between land and atmosphere. Forests act as reservoirs by storing carbon in biomass and soils. They act as carbon sinks when their area or productivity is increased, resulting in greater uptake of atmospheric CO<sub>2</sub>. Conversely, they act as a source of green when the burning and decay of biomass and the disturbance of soil result in emissions of CO<sub>2</sub> and other greenhouse gases. Changes in land use (primarily deforestation occurring mainly in tropical areas) currently constitute about 20 percent of global anthropogenic CO<sub>2</sub> emissions. Appropriate forest management decisions can result in cost-effective net reductions in greenhouse gas emissions, either by diminishing the contribution of forests to global net emissions, or by enhancing their importance as carbon sinks. By providing renewable materials and fuels - thereby reducing reliance on fossil fuels - and still maintaining their role as carbon reservoirs, forests can make a long-term contribution to mitigating climate change."*

Details of the Kyoto Protocol may be found at [www.unfccc.de](http://www.unfccc.de). Article 3.3 states that:

*The net changes in greenhouse gas emissions from sources and removals by sinks resulting from direct human-induced land use change and forestry activities, limited to afforestation, reforestation, and deforestation since 1990, measured as verifiable changes in stocks in each commitment period shall be used to meet the commitments in this Article [i.e. emission limits for the first commitment period] of each Party included in Annex 1. The greenhouse gas emissions by source and removals by sinks shall be reported in a transparent and verifiable manner and reviewed in accordance with Articles 7 & 8.*

One may assume from such a statement that there will be some accounting for changes in forests due to afforestation, reforestation and deforestation (ARD) nationally and globally.

Unfortunately, the ARD terms were not defined in the Kyoto Protocol and how they are interpreted could vary nationally. Clear definitions are required for accurate global accounting and reporting. Consequently, the UNFCCC (1998) Secretariat, through the Subsidiary Body for Scientific and Technological Advice (SBSTA) called for clarification of the use of ARD.

To respond to the UNFCCC request, the International Union of Forestry Research Organizations, Working Unit 6.03.02 undertook a study and discussion

of the magnitude of ARD definitions in use. The study, which still continues, involves a literature review, web search and Internet requests and discussions. This paper reports on what we learned from that study (see Lund 1999) and what are some of the implications of various interpretations of ARD for the Kyoto Protocol.

## 1. FINDINGS

ARD are actions that bring about changes in a nation's forest base. Many countries had official or legal definitions of "forest" or "forest land" but few had official or legal definitions of the ARD terms. If ARD are considered actions taken to change the amount of land a country classifies as "forest" then, one must have an understanding of how "forest" interpreted nationally. Further, to understand how "forest" is defined, we also have to understand how a nation defines "tree." Lastly, the definitions of both "forest" and "tree" are important to the people who are accountable for providing reliable statistics - those that have to inventory and assess changes in a nation's forest resource base. Thus, in our quest for definitions of ARD actions, we also sought definitions of the base terms "forest" and "tree" and any corresponding thresholds. Thresholds are criteria that help sort out if lands should be included in the definition of forest or excluded.

### 2.1 Base terms

#### 2.1.1 What is a Forest?

"Forest" comes from 'foris', a Latin word that means 'out of doors', in this case 'out of civilisation' (Le Goff (1967) and Makkonen (1974: 18-19)). "Forest" may be defined as a proclaimed or administrative unit, land cover, land use or a combination land cover/land use. The following are examples of each type of definition:

##### Administrative Unit

(USA) (National Forest) - *A unit formally established and permanently set aside and reserved for National Forest purposes.* ([www.fs.fed.us/database/lar/lardefn.htm](http://www.fs.fed.us/database/lar/lardefn.htm)). An example would be the Ochoco National Forest.

##### Land Cover

(Malaysia) - *An ecosystem with a minimum of 10 percent crown cover of trees and / or bamboos, generally associated with wild flora, fauna and natural soil conditions, and not subject to agricultural practices. This definition is also applied to the term "forest land".* From: [hcthang@forestry.gov.my](mailto:hcthang@forestry.gov.my) (Thang Hooi Chiew), Forestry Department Peninsular Malaysia

##### Land Use

(Japan - legal definition) - *1) Land aimed at growing a group of trees (includes a non-forested land at present) or 2) a mountainous area with tree cover registered as 'forest' on a land register. Note: House lots and shrine enclosures*

*being not aimed at growing trees are not forests even if they are covered with trees.* Yukichi Konohira <Konohira@cc.tuat.ac.jp>

Note many land use definitions also included threshold values for tree crown cover and other attributes. An example is that being used for the Global Forest Resource Assessment 2000.

*Land with tree crown cover (or equivalent stocking level) of more than 10 percent and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity in situ. May consist either of closed forest formations where trees of various storeys and undergrowth cover a high portion of the ground; or of open forest formations with a continuous vegetation cover in which tree cover exceeds 10 percent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 10 percent or tree height of 5 m are included under forest, as are temporarily unstocked as a result of human intervention or natural causes but which are expected to revert to forest. Includes: Forest nurseries and seed orchards that constitute an integral part of the forest; forest roads, cleared tracts, firebreaks, and other small open areas within the forest; forest in national parks, nature reserves and other protected areas such as those of special environmental, scientific, historical, cultural, or spiritual interest; windbreaks and shelterbelts of trees with an area of more than 0.5 ha and a width of more than 20 m. Rubberwood plantations and cork oak stands are included. Excludes: Land predominantly used for agricultural practices (UN-ECE/FAO 1997).*

We found over 150 definitions of forest and forest land. Over 50 of these were national or legal definitions grouped as indicated in Table 1.

**Table 1 - Listing of national forest land definitions by type. An entry in a cell means that type of definition is used in that country. Where there is more than one entry per row, there was more than one definition found for that country. Source: Lund (1999).**

Country	Forest land as defined as:		
	An administrative unit (Forest)	A land cover (forest or forested land)	A land use (forest land)
Argentina		X	
Australia			X
Austria		X	X
Belgium			X

Bolivia		X	X
Cameroon		X	
Canada			X
Chile		X	
China		X	
Croatia		X	
Czech Republic			X
Denmark			X
Eritrea		X	
Estonia		X	X
Ethiopia		X	
Finland			X
France		X	
Germany			X
Greece			X
Hungary			X
Iceland		X	X
India	X	X	
Ireland			X
Italy	X		X
Japan		X	X
Kenya		X	
Latvia		X	X

Liechtenstein		X	
Malawi		X	
Malaysia		X	
Mexico		X	X
Morocco	X	X	
Mozambique		X	
Namibia		X	
Netherlands			X
New Zealand		X	X
Norway			X
Papua New Guinea		X	
Poland			X
Portugal		X	X
Russia		X	
Slovenia		X	
Somalia		X	
South Africa		X	
Spain		X	
Sudan		X	
Sweden			X
Switzerland		X	
Tanzania		X	
Thailand			X

Uganda	X		
Ukraine		X	
United Kingdom			X
USA	USFS-NFS	FGDC, NPS	USFS, NRCS, USGS
Yemen		X	
Zimbabwe		X	
United Nations		UNESCO	FRA

### 2.1.2 What is a Tree?

To understand what a forest is, we also need a description of tree. Many of the forest definitions included parameters for qualifying trees. The previously cited FRA 2000 definition is one example. In addition to those contained in the "forest" terminology, we found nearly 40 meanings of tree. Here are three examples. The first is a general purpose definition, the second one with a threshold, and the last - one that includes other kinds of vegetation.

#### General purpose

(Estonia)[puud] - *Long-lived higher plants with lignified stem.* Estonian Encyclopedia From: "Sulev Svilponis" Sulev@ekm.envir.ee. Definitions are unofficial translations.

#### Definition with threshold

(Japan) *A woody perennial plant whose cambium makes secondary growth (often includes tree ferns and bamboo). High tree: a tree with enough height (usually more than 5m) and with a stem readily distinguishable from branches. Low tree: a tree with a certain height limit and the general absence of a well-defined main stem.* Yukichi Konohira Konohira@cc.tuat.ac.jp.

#### Definition with other vegetation

(Tanzania) - *Includes palms, bamboos, canes, shrubs, bushes, plants, poles, climbers, seedlings, saplings and regrowth thereof, all ages and all kinds and part.* From: Tanzania Forest policy, Roger Malimbwi, Faculty of Forestry <forestry@sua.ac.tz

### 2.1.3 Thresholds

Several definitions of forest and tree have built-in height thresholds varying from 2-8 m. Some height thresholds include words such as "at maturity." This leads one to wonder if any other thresholds that may be included are also "at maturity." Additional thresholds included minimum area and minimum tree

crown cover. Some definitions included exclusions. Table 2 lists the thresholds and exclusions we found for national definitions of forest and tree.

**Table 2 - Threshold values used for defining forest land. Blanks mean no threshold values were stipulated in the national definitions. Source: Lund (1999)**

Countries for which "forest" definitions were found	Threshold values			Exclusions
	Min. Area (ha)	Min. Crown Cover (%)	Min. Tree Height (m)	
Argentina				
Australia 1		20	2	
Australia 2		30	5	
Austria	0.1	30		Strips of trees less than 10 m wide
Belgium (Walloon Region)	100			
Belgium (Flemish Region)	20	20		Strips of trees less than 25 m wide.
Bolivia				
Cameroon		30	5	
Canada				
Chile	5	10		Degraded areas, and areas used for agriculture, fruit trees and intense grazing
China		20		
Croatia				
Czech	0.01			Strips of trees less than 20 m.



Republic				
Denmark	0.5		6	Trees in strips less than 30 m wide.
Eritrea		10		
Estonia	0.5	30	1.3	
Ethiopia		68	7	
Finland				Land producing less than 1m <sup>3</sup> /ha stemwood
France	2	10		
Germany		50		
Greece	0.5	10		
Hungary	0.15			
Iceland				
India		10		
Ireland				
Italy	0.2	20		City parks, gardens, nurseries, orchards
Japan		30	5	Agricultural lands, and lands used for housing
Kenya		40	2	
Latvia				
Liechtenstein		20		
Malawi		80		
Malaysia		10	5	
Mexico	0.15	10	3	Urban areas, permanently degraded areas, agricultural

				lands
Morocco	3	20	7	
Mozambique		25	7	
Namibia		20	5	
Netherlands	0.5	20		Strips of trees less than 30 m wide.
New Zealand 2	5	20	6	
Norway				
Papua New Guinea	100	10	5	
Poland	0.1			
Portugal	0.2	15	1.5	Strips of trees less than 15 m wide.
Russia		30		
Slovenia				Individual trees, riverine and windbelt trees, plantations, etc.
Somalia		20	5	
South Africa		75	3	
Spain		10		
Sudan		40	10	
Sweden	0.25			Land producing less than 1m <sup>3</sup> /ha stemwood
Switzerland		20		
Tanzania				
Uganda				

Ukraine				
United Kingdom	1	20		Strips of trees less than 50 m wide.
USA-FWS			6	
USA-NPS		60	5	
USA-NRCS	0.4	25	4	Strips of trees less than 30 m wide.
USA-USFS	0.4	10	4	Strips of trees less than 36 m wide
USA-USGS	0.4	20	2	
Yemen	3	10	5	
Zimbabwe		80	15	
United Nations -FRA	0.5	10	5	Strips of trees less than 20 m wide and land used primarily for agricultural purposes
United Nations - Land Use				Woodland or forest used only for recreation purposes. Stands of permanent crops such as rubber, fruit trees, nut trees, are classed as permanent crops under agricultural lands
United Nations - LCCS			3	
UNESCO		40	5	

## 2.3 ARD Actions

Afforestation, reforestation, and deforestation are actions or acts that nations must account for under the Kyoto Protocol.

### 2.3.1 What is Afforestation?

Afforestation is generally regarded as a sink in the accounting for greenhouse gases. We found nearly 40 definitions of afforestation. Afforestation may be a legal term or a process of stocking land. In the case of the latter, we group the definitions into those that imply a change in land cover only and those that

imply a change in land cover and use. Four definitions specify "crops" implying that the trees will be later removed for commercial purposes. The time period for lands "never having been forested" vary from never to 30 to 100 years.

Establishment of a new land cover

(Australia and New Zealand) *The establishment of a species of forest on an area where it does not occur naturally* (British Commonwealth Terminology) (Ford-Robertson 1971).

Establishment of a new land cover and use.

(USA) *Establishment of forest crops by artificial methods, such as planting or sowing on land where trees have never grown.* (Stokes et al. 1987).

Table 3 summarizes the interpretations of "afforestation" by country.

Table 3 - Listing of national "Afforestation" definitions by type. Where there is more than one entry per row, there was more than one definition found for that country. Source: Lund (1999).		
Country	Afforestation defined as:	
	Establishing a new land cover	Establishing a new land cover and use
Australia	X	
Austria		X
Bolivia	X	
Canada		X
Denmark		X
Hungary	X	
India	X	
Italy		X
Latvia	X	
Malaysia	X	
Morocco	X	

New Zealand	X	
Papua New Guinea	X	
Ukraine	X	
USA		X
Yemen	X	
United Nations	X	

### 2.3.2 What is Reforestation?

Reforestation is usually viewed a neutral action when computing areas that serve as sinks or emissions. We found over 40 definitions that could be grouped by restoration of land cover or land cover and use. Four specified the planting of "crops." Example definitions are as follows:

#### Restoration of land cover

(Austria) (Wiederbewaldung): *Reforestation areas are temporarily unstocked areas caused by harvesting, wind breaks, natural disasters and so on. These areas have to be reforested artificially (usually within 3 years, under certain circumstances within maximal 8 years) or with methods of natural regeneration (usually within 8 years, under certain circumstances within maximal 11 years). In Austria reforestation has always been recognized as a part of forest management and has never been linked up to land use change.* (Austrian Forestry Act (Federal Legal Gazette no. 440/1975, as amended Federal Legal Gazette 231/1977, 142/1978 and 576/1987) From: Weiss Peter weissp@ubavie.gv.at)

#### Restoration of land cover and use

(India) *Bringing any deforested land under forest cover.* [Source: Glossary of Technical Terms, Forest Research Institute, India. From: "Vivek K. Varma" <v.varma@landfood.unimelb.edu.au Date: Fri, 17 Jul 1998 02:28:29 -0400 (EDT)]

Table 4 summarizes the interpretations of "reforestation" by country.

Table 4 - Listing of national "Reforestation" definitions by type. Where there is more than one entry per row, there was more than one definition found for that country. Source: Lund (1999).		
Country	Reforestation as defined as:	
	A restoration of land cover	A restoration of land cover and use

Austria	X	
Bolivia		X
Brazil	X	
Canada	X	
Chile	X	
Denmark	X	
India		X
Italy	X	
Latvia		X
Malaysia	X	
Morocco	X	
Russia	X	
Ukraine		X
United Kingdom	X	
USA	X	
Yemen	X	
<b>United Nations</b>	X	

### 2.3.3 What is Deforestation?

Deforestation is generally viewed as an greenhouse gas emission. We found over 40 definitions of "deforestation." Definitions are grouped depending on if they are changes in land cover, land use or both.

Land cover change

(Canada) *To clear an area of forests or trees, usually for commercial use of the lumber or agricultural use of the land.*  
<http://environment.nelson.com/glossary.html#D>

## Land use change

(Italy) *A loss of forest area because of change of land use to agricultural lands, barren lands, buildings, roads, pipelines, etc. Burned forest areas are not considered deforested.* (ISTAT).

## Land cover and use change

(Papua New Guinea) *The removal of trees from forestland and subsequent conversion of land-use from forestry to other such as agriculture.* Vitus Ambia, Papua New Guinea Forest Authority.

Table 5 summarizes the interpretations of "deforestation" by country.

Table 5 - Listing of national "Deforestation" land definitions by type. Where there is more than one entry per row, there was more than one definition found for that country. Source: Lund (1999).			
Country	Deforestation defined as:		
	A change in land cover	A change in land use	A change in land cover and use
Austria			X
Bolivia	X		
Canada	X		X
India			X
Italy		X	
Malaysia		X	
Morocco	X		
Papua New Guinea			X
Uganda	X		
Yemen	X		
United Nations	X	X	

### 3. Interpretations and implications.

Table 6 lists some interpretations of afforestation, reforestation and deforestation according as to how one defines forest or forest land.

Table 6 - Definitions of deforestation, reforestation, and afforestation by interpretation of " <i>Forest</i> " or " <i>Forest Land</i> "				
Change action	<i>Forest</i> or <i>forest land</i> interpreted as:			
	An administrative unit	A land cover	A land use	A combination land cover and use
<b>Deforestation</b> Generic definition: The act or process of changing forest land to non-forest land.	The act of changing the proclamation of the land to a category other than "Forest"	The act of reducing the tree cover to below the threshold value for "Forest."	The act changing the employment of the land to some other use other than forestry purposes.	The act of removing tree cover to below the threshold value for "forest cover" and changing the employment of the land to some use other than forestry.
<b>Reforestation</b> Generic definition: The act or process of changing previously (historically) deforested lands back to forest land.	The act of re-proclaiming land previously listed as "Forest" as "Forest."	The act of re-establishing tree cover where it once existed to meet or exceed the threshold value for "Forest."	The act of reestablishing use back to forestry purposes.	The act of re-establishing tree cover where it once existed to meet or exceed the threshold value for "forest cover" and where the land use has been or is currently used for forestry purposes.
<b>Afforestation</b>	The act of	The act of	The act of	The act of



Generic definition: The act or process of creating forest land where it previously (historically) did not exist	proclaiming land as "Forest" where it was not previously (historically) so designated.	establishing tree cover, where it previously (historically) has not existed, to meet or exceed the threshold value for "Forest."	establishing forest use where it previously (historically) has not existed.	establishing tree cover, where it previously (historically) has not existed, to meet or exceed the threshold value for "forest cover," where the land will be used for forestry purposes, and where it has not been previously (historically) been used for such employment.
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### 3.1 From an administrative unit interpretation

If taken literally:

*Forest land* would be *lands proclaimed as National Forests*.

*Afforestation* would be *the designation of lands that have never been designated a national forest*.

*Reforestation* would be *the reclassification of lands that were once classed as a national forest, then unclassified, and then classed as national forests once again*.

*Deforestation* could be *the redesignation of a national forest to some other class such as private ownership or a national park*.

Accounting is very straight-forward. Administrative units are usually mapped. If lands are in, they are Forest. If out - they are something else. The Forest lands may or may not contain trees and the ARD terms would have nothing what-so-ever to do with changes in carbon sinks or emissions. Fortunately there are only a very few cases where countries use this interpretation of forest land.

### 3.2 From a land cover interpretation

If taken literally:

*Forested land* would be *any land that has tree cover above a certain threshold crown cover percentage. This would include orchards, urban areas, etc.*

*Afforestation* would be *the establishment of tree cover on areas not formerly classes as forest land with canopy cover equal to or exceeding the threshold for forest land.*

*Reforestation* would be *the restoration of tree cover on areas formerly classed as forest land to at least the threshold canopy cover or greater.*

*Deforestation* would be *the removal of tree cover below the threshold for "forest land" regardless if the reduction is permanent or not.* Such a definition may not be politically acceptable. On the other hand, if such a loss of biomass is not tracked, one could remove the overstory to within the crown cover threshold and not be required to report any emissions since the land still qualifies as forest.

Under a land cover scheme the planting of trees may be considered afforestation or reforestation. However, the land would not be called forested until the trees and canopy closure met or exceeded the threshold values.

One may easily obtain estimates of a land cover and land cover changes from remote sensing depending on sensor and scale. Thus accounting would be rather straight forward. Determining if the change is human-induced or not may be more difficult. Of the ARD terms, deforestation is the most likely brought about by both human-induced activities and natural phenomenon. Countries do not want to be penalized for emissions brought about by natural disasters - earthquakes, volcanic eruptions, hurricanes, wild fire, flood, etc. However, many countries would have records of where these events took place so any other changes in forest cover would be assumed to be human-induced.

### 3.3 From a land use interpretation

If taken literally:

*Forest land* would be *any land used for forestry activities regardless if there were trees present or not.* Forestry activities would have to be defined. If forestry activities include soil and water protection, recreation, enhancing scenic values and wildlife habitat, then most any land capable of supporting trees would qualify including urban areas, orchards, and agricultural lands.

*Afforestation* would be *the designation of land for forestry activities where they had never been carried out before.* Again, changes in tree cover may or may not take place.

*Reforestation* would be *the reestablishment of forest use where it previously existed.* Reforestation, under this definition, would not necessarily mean the replacement of tree cover.

*Deforestation* would be a change of land use from forestry to some other use regardless if the tree cover were removed or not. If protected areas, wilderness and national parks for example are not considered forestry activities, then a change of management or designation of otherwise timber producing lands to these categories would be considered deforestation even though there is not change of biomass or tree cover. If changes in biomass (growth, decline) are not to be tracked then a nation could clear cut all its forest lands and still report the lands as forest lands. If change of a designation of forest land to protected, wilderness, or national park is considered a change in land administration or use, and if change in land use is considered deforestation and if deforestation is considered an emission, then a nation may be reluctant to protect or preserve its forest resources.

Under a land use interpretation, one would not reforest a deforested site unless there was a corresponding change in land use. Similarly, one would not afforest land unless it was the intent to manage the trees for forestry purposes. The mere planting of trees on "non-forest land" would not necessarily be considered afforestation unless there also was a change in the land use.

Land use depends on each individual owner wants and needs. This is very difficult to determine except by the use of questionnaires and on the ground interviews. Therefore accounting will be more difficult. All changes in land use would be human induced, as they are decisions on how the land is to be utilized.

The separation of the functions of trees and land use is also very difficult. Table 7 lists some of the major roles trees serve under various land use settings. The question arises which are considered forestry activities and which are not.

Table 7 - Roles of trees in various settings			
Functions provided	Forest	Urban	Plantation (Timber or Agriculture crop)
Wood/crop production	Usually - note some forested areas like national parks, may not be used for wood production.	Sometimes	Yes
Soil stabilization	Yes	Yes	Yes
Watershed protection	Yes	Yes	Yes

Air filtration	Yes	Yes	Yes
Noise abatement	Sometimes	Yes	Sometimes
Carbon storage	Yes	Yes	Yes
Energy conservation	Sometimes	Yes	Sometimes
Wildlife habitat	Yes	Yes	Sometimes
Scenic beauty	Yes	Yes	Rarely
Recreation	Yes	Yes	Sometimes

### 3.4 From a combination cover and use interpretation

If taken literally:

*Forest land* would be *any land used for forestry activities regardless if there were trees present or not provided the land could support tree cover meeting the minimum thresholds*. Forestry activities would have to be defined. If forestry activities include soil and water protection, recreation, enhancing scenic values and wildlife habitat, then most any land capable of supporting trees would qualify including urban areas, orchards, and agricultural lands.

*Afforestation* would be *the establishment of tree cover to equal or exceed the threshold value of forest and the designation of land for forestry activities where they had never been carried out before*. Lands could be planted with trees, but if they were not used for forestry activities, then the lands may not count as a sink. Examples may be the planting of trees for fruits, oil, control of soil erosion, windbreaks, etc.

*Reforestation* would be *the reestablishment tree cover to equal or exceed the threshold value for forest and the continued use of the land forestry activities*.

*Deforestation* would be *a reduction of tree cover to below the threshold value for forest and a change of land use from forestry to some other use*.

For accountability, this interpretation has the same limits as those listed under land use. Cover is easy to determine, but intended use is more difficult.

## 4. Conclusions and Recommendations

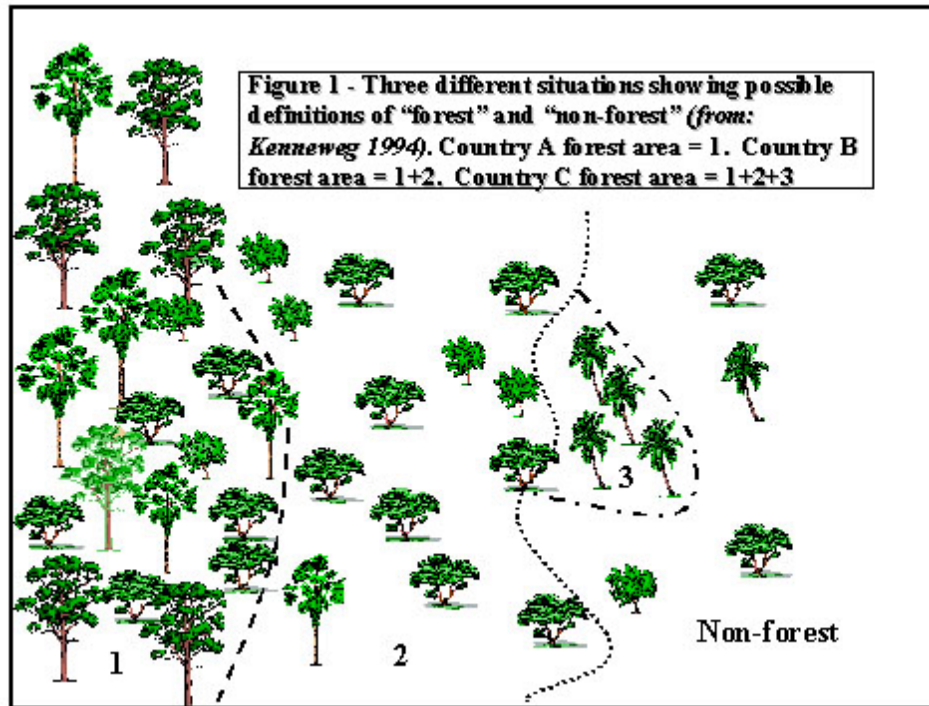
There are essentially two options regarding forest and ARD definitions to be used for accounting within the Kyoto Protocol agreements:

1. Each nation uses its own national definition of forest with ARD being actions that increase or decreases the forest base.
2. Develop a universal definition of forest and ARD terms and have countries report according to that standard.

There are advantages and disadvantages to both.

#### 4.1 For the national approach -

- First there are a variety of national definitions in use making the comparison or aggregation of national statistics into some global analysis and summary very difficult. It is obvious from the IUFRO 6.02.03 study many nations have their own definitions of forest and ARD and there is little consistency among nations. With little consistency, one must question the value of global reporting of emissions and sinks due to ARD if ARD definitions reflect national changes in the forest situation.
- Using national definitions may put some countries at advantage over another in reporting sinks and emissions. Those who have a *land use* clause built into their definition have an advantage over countries that only have a *land cover* approach - especially in reporting deforestation. Countries with forest definition that includes *land use* may not report the remove of forest cover as deforestation as the *land use* has not changed. Those countries that use only *land cover* would have to report the forest removal as deforestation. However, the reverse is true in reporting afforestation. Under the *land cover* approach, any new areas that are planted with trees and that meet the threshold requirements, would qualify as a new sink. This could include urban areas, agricultural lands, etc. Those countries that are based upon *land use* would only count new areas if they were to be used for forestry purposes.
- In addition, countries with more restrictive thresholds (larger minimum area, strip width, crown closure, and tree heights) may have an advantage over countries with more liberal thresholds for reporting deforestation. For example see figure 1. We have three identical countries - A, B and C. They differ only by how they define forest land. Country A has the most restrictive thresholds where forest are defined as having a 20% crown closure or greater. Country A's forest land is restricted to area 1. Country B has a 10% canopy and/or a shorter tree threshold. B's forest area is equal to areas 1+2. Country C is like B but has a smaller minimum area. C's forest area is equal to 1+2+3. If Country A reduces its forest cover to 15 percent crown cover, that could be considered deforestation, where as it would not be for Countries B and C. If A and B cleared areas smaller than their area threshold, the cleared areas may not be counted as deforestation. They could be for Country C. Additionally; countries with more restrictive thresholds may also be at a disadvantage for afforestation and reforestation credits. To be counted the lands would have to have met or exceeded the crown cover or area thresholds.



- Lastly, some countries may have multiple national definitions of *forest land* - the USA for example. They may have an advantage over countries with only one definition - as the multi-definition country could pick and choose the definition that is most advantageous to their own need.

To prevent changing of definitions, a country should use whatever definition was in effect in 1990 and used for the Global Forest Resource Assessment 1990. An exception would be a country that has data (including remote sensing) that would allow it to go back in time and objectively determine the area and stocks of forested lands based upon the new definition. Once a *forest land* definition is established for 1990, a country could not change it in subsequent years.

#### 4.2 For a global approach

Under this approach, countries would report forest and ARD based upon a "universal" standard. This has the advantage in that all countries would be on equal footing. Comparisons and aggregations could be made.

- One disadvantage is that the countries may not have the data or resources available to provide information in accordance with the "universal" standard. This would be especially true where the "Universal" standard is more liberal than current national definition of *forest land*. For example, referring back to figure 1, if the national standard for Country A were equal to area 1 and the universal standard were equal to areas 1+2, Country A may not have data on hand for area 2 as it was not considered forest land at the time of the inventory.

- A further disadvantage may be the confusion that could occur when national estimates of *forest land* and change are provided using two different definitions - the national definition to meet national needs and the "universal" standard.

### 4.3 Recommendations

We need to assume the reporting of carbon sinks and emissions will go on for some time. Therefore, it is desirable to develop a universal definition of forest and ARD terms standard and for countries to slowly adopt that standard. A *land cover* approach may be the most objective and most doable. FAO has a good definition of *forest land* that could be used if the *land use* element were removed. (UN-ECE/FAO 1997). Countries are already providing or adjusting their national estimates of *forest land* for the Global Forest Resource Assessment 2000. Where country definitions differ from the "universal" definitions, the country should provide crosswalks and documentation as to how adjustments were made and what assumptions were included. Again, a *forest land* definition is established for 1990, it would not change it in subsequent years. In addition:

- To provide the most consistent results for the Kyoto requirements, all nations should a common approach to the definitions of forest, tree, and ARD such as that being used in the Global Resource Assessment 2000 (UN-ECE/FAO 1997). However, some countries may not be able to recast their old inventories under the global definition as the thresholds may have been different. We frequently ran across this problem when trying to supply U.S. data for the Global Forest Resource Assessments. The worse case scenario is if the Global definition is broader than the national definition - i.e. includes lands that the country did not or does not inventory. A final problem in recasting data to set of global definitions is the possible conflict and understanding of two differing sets of national statistics - one developed at the national level for national assessments and the other at the global level for global reports.
- The people that will be responsible for collecting the data need clear and succinct definitions of what lands (and vegetation) to include in the inventory. The less subjective the criteria are, the more we will be able to understand and evaluate the results of the assessment. Land cover is the easiest and most objective to track and should be the basis for a general set of definitions.
- From an inventory perspective, some other criteria need to be included for a working definition of forest or forest land. These would include the minimum size area to be included in the survey, a minimum width of stringers, stringers, windbreaks, riparian areas, etc., and as a caveat for biomass, a minimum tree height and crown cover. As indicated above, we found the following:

- For minimum area - the range is between 0.01 ha and 100 ha with most reporting countries using 0.5 ha as a threshold.
- For minimum width - 10-50 m - somewhere around 25 m would be a common threshold.
- For tree crown closure or cover - the range is between 10-75% with 10% being the most common.
- For tree height - 1.3 - 7 m as a threshold - with 5 m. the most common. The wording for this attribute should be "land with trees usually reaching at least Xm in height at maturity.
- To this list one must also add any exclusion - lands that should not be included in the inventory.
- If one is seeking to monitor changes in of carbon sequestration and emissions, the fact that some lands are considered forests and others are used for other purposes is unimportant. Rather than getting embroiled with definitions of forests, etc., we may prefer to speak of vegetated, revegetated, and devegetated lands where woody vegetation is the primary interest. Thus, to track changes in carbon, one would include all lands with trees on them (forests, agricultural lands, urban areas, etc) and note the changes in that occur in area.
- It is important to track change in biomass as well as area. This is especially true for reforestation efforts. A question emerges as to what to call the removal of tree cover on forest lands that will remain forest lands and will be replanted in the near future. If reforestation were interpreted to include planting trees after harvesting, a huge imbalance in reporting and actuality may be created. Because emissions from harvesting are not counted, this would amount to only counting the credit side of the carbon reservoir ledger (Timo Karjalainen Timo.Karjalainen@efi.fi.). To avoid this problem, harvest would have to be called "deforestation."
- For accounting purposes, one can determine the kind, amount (extent and size) of the woody vegetation from remote sensing and ground samples. The relative permanency depends, in part, on the landowners' management objectives.
- The area of forested land may be easily determined from national inventories or remote sensing projects. If the inventories involve permanent sample sites or if periodic remote sensing coverage is obtained, one can determine which areas have changes in vegetation cover. Again, monitoring is an essential if one is to determine areas of afforestation, reforestation and deforestation. The results from national forest inventory program that do not have monitoring components should be questioned.
- Lastly, most forest inventories do not look at lands where there are no trees. Consequently statistics on areas suitable for reforestation and



afforestation may be lacking nationally and globally. This should change in future assessments.

Failing the acceptance of a land cover approach, a nation may use any definition of forest land it chooses, but would have to keep and use the same definition over the reporting periods. However, we would not be able to make country to country comparisons or analyses unless all countries used the same definition. And without the ability to compare and analyze, we will never know if we are meeting the goals set forth in the Kyoto Protocol and the United Nations Framework Convention on Climate Change.

As a final note, the results of the above study has been shared with the Intergovernmental Panel on Climate Change (IPCC). The IPCC has been instructed to prepare a special report on the implications of the various interpretations of the terminology used in the Kyoto Protocol including ARD. The IPCC report will be presented to the COP in 2000 who, I believe, will make the decisions on how ARD will be interpreted and implemented.

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