The global forest and tree-cover situation in 2020

– Facts, Myths, Lies & White Lies

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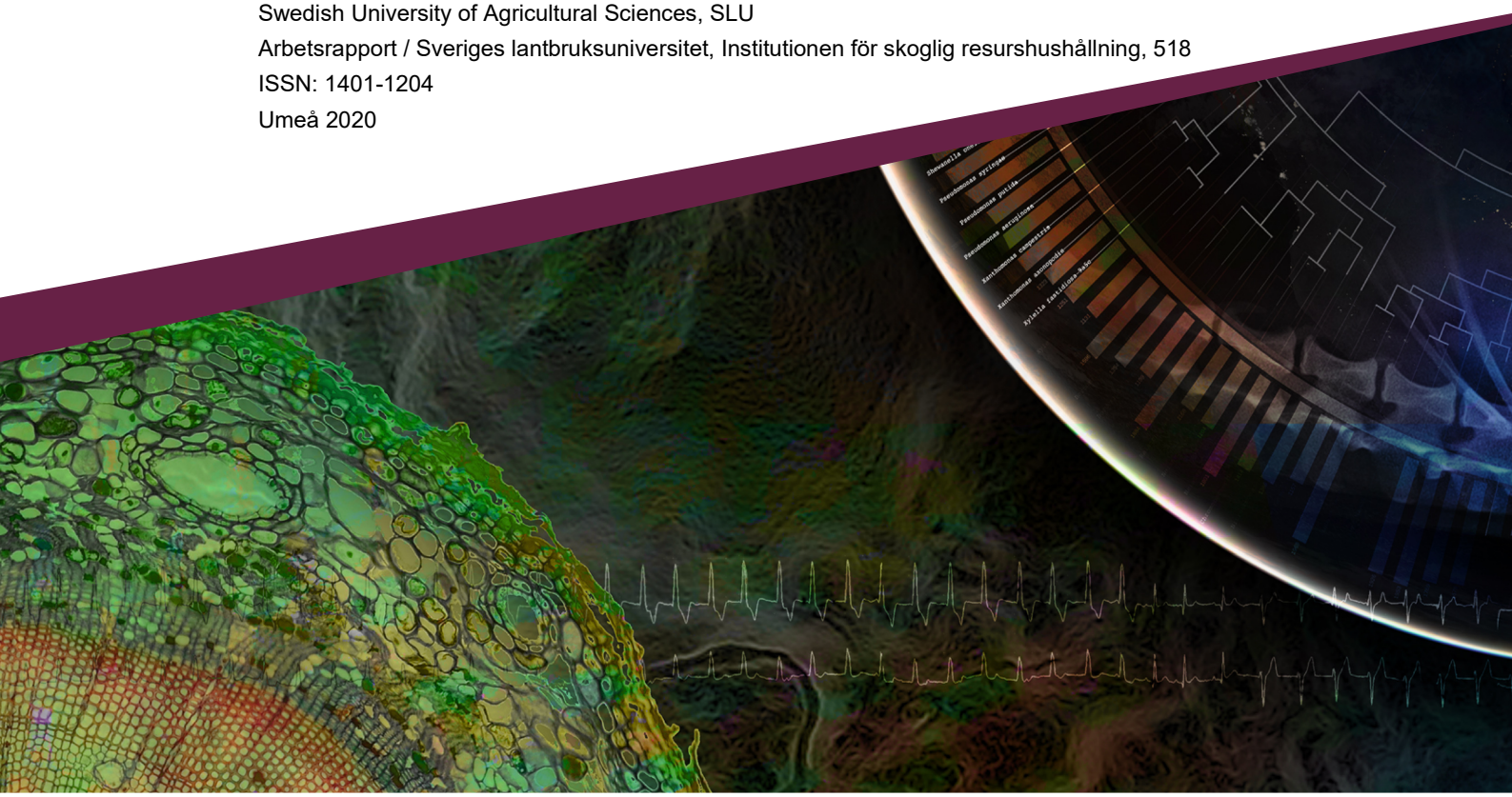

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Preface

Dr. Reidar Persson, born 1939 is a most experienced person when it comes to issues related to global forest resources. He joined the World Forest Inventory at FAO already in 1968. He has since then held key positions in a large number of national and international organizations related to forest resource assessments and utilization. As a long term senior employee at the Swedish International Development Agency (SIDA), he contributed to the funding of the World Resources Institute (WRI) in Washington during its early starting period in the mid1980s. Reidar Persson has also been an adjunct professor at the Swedish University of Agricultural Sciences.

This working report has been written on the initiative of Reidar Persson. It provides valuable perspectives gained from his lifelong work with global forest resources. It also contains criticism against the sometimes misleading way figures about “tree cover loss” are reported from WRI and other organizations. The department of forest resource management at the Swedish University of Agricultural Sciences (SLU) finds it valuable that the unique personal perspectives of Dr Persson becomes easily accessible and saved for the future by this publication in our working report series.

Hans Petersson
Head of department

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1. Introduction and Background

Man has been in the "wood age" for most of its existence. Attempts were made early to try to describe existing forest resources. Deforestation has also worried man since antiquity. Often there became a shortage of e.g. fuelwood, mining-wood and ship-timber. Plantations started early and attempts with something like sustainable forestry (e.g. coppice) started early. But it was really not until the late 18th century that the principles of sustained yield forestry (or "scientific forestry") was developed in Germany. At the end of the 19th century the heavy deforestation in the USA worried many. In 1910 Raphael Zon published the "Forest Resources of the World". I assume Zon's report was partly depending on a fear for a coming shortage of wood in the USA. In 1923 Zon & Sparhawk published "Forest resources of the World". An enormous report of 997 pages. During the coming decades not much happened concerning information about global forest resources. But Thorsten Streyffert´s "Världens Barrskogstillgångar" (Coniferous resources of the World) published in 1931 can be mentioned. And work started at the national level in many countries. The National Forest Inventory in Sweden started e.g. in 1923. At the first session of the FAO Conference in 1945 a recommendation was made that a world forest inventory should be undertaken as soon as possible.

1.1. The start of World Forest Inventories

The first so-called "World Forest Inventory" was carried out in 1947/48. The WFI 1948 was based on a questionnaire and is starting with the words, "The whole World is suffering from a shortage of wood." Europe needed to be rebuilt after WWII and it was a fear that there would become a shortage of wood. WFIs were then published for the years 1953, 1958 and 1963. Ideas to see changes in forest area was possibly around but the accuracy in reported figures were not such that this was possible. The definition of forest was changing and was also often very vague (e.g. "capable of producing timber"). Many countries reported more on "forest land" than on "forests". Large areas with open woodlands (savanna forests) were included in "forest". In 1967 it was decided that information should be given on "closed forests" and "open forests".

The planned WFI 1968 was very ambitious. Special questionnaires were developed for all regions. The results for industrial countries (OECD) were quite

OK. A questionnaire was sent to 55 countries and territories in Africa but after one year only 20 rather bad answers had been received. Most countries were now independent and the colonial administrators had left. The new administrations were weak and had more important problems to deal with than answering questionnaires from FAO. The old WFI was abandoned and FAO/WFI had for some years a cooperation with The Royal College of Forestry in Stockholm. Reports were published for the World and Africa (Persson 1974, 1975 & 1977). What was sometimes called an expert-method was used. The information published was mainly a summary of published material. The same method was used for the Tropical Forest Resources Assessment 1980 (TFRA). With TFRA 1980 deforestation became the most important issue. In Forest Resources Assessment 1990 questionnaires were again made use of. "Open forests" were on new included in "forests".

After FRA 2000 a new assessment has been made every fifth year. The methods have been gradually improving. It is no longer just forest production that is important. Environmental issues are increasing in importance. Since the 1970s there has been a debate claiming higher figures on deforestation than reported by e.g. FAO. The worse the better in other words. In the 1970s Norman Myers gave deforestation as 24.5 million ha/year (1979) and 20.5 million ha /year (1980). That was much higher than other authors (e.g. Persson (1974, 1976), Sommers (1976) and later FAO (1982)). Myers did no really write about deforestation but about "conversion". Selectively cut forests were e.g. considered destroyed. Nowadays University of Maryland (UMD) and World Resources Institute (WRI) are publishing figures that differ greatly from e.g. FAO. They report often about tree-covered land but this is rarely noticed.

2. The global forest situation according to FAO/FRA 2020

FAO/FRA 2020 gives information about forests for all countries in 4 different tables (with 24 variables)[1]. There are more information given for regions. Here is mainly discussed some figures about area and area changes.

2.1. Forest area and growing stock according to FAO/FRA

Forests are defined by the FAO as: "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 agriculture or urban use."

Table 1 gives information about the World's forest resources and Figure 1 shows the most important forest types in the World. The figures that come in to FAO can have some shortcomings in e.g. some tropical countries. However, I would guesstimate that the weakest figures in the table at least are in the range of +- 5 %.

[1] In FRA 2015 it was 34 different tables and 117 variables.

Table 1: World forest resources 2020 (million ha). Source: Mainly FAO/FRA.

Regions	Land-area	Forest	% Forest	Of which Open forests[2]	Of which Coniferous forests[3]	Of which Man-made[4]	OWL[5] (2010)	Growing stock in forests billion m^3
Africa	2974	637	21	320	4	11	446	76
Asia	3091	623	20	150	90	135	191	63
Europe[6]	577	202	35	35	84	56	25	35
Russia	1638	815	50	190	600	19	75	81
NA/CA/C[7]	2135	753	35	290	315	47	91	95
Oceania	849	185	22	110	10?	5	130[8]	19
SA[9]	1746	844	48	250	26	20	147	187
Total	13010	4059	31	1345	1129	294	1105	557

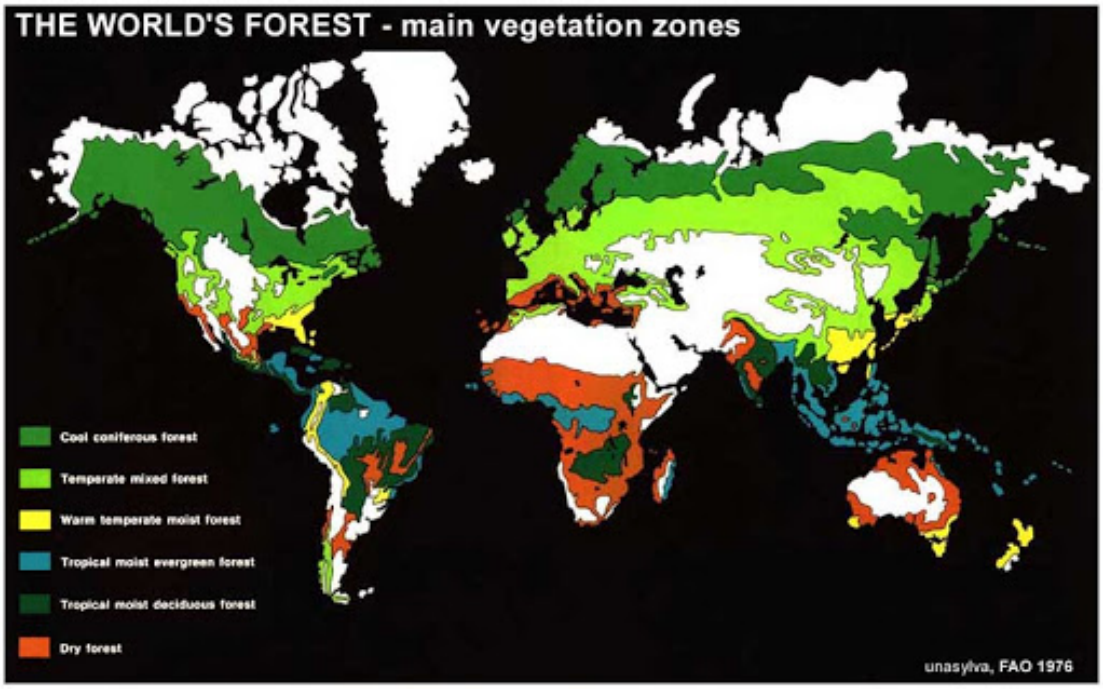

Figure 1. The World's forests (Source FAO)

[2] From Persson 1995.
[3] From Persson 1995.
[4] In at least Sweden there is some confusion around the words “plantation”, “planting” and “planted”. I therefor often use the old term “Man-made forest”.
[5] Other wooded land.
[6] Excluding Russia.
[7] North America, Central America, Caribbean.
[8] From FAO 2019a. FRA 2020 gives only 2.5 million ha.
[9] South America.

Fig. 2. Miombo - Open tropical forest.

The information given in Table 1 roughly means that:
- About 30 % of the World's land area is covered with "forest".
- About 30 % of the “forest” is covered with coniferous forests.
- About 7 % of the forest is planted (man-made forests).
- FAO is often criticized for including a lot of bad and open forests in "forest". This is true. In Table 1 I have included some old figures that show approximate area with "open forests" (see fig. 2). In total, such forests covered about 1350 million ha. "Closed forests" (or forests of "industrial interest") thus covered about 2650 million ha. For the closed forests, forest inventories have normally been carried out.
- The table also provides information on "Other wooded land" (OWL). These are open wooded areas that have a possible crown cover of trees of 5-10 %, or that have a crown cover of more than 10 % with bush vegetation. The area should not be used for e.g. agriculture. Originally, the term was used to refer to areas without “forest” managed by the forest authorities.
- In FRA 2020 the global growing stock is given as 557 billion m3 (137 m3/ha).

2.2. Deforestation

2.2.1. Deforestation - general

Many people seem to think that deforestation is something that people in “developing countries” has invented. However, deforestation started already when

man begun using the fire (Persson 2017). Over the past 8000 years, the World's forests have decreased by 30-40 %. In e.g. Sweden, deforestation began when the people and the forest came back after the ice age. Around 1900, the forest area in Sweden was about 65 % of the original and the volume was probably less than half. The reason for deforestation was primarily agriculture. Around 1900, forest development in Sweden reversed. The main reason was that agriculture was intensified and smaller areas were needed to support the population. The development of the forest industry also increased the value of the forest and all the strong players got an economic interest in protecting and rebuilding the forest. At present, the area has increased by 15-30 % and the volume by about 100 % since the bottom level. According to official figures, annual growth has increased three times since 1925. However, all this increase is not due to "better forest management". Also important in this context is e.g. increased average temperature, increased CO_2 content in the atmosphere, increased nitrogen deposition and reduced grazing. The interest in forest rehabilitation in Sweden around 1900 produced results that are worth noting in today's global situation. Sweden got in 1903 its first forest law and the forest administration began to be built up.

2.2.2. Net-change of forest according to FAO/FRA 2020

In Table 2 I have compiled some figures from FAO/FRA 2020 on net-change of forest area:

Table 2. Net-change in forest area according to FAO/FRA 2020 (million ha). (Note that a minus sign means net-deforestation.)

Regions	Net- change 1990-2000	Net- change 2000-2010	Net- change 2010-2020
Africa	- 3.3	- 3.4	- 3.9
Asia	+ 0.2	+ 2.4	+ 1.2
Of which China	+ 2	+ 2.4	+ 1.9
Europe	+ 0,8	+ 0.6	+ 0.3
Russia	0	+ 0.6	0
North America & CA	- 0.3	+ 0.2	- 0.1
South America	- 5.1	-5.2	- 2.6
Oceania	- 0.2[10]	- 0.2	+ 0.4
Totalt	- 7.8	- 5.2	- 4.7[11]

[10] This loss was mainly caused by fire. During the period 2010-2020 much of the forest was coming back.

[11] FRA 2015 gave 3.3 million ha. The increased net-deforestation in FRA 2020 is mainly explained by a reduction in the rate of forest expansion in Europe and Asia. Gross-deforestation was being reduced during the period 2015-2020 compared to 2010-2015 (from 11.8 to 10.2 million ha/year).

According to FAO/FRA, deforestation means replacing "forest" with other land uses (e.g. agriculture). It may also mean that the crown cover for some reason is below 11 % in the long term.

For the period 2010-2020, there was deforestation, especially in Africa and South America. The small decrease in North America & CA depends mainly on decreasing forest area in Mexico. For Europe and Oceania, the forest area increased somewhat. It is also an increase in Asia and that is largely due to China reporting increased forest area (due to large areas being afforested). For many other countries in Asia, however, continued deforestation is reported. Russia's forest area is likely to increase more than is reported. Both gross and net-deforestation seem to go down and this may seem hopeful. FAO/FRA 1990 reported e.g. a gross-deforestation of about 16 million ha, while net-deforestation was in the order of 11 million ha per year. However, the figures for 1990 are hardly completely comparable with the figures for 2020. It seems, for example, to be a fact that natural regeneration of forests often has been underestimated in earlier FRA.

3. Information from University of Maryland (UMD) and World Resouces Institute (WRI)

Scientists have for long tried to use remote sensing in order to better describe deforestation (or tree-cover change) and forest resources. At present most of the remote-sensing information related to worldwide forest resources is coming from University of Maryland (see e.g. Hansen et al. 2013)[12]. This type of world-wide remote sensing studies are generally done using a large amount of images from e.g. the Landsat satellites, but with a shortage of field reference data. Much of the results from UMD are now published by WRI and its Global Forest Watch (GFW). The images on which the material is based have a minimum pixel size of 30 meters. What is not always clear is that what WRI and UMD report about is not "forest" but "tree-covered land". In satellite images, UMD cannot identify the difference between e.g. a forest and an apple tree plantation. What UMD identifies as a tree-cover varies but 30 % is a default for most published statistics.

On the net WRI gives some scattered figures (and maps) for most countries. I discuss below some figures for Sweden. Sweden knows its forest resources well so it is possible to compare results from a field-inventory with results from remote-sensing.

3.1. Information about Sweden´s forests from WRI/UMD and similar organizations

WRI presents online figures on the Swedish forest[13] situation[14]. According to WRI, 333,000 hectares of forest are lost (“loss”) annually. The National Forest Inventory in Sweden gives, however, harvested (clear-cut) area as about 187,000 ha. According to WRI's typical language (e.g. Weisse & Goldman 2019), this means

[12] FAO has also used remote sensing since FRA 1980. See latest results in FAO2012.

[13] Or really tree-cover. WRI reports about 80-90 % of forests and some areas with e.g. apple-plantations.

[14] The information published by WRI/GRW is under continuous change. The figures below from 2020-09-29

that an area like Denmark will be destroyed in just 13 years. Since 2000 (to 2019), forest in Sweden has decreased by 16 %, it is claimed[15]. Sweden seems nearly comparable to Brazil and Indonesia (According to FRA place number 7 between Paraguay and Myanmar)! This is simply the area of forests harvested during the last 19 years. It is now under regeneration. During this period the growing stock increased by 500 million m^3 (15 %)! WRI also reports that there is a "gain" of forest of about 128,000 ha/year (2001-2012). I do not know what is meant (reforestation and afforestation should be over 200,000 ha/year). The data from the WRI could, however, be interpreted as that the forest in Sweden is decreasing by about 200,000 ha per year. However, this is not the case, but instead the forest area (tree-covered land) is now more or less stable. WRI also reports that plantations cover 280,000 ha[16]. The total area planted is, however, about 14 million ha. WRI/UMD can probably only identify dense plantations on former agricultural land. The figures presented by WRI do not really say anything about the forest situation in Sweden.

It is easy to give a different and more meaningful picture. Since 1925, the volume of wood in Sweden's forests has increased from 1.7 billion m^3sk to 3.4 billion m^3sk (figures from the National Forest Inventory). The volume is also increasing today. Growth per year is given as 128 million m^3sk, while the "reduction/harvesting" is about 100 million m^3sk. The increase in volume per year is in the order of 20-30 million m^3sk (0.5 %). Forests are said to handle about 30 % of Sweden's CO_2 emissions. There is certainly some gross-deforestation (because of e.g. roads, houses), but afforestation due to plantations, abandoning of farmland, tree boundary moving upwards and dehydration of marshes are at least as high. Around 1900, the Swedish forest area was 3-5 million ha smaller than now (Persson 2017), but at present it seems rather stable. This is a brief history of Sweden's forests. Similar short descriptions can be given for most countries. The facts about Swedish forests based on national statistics do not have much similarities with the figures from WRI based on remote-sensing.

Strange figures based on UMD data is not only being produced by WRI. Recently Nature published an article from EU Joint Research Center (JRC) that gave strange results (Ceccherini et al. 2020). It is reported that in Europe´s forests the loss of biomass should have increased by 69 % between 2011/2015 and 2016/2018. The area harvested should during the same period have increased by 49 %. The loss of biomass should be most pronounced in Sweden which accounted for 29 % of the increase in harvesting. This should mean that the clear-cut areas should have increased by roughly 50 % and the Forest Authorities should not have noticed it. Swedish sources on the other hand report that the area harvested has decreased by 8 percent between the two periods (Though over the last years it is rather stable). Production seems to have increased by about 4 %. The JRC-report seems to be a

[15] Figure from UMD. Why not also report that during the last 100 years the forests have decreased by 150 % or so (certain areas cleared several times).

[16] At 3 PM the 24th of May 2020 "plantations" are given as 280 ha on Global Forest Watch. I assume it should be 280 000 ha. The area with "plantations" in Sweden was given as 700 000 ha in 2005 (mainly P. contorta).

kind of trial about the possibility to use remote-sensing. The strange results they produce is probably depending on that the quality of the images has improved between the periods discussed. UMD has warned that their datasets were not calibrated for comparisons over time, which however Ceccherini et al. has overlooked. Sometimes thinning may also be classified as a clear-cut.

There are certainly many in Sweden who do not like today's forests and forestry. Sweden has monotonous forests, biodiversity can have problems, the old forest is cut down, etc. This certainly needs a discussion. However, it is not facilitated by rather meaningless and inaccurate figures collected by satellite data analysis with a shortage of reference data. Conveniently, one should also in this context discuss what would be the result if Sweden, of for example environmental considerations, drastically reduced its logging. It would improve Sweden's CO_2 balance (for a period) and possibly biodiversity, but it is by no means certain that it would be better for the World. It would also cause problems for the rural population in Sweden.

3.2. WRI/UMD´s global picture of forests

The reports that are now published in Swedish newspapers about deforestation in the World are mostly based on material published by the World Resources Institute in Washington (WRI) and its program Global Forest Watch (GFW). The figures that WRI/GFW and JRC provides for Sweden are quite meaningless and in much inaccurate. In the name of honesty, WRI probably does not put much effort into gathering information about Sweden. The main interest lies on the tropics and global figures. For example, the group at Maryland University (Hansen et al. 2013)[17] reported in an article that there are (or were) about 4 billion ha with “tree-covered land” (i.e., much like FAO for “forest”). Each year, 19 million ha was lost and 7 million ha was recovered (gain). Sometimes this is interpreted as if the World was losing an area of 12 million ha of tree-covered land every year[18]. However, the figures for "loss" and "gain" are not comparable. It is relatively easy to roughly see "loss" but more difficult to see "gain" (e.g. new plantings). It is a little strange that some of the authors analyzed about the same material and in a report claimed that tree-covered areas increased by 7 % between 1982 and 2016 (X-P Song et al. 2018). Over a 35-year period, one could evidently see that vegetation had returned, but this is difficult for shorter periods of time.

[17] This article was published in Science. It was heavily criticized. The critique was mainly that Hansen et al. couldn’t separate natural forests from plantations. As that was the main problem!
[18] Note that figures vary depending on year or time-period chosen.

WRI/GFW website (2020-08-12) reports in Summary the following about the Worlds tree-covered areas:

- Tree-cover in 2010 was 3920 million ha.
- In 2019 the World lost 24.2 million ha of tree-cover.
- The period 2002- 2019 61.4 million ha of humid primary forests were lost. That is 3.4 million ha /year.
- Tree-cover gain was in the period 2001 – 2012 80.6 million ha (6.7 million ha/year).
- Natural forest in 2000 was 3866 million ha.
- Plantations were 137 million ha.
- Intact forest was 927 million ha.
- WRI also included some scattered figures from FAO/FRA.

Do these figures from WRI give information that tells the truth about the global "forest and tree-cover" situation? Hardly! Compare e.g. with table 2. WRI publishes also some scattered figures about forests in most countries. Do information for e.g. Brazil and Indonesia have the same "quality" as the Swedish figures? Probably! When it comes to give information about the forest resources in different countries WRI cannot in any way compete with FAO. But the maps produced and published by WRI can evidently be of some use.

4. Global tree-resources

4.1. Area of global tree-resources

When FAO began publishing figures on the World's forest resources in 1948, there was a fear of a lack of timber. Europe needed to be rebuilt after the World War and for this, wood was needed. So it was quite natural that one often tried to capture details about the closed forest (the "industrial forest"). It was mainly "sawn timber" that was needed. It was also for the closed forests that any form of inventory had been made. The growing interest in firewood in the 1970s led to that other tree resources also became of interest. For example, Bangladesh derives most of the wood from home gardens and scattered trees in agricultural land. However, for these resources - "trees outside of forests" (TOF) - there were (and are) usually very incomplete data. Interest in "open forests" also increased. With today's knowledge, one can claim that the figures published by FAO/FRA gives a somewhat incomplete picture of the forests (or rather the tree-resources). In the table below, for the sake of discussion, I give some figures on the "forest and tree-resources" in Java:

Table 3. Tree resources in Java (million ha). Persson 2003.

Type of tree–cover	Area (mill. Ha)	Area %
Natural forests (usually in National Parks)	1	7
Tree plantations (teak and pine)	2	15
Home Gardens	2.4	18
Agricultural tree-crops	3.5	27
Shade trees and the like	0.3	3
Total tree covered area		70[19]
Total land area	13.2	100

An environmentalist would often claim that Java has 7 % forest cover, since only natural forests should be counted ("a planted forest is not a forest"). A forester (and FAO/FRA) would argue that there is 22 % of "forest" (natural forest plus tree plantings). In reality, however, the truth is that Java has a tree-cover of 70 % of the land area. One can't give one figure that gives the truth for Java. One has to give the whole story. What is probably now needed is to start trying to provide such information for the whole World. It is needed in view of wood production, climate, environment, biodiversity etc. In Table 4 below, I have tried to gather some scattered figures on the global tree resource and its changes:

[19] Figure mentioned by Dennis Garrity.

Table 4: Global tree resources in 2020. Million ha.

Type of tree-resource	Area	Tree-cover loss 2010-2020
Forest (acc. FAO/FRA)	4059[20]	25-35[21]
Other wooded land (OWL)	1100 (977)[22]	1-3
Other land with tree-cover	200	2
Agroforestry	1000	5-10
Alleys, windbreaks, small groves etc.	40	1
(Land in fallow	250)	
Tree-loss in shifting cultivation	..	5-35[23]
Total	6500	40-60

Some comments on table 4 are given below:

Forest. For comments on forest see text to Table 1. The loss of tree-cover in forests are discussed below:

Gross-deforestation*:* When it comes to what is being done in "forest", maybe in the order of 10 million ha is cut and converted into e.g. agricultural land, buildings or infrastructure (FAO 2020). But there is afforestation of 2-3 million ha per year and forest/trees also spontaneously come back to e.g. abandoned agricultural land. So net–deforestation is given as 4.7 million ha/year in FRA 2020.

Clear-cuts: There are estimates available for e.g. USA, Russia and Canada. With a little addition of gaps, I end up with 6 million ha per year. The areas that are clear-cut are replanted or self-rejuvenated.

Fires / Insect attacks: Estimates of forest fires area are being produced by several organizations. The areas vary widely from year to year. Large areas are damaged every year so that development has, so to speak, to start from scratch. Large forest areas have historically been in a kind of balance. A number of million

[20] According to FRA 2020. "Frontier forests" shows "real forest" according to WRI and many other environmental organizations. The American wilderness dream in other words. In 1997 “frontier forest” was reported as covering 40 % (1.35 billion ha) of remaining forests (Bryant et al. 1997). In FRA 2020 “primary forests” are reported to cover 24 % of forest area in reporting countries.

[21] Consisting of e.g. gross-deforestation, clear-cuts in forestry, fires, insect infestation, storm damages and tree fallows cleared in shifting cultivation.

[22] According partly to FRA 2020. FRA 2020 reports however only 2.5 million ha of OWL in Australia. In FRA during the period 2000-2015 an area from 135 to 420 million ha was reported for Australia. Note that FAO 2019a gives 130 million ha as OWL in Oceania. I add so that the total becomes 1100 million ha.

[23] For the total I guesstimate that 5-10 million ha/year was cleared.

ha has been burnt every year, but on average the same amount has been reforested. Research shows e.g. that 150 years ago about one (1) % of the forest in Sweden burnt every year (Visa Skogen 2020). There have probably been no drastic changes in the biomass over long periods. However, this can now be changed. The warmer climate can lead to the development of new fire climaxes (e.g. in Portugal, Australia and California). This may mean that these forests will contain lower biomass than at present. Unfortunately, we must accept that sometimes it is impossible to fight against nature. In practice it will be impossible to control all wildfires.

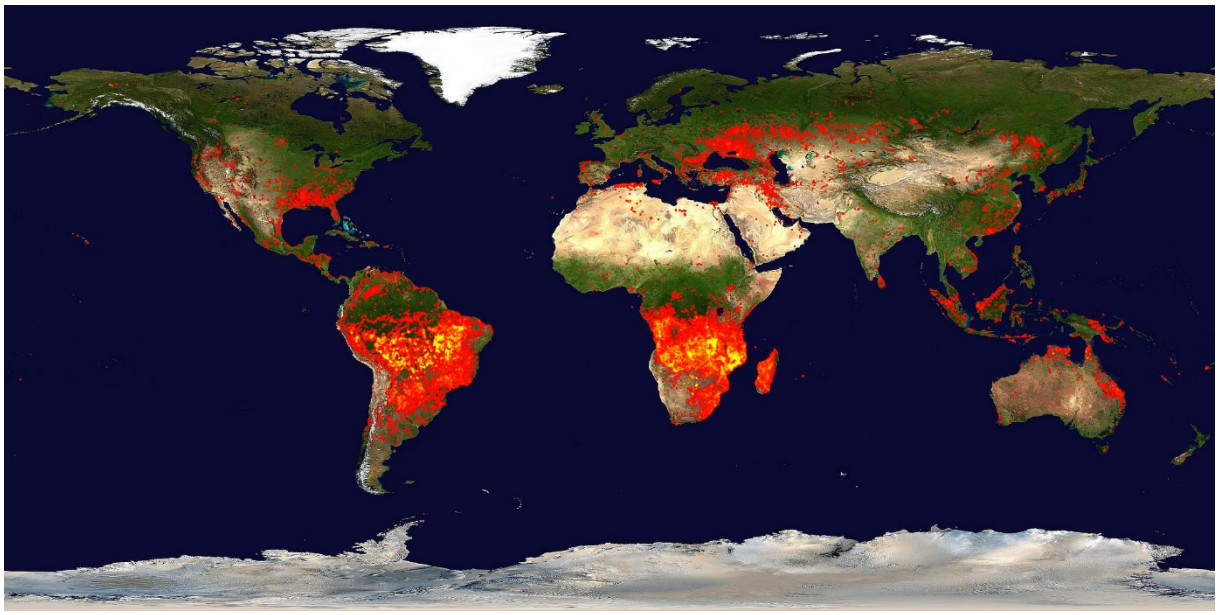

Figure 7: Fires according to NASA [24]

Large areas are also damaged by insect infestations and diseases. For example, in Sweden's mountain birch forests, there is a major attack by mountain birch meters about every 100 years when the forest is old (Persson & Sprängare 1967). It can be seen as part of the rejuvenation of the forest. In Canada, there has been major attacks of pine bark beetle in recent times. In Europe, there is now a large infestation of spruce bark beetle. The latter is hardly solely due to the fact that the forest is old. Because of the warmer climate, the damage picture (can) begin to change.

The areas reported to be "damaged" in forests are very large. For example, FRA 2010 reports that 35 million ha had been injured by insects and around 40 million

[24] The map shows the situation for October 2009. In a square of 1000 km^2 the satellite identifies at least one fire per day (red). In yellow there is 10 fires a day.

ha had been damaged by fire each year. Diseases damaged about 4 million ha every year. The sum of damage is given as 1-2 % of the forest area. FRA 2015 reports that fires, insect infestations, storms and diseases damage about 200 million ha per year (5 %). FRA 2020 reports that about 98 million ha of forests were affected by fire in 2015[25]. In the tropics 4 % of forests were burnt. Insects, diseases and storms damaged about 40 million ha of forests in 2015, mainly in the North. Large areas are certainly damaged each year (with great variation), but as mentioned only parts are "destroyed". I have dug into information about forest fires and serious ones seem to cover (or covered) in average 5 million ha per year. I "guesstimate" that the "tree-cover loss" of all kinds of damages in all 5-10 million ha[26]. This can be a grave underestimate. I can mention that Australia often reports deforestation because of large fires. However, increasing forest area is often reported in the coming years when the forest returns.

To the areas cleared for gross-deforestation, fires/insects, storms and forestry should be added areas cleared in a shifting cultivation cycle. These changes can be difficult to see in course resolution satellite imageries. This can be in the order of 5-10 million ha (at least if also areas in other wooded land are included)[27].

This means that the total area cleared in forests can be at least 25-35 million ha per year.[28]

Other wooded land (OWL): Includes e.g. the part of Sweden's mountain birch forests that do not have a crown cover of more than 10 %. Often, a global area of 1.2 billion ha is reported as shrub lands. I suppose most of these shrubs are now included in OWL. After some guesstimating I end up with 1100 million ha for 2020. FRA 2020 gives a lower figure but the area of OWL in Australia is underestimated.

[25] Note that large areas of "savanna forests" are in a kind of fire climax.

[26] The damages are difficult to describe by just area figures. Information about biomass losses is really needed.

[27] See more details about shifting cultivation below.

[28] But about 90 % seems to come back.

Fig. 4: Agricultural landscape in Crete. No forest but many trees.

Tree-cover loss in Other Wooded Land (OWL): Forest appears to be cleared by about 0.7 % per year. I expect that the tree-cover loss in OWL is less. It is e.g. hardly much clearing for forestry or agriculture. But fires, grazing and fuelwood production will have an impact. However, FRA 2015 reported that the area of OWL increased between 2010 and 2015. Many countries also reported a sharp increase in area since 1990. This is probably due to reclassifications and new inventories. Hardly any real increase in area. So there is evidently some problems with the statistics. Not much effort is probably put into having good statistics about OWL. FRA 2020 can be interpreted as that OWL has decreased by 1 million ha per year between 1990 and 2020. A clearing of 0.1 % seems low. I guesstimate that 1-3 million ha is cleared per year.

Other land with tree-cover (OLWTC): These areas have over 10 % tree-cover and would be called forest if it was not for the land use type. In FRA, all land that is not forest is called "other land". In FRA 2015, an area of 284 million ha was given as "Other land with tree-cover". However, this figure only provides information for 78 countries that reported a value greater than 0 (plus 20 countries that sometimes incorrectly reported 0). I therefore guesstimated that the total area in all countries was at least 400 million ha. The area of “permanent crops” is given by FAO as 170 million ha for 2015. Much of this is bush crops. I have estimated that about half are tree crops. This figure includes e.g. fruit trees, olive trees, oil palms and coconut palms. FRA 2020 reports an area of OLWTC as 60 million ha (if excluding agro-forestry). In this figure is included palms, tree orchards and trees in urban settings. Only about a third of all countries have reported areas. If all countries were included the total area could increase to 200 million ha. I suspect some underreporting of these areas.

Clearing in Other land with tree-cover: I roughly estimate that one per cent of this tree-cover is renewed per year - i.e. 2 million ha. In this resource, olive trees can become very old, but most other tree crops must be renewed every few decades. Many fruit-trees and oil-palms, for example, have a production time of 25-40 years. The total area with tree crops is most likely growing every year.

Agroforestry: According to a study (Zomer et al. 2014), approximately 40 % of "agricultural land" has a crown cover of trees of more than 10 % (i.e. about 900 million ha). However, the agricultural land in the study is said to have a total area of 2.2 billion ha. FAO gives arable land as 1.5 billion ha. When pasture is included, agricultural land is usually given as 5 billion ha. Large areas of pasture have a tree-cover. The figures are based on very uncertain satellite estimates and probably do not give the whole truth. For the sake of discussion, I estimate that one billion hectares of agricultural land is agroforestry. This would mean that about 20 % of the agricultural land (arable land plus pasture) has a crown-cover of over 10 %. It is worth mentioning here that according to a FAO report (FAO 2019a), 30 % of agricultural land and 60 % of urban areas in dry areas have some tree-cover. In Java, 18 % of agricultural land was estimated to be home gardens. However, Priyadarshini (2020) states that only 10-20 % of agricultural land has a tree-cover. So the figures on area of agroforestry thus appear to be quite uncertain (or in the order of 0.5 - 2 billion ha). FRA 2020 reports that agro-forestry covers 45 million ha in the 71 countries that give a figure. That must be an underestimate. It may be that the countries tried to identify areas that has planned agro-forestry areas (e.g. alley-cropping, shade-trees, taungya). But agricultural areas can have more than 10 % tree-cover without it being "officially" called agro-forestry. Zomer et al. 2014 was looking for tree-cover. Many grazing areas has e.g. a tree –cover[29].

Clearing in agroforestry areas: There are reports claiming that the proportion of trees in agricultural land is increasing, but there are also those who claim that in many places tree-cover in agricultural land is decreasing. This may be necessary if one start to use machines. Even if the agroforestry areas were in balance, there would certainly be some felling of trees from time to time. I have estimated that at least 0.5 -1 % is renewed per year. It is most likely not a question of "clear cuts" but rather that scattered trees are cut a little here and there. But trees are coming back and it is uncertain if the growing stock is changing.

Alleys, wind breaks, small tree groves, scattered trees and the like: Tree groups smaller than 70 x 70 meters are not considered "forest" by FAO/FRA. In many areas, however, such groves cover large areas. In many places windbreaks and alleys are also common. Sometimes attempts have been made to give an area

[29] There is then a risk that grazing areas and OWL are sometimes mixed up in the statistics.

figure for e.g. windbreaks. This should be done in a complete account of the tree-cover situation. There are approximately 4.4 billion hectares of "other land" according to FAO (e.g. urban areas, infrastructure, deserts and mountains). Assume that 25 % have an average of 10 trees per ha (see fig.4). I also guesstimate that 1.5 billion ha of agricultural land (about 40 % of non-agroforestry land) has an average of 10 trees per ha. This would mean a total of about 25 billion trees. If the distance between the trees is 4 meters, this would correspond to a forest area of 40 million ha[30].

Clearing: Often these scattered tree-resources are used quite intensively. I estimate that 1 million ha of these trees are cut down (and renewed) every year. In many places this tree resource is probably increasing.

Fallow in shifting cultivation: FAO/FRA 1980 (FAO 1982) estimated that 400 million ha of tree-covered areas were in a shifting cultivation cycle and that this area increased. In a more recent study the area in a shifting cultivation cycle is estimated to 280 million ha (Heinimann et al. 2017). Most of this area is probably now considered forest by FRA. Areas that are fallow (most of which are called forests) can be in the order of 250 million ha.[31] See figures 5 and 6. The figure is not added to the Total.

Figure 5: Newly opened shifting cultivation area in Laos.

[30] This “area” can be higher.

[31] I guesstimate the area in shifting cultivation to 300 million ha (including areas in open forests).

Figure 6. Old shifting cultivation area in Laos. What is forest?

Clearings in fallow: The area of forest found in a shifting cultivation cycle is most likely decreasing. However, it is probable that there are still large areas that are cleared every year. This is something that can be difficult to see in course resolution satellite images. In a relatively dense tropical forest, perhaps the biomass is 300 m^3 / ha. If the area is in a shifting cultivation cycle the biomass may e.g. on average be around 200 m^3 / ha and this average volume changes very slowly. The small openings that are utilized are moved around. Assume that the rotation cycle is 30 years (and total area 300 million ha). Then an area of 10 million ha would be cleared every year. Rojstaczer et al. 2001 can be interpreted as if about 35 million ha with "forest" is cleared every year in shifting cultivation. WRI reports that 4.52 million ha are deforested because of shifting cultivation in 2015. Shifting cultivation, however, occurs not only in closed forests (which the University of Maryland can identify), but also in open forests. I guesstimate that 5-10 million ha of tree-fallows are cleared every year.

Additional information

En passant can be mentioned here that a study by ETH Zürich (2019) claims that 8.7 billion hectares of the land area could sustain forest. As an anecdote, it can also be mentioned that Crowther et al. (2015) used all kinds of sources and found that there should be 3.04 trillion[32] trees in the World. If this now makes us so much wiser.

In “forests” there is as mentioned 557 billion m^3 of wood (i.e. 137 m^3/ha). FRA 2010 reported that there were 15 billion m^3 of wood (12 m^3/ha) in OWL. By using a "back-of-an-envelope-calculation", I estimated that there are at least about 100

[32] Of which 15 billion are lost per year. But how many come back (planted and natural regeneration)?

billion m^3 in the remaining (non-forest) tree-covered areas. The global growing stock could thus be in the order of 650 billion m^3. Of some interest in discussions about the carbon cycle.

I hardly need to point out that the figures given here on tree-covered areas are very uncertain. Much information is e.g. collected from satellites and the errors can be large. The sources are also often unnecessarily imprecise. It is, for example, sometimes unclear if information is provided for agricultural land or arable land. There can possibly also be some overlaps. From time to time I have also made highly qualified guesstimates. At present I may at least dare to say that land with wooded vegetation covers 6–7 billion ha. Most of the guesstimated figures about different land-cover types should hopefully be in the right order of magnitude.

BOX 1

Thoughts about the value of forest

According to many conservationists, planted and utilized forests are not worth the name "forest". When I started working on deforestation and the like in the 1970s, we looked a bit different on the matter. We then began to seriously worry about deforestation in the South as this could cause major problems. It could give a shortage of firewood and other forest products that the poor locals in "developing countries" needed. Deforestation could also cause erosion, altered water balance, altered local climate and more. In many places, no forest was left, and the primary concern was to recreate the resource. Often planting was the best option. Plantations may not provide everything that a natural forest can provide, but they often provide most. Biodiversity is now often considered by many "experts" to be the most important forest product. It is not necessarily so for the locals. Sometimes a degraded forest (e.g. bamboo) can be of the greatest value. What nature fanatics should learn is that one can't always get everything. A planted or utilized forest may not provide everything of value that is possible, but also a degraded or planted forest can be of great value to the locals. Those who frantically claim that a real forest should be a wilderness easily fall into pure Eco fascism. Perhaps it should be added that sometimes a planted forest (and even a natural forest) can be negative for the local population (e.g. by consuming a lot of water). It can also be added that many argue that the total value of forests (e.g. due to environmental effects) can be double the wood value.

In BOX 2 I have given a short summary about what can be said about the global tree-cover situation in 2020.

BOX 2

The global tree-cover situation in 2020

It has been estimated that 8.7 billion ha in the world could be covered by trees or woody vegetation (Bastini et al. 2019). Presently about 6.5 billion ha is still covered by woody vegetation. Of this area about 4 billion ha is covered by what FAO calls "forest" (can in theory primarily be used for wood production). The tree-covered areas not called "forest" (2.5 billion ha) consists of other wooded-areas, agro-forestry areas, agricultural tree-crops, parks, tree-covered fallows, trees outside of forests etc.

The tree-covered area may be cleared by 0.5-1 % (40- 60 million ha) every year. The reason is traditional deforestation (or change of land use), clear-cuttings in forestry, fires/insects, storm damages, renewal of tree-crops, clearing of tree-fallows, etc. Of this area possibly about 90 % is coming back relatively fast. The "forest" area is being reduced by 4.7 million ha /year (the gross-deforestation is about 10 million ha/year). This means that the forests will in theory last for 860 years! Both net- and gross-deforestation have been going down since at least 1990. There is as mentioned still some loss of "forests" every year. For some of the other tree-covered types (e.g. agricultural tree-crops, TOF) the area is on the other hand probably increasing. In some decades the net-deforestation is likely to cease[33]. WRI reports a loss of 24 million ha of dense tree-covered areas in 2019. This is a mixture of different types of land-use, the sum of which is of limited use to know.

Deforestation has been going on since the forests came back after the ice-age. In antiquity it was much deforestation in the Mediterranean area. During the Middle Ages deforestation was heavy in Europe. In the 19th century there was serious deforestation in Russia and North America. After WWII a lot of deforestation has taken place in many tropical countries. During this later period the forest area has on the other hand increased in many industrial countries. In summary the forests have decreased by 30-40 % during the last 3000 years. Deforestation has often gone in waves. During a period deforestation has been heavy in an area but then, of some reason, the forests often recover for a period.

The growing stock in "forests" is about 557 billion m^3. In other tree-covered areas there may be around 100 billion m^3. The volume in tree-covered areas do not seem to change very much.

[33] This is if I look back for the trends seen during the last decades and even now. Climate change can, however, change everything. Even if the change is only 1.5-2 degrees there will be drastic changes. Forests will most likely expand in Alaska, Canada, Scandinavia and Russia. But in many areas in the South .fires may e.g. lead to new fire-climaxes. What will happen if the temperature increases with 3-4 degrees (which is likely) hardly anyone has a clue.

5. Discussion of different appraisals

There are large differences in the figures published by FAO and e.g. WRI (or many other studies based on remote sensing). The "methods" used have their problems. There is often a belief that analysis of information from satellites should be a neutral and reliable method for capturing what is happening in the forest. The method used by FAO/FRA - i.e. above all, questionnaires - are sometimes considered more unreliable. But is it really to be expected that “experts” sitting in Maryland processing satellite imageries can provide the truth? Wouldn't it be more likely that on-site analysis will produce better results? The information that WRI provides about Sweden is very problematic (to express it very polite). What is the reliability of the information for e.g. Amazon and Borneo?

On the American side, however, remote sensing (satellites) has long been advertised as the best method for studying what is happening with the World's forests. The figures presented by organizations that mainly use remote sensing seem, however, to have major shortcomings. Organizations working with remote sensing must, however, constantly trumpet out that for the first time in World history some new knowledge is presented. It is nearly always reported an improvement over e.g. FAO. But the information provided is rarely comparable to FAO's information.

I conclude that the University of Maryland (UMD) often has difficulties to see the open tree resources[34]. UMD (and remote sensing) probably also sometimes has difficult to see parts of the "tree-cover loss". UMD can certainly see large clear cuts in Sweden and clearings for e.g. pastures in the Amazon. However, it seems that UMD sometimes can have difficulties to identify e.g. small openings for shifting cultivation, openings in agroforestry, and openings in open forests and of course changes in the resources of scattered trees and groves. What UMD happens to see is sometimes dependent on the circumstances (e.g. season). UMD has even greater difficulties in seeing “gain” (i.e. reforestation). It is quite natural that UMD cannot see if an opening is covered with small plants. For this, field visits are needed. Remote sensing can sometimes provide the information needed, but this is not

[34] So has FAO/FRA when remote sensing is used! FRA 2000 reported e.g. a forest area of 674 million ha for Africa. A parallel remote sensing study reported only 564 million ha. At least part of the difference was due to difficulties to identify open “savanna forests”.

always the case. It is often the case that the information presented is the information that remote sensing happens to provide.

Much criticism is directed against the fact that FAO collects information primarily with a questionnaire. When using a questionnaire, there may be a temptation for countries to cheat. However, most countries have now carried out some kind of forest inventory. Nowadays, there may also be some financial resources in deforestation because of REDD (Reduced emissions from deforestation and forest degradation). Therefore, there are no longer any strong incentives to try to hide e.g. deforestation. Decisions to try to reduce deforestation are also taken at national level. Therefore, the authorities in the countries should be involved in the process of obtaining information about forest resources and deforestation. It will not be "action" just because an American organization comes with alarming numbers.

Over the years I have discussed issues with FAO/FRA (Persson 2017). In some countries the information is e.g. still bad. It is not really possible to compare results from one FRA to the next FRA. At every opportunity, the FAO/FRA tries to make the best possible of a rather difficult situation. This has e.g. given the result that the forest area reported by FAO/FRA has increased from 3442 million ha in 1990 to 4069 in 2020, although deforestation is reported at the same time. This is due to new inventories and glides in the interpretation of definitions (e.g. that forests in fallow now often are classified as forests and not as agriculture). FAO, despite certain limitations, provides as much detail as possible about what is called "forest". We know what the FAO/FRA is trying to give. The information gets better and better[35]. In FRA 2020 e.g. over 90 % of forest area information was in countries with high reliability. Only 2 % were in countries with more limited reliability. Some criticism of FRA is coming from scientists who want to work out models of deforestation using FRA-figures. This is now hardly possible. I question if that can be an important objective for FAO/FRA´s work.

It seems to be natural if FAO is responsible for collecting information about the World´s forest resources. FAO has good contacts with Forest Authorities in all countries. No other Organization can compete with that. Environmental Non-Governmental Organizations (ENGOs)[36], including different Think Tanks, can hopefully complement FAO's information in different ways. FAO has e.g. problems to criticize a member country.

FAO/FRA reports about forests. UMD/WRI reports about dense tree-covered areas. But WRI can't give information for about 40 % of the wood-covered areas, can't estimate recovery of tree-covered areas with sufficient accuracy and mix

[35] Note that old (underestimated) figures on e.g. forest area are updated in every new FRA.

[36] Much of what I say about WRI is often valid for ENGOs. When possible I use therefore ENGOs in the coming pages.

together forests, parks, agricultural tree-crops, dense agro-forestry areas etc. From my horizon WRI doesn't really give much value added. Reports/Articles based on information from WRI often cause confusion. It would of course be an advantage if WRI used its resources in a more meaningful way. There is e.g. much which we don't know about different types of tree-covered areas, which would be of value to learn more about[37].

[37] E.g. what happens in shifting cultivation areas, with TOF, with OWL and with agro-forestry areas?

6. Some Conclusions

- There is a need for FAO/FRA to start giving information for all wood-covered land and not only for forests. That means to start the reporting with a total area of wood-covered land of about 6.5 billion ha. In the next step FAO/FRA can give more details about forests, other wooded areas, other tree cover, agro-forestry areas, scattered tree-resources etc. In a very first step FAO could perhaps also report about land use at large. FAO has e.g. good information about agricultural land.

- Deforestation and tree-cover loss is normally discussed by using area information about changes. This is often difficult (e.g. concerning shifting cultivation). It seems necessary to start combining area-information with information about changes in biomass.

- There are big gaps in our knowledge about different types of tree-covered areas other than forests.

- UMD should try to supply raw-data in a form which is not so often misunderstood/misused by the users. WRI must be careful in explaining what the information given is really saying. It is hardly advisable to publish some scattered selected figures which just support the agenda of WRI.

- It is important to try to give the whole story and not just some scattered figures.

- WRI is informing the World that a football field of valuable rainforest is destroyed every 6 second. But one can consider that in 6 seconds 25 children are born, 10 persons die (of which one child) and a third of a football field of good agricultural land is covered by concrete (Bren d'Amour et al. 2017). To replace this at least one ha of forests (2 football fields) may have to be cleared. In 6 seconds 6850 tons of soils is also eroded in the World (FAO 2019b). By selecting figures one can tell horror stories about many other things than forests.

- With the help of analysis of rather unsecure satellite imageries WRI reports that 24 million ha of tree-covered land (with over 30 % crown-cover) is cleared (destroyed) each year. In 170 years all "forests"/tree-covered areas should vanish? Is this the right picture to give? One can also allege that about 20 million ha of rather tree-less areas is being tree-covered on new each year. In just two years an area like Sweden is reforested. Is this a true picture? To me it is a white lie. But this is, however, as good a picture of the forest situation in the World as the one WRI gives with the help of deforestation/tree-cover losses.

- When ENGOs describe deforestation they tell all the negative effects deforestation have. But there is often a negative and a positive side of issues. Deforestation can e.g. give erosion and emissions of CO_2. But deforestation can also give good agricultural land and reduce poverty. For a serious discussion one needs to give the whole package.

- WRI/GFW seems to give priority to report about[38] deforestation (tree-cover loss). One reason is probably that reduced deforestation is sometimes said to have the potential to reduce emissions by up to 30 % (Seymour & Busch 2016). This is overoptimistic. With information from 2000, IPCC 2007(Nabuurs et al. 2007) reported that deforestation caused 17 % of emissions. If information from 2019 is used deforestation may cause "only" 6-10 percent of emissions (deforestation has been reduced and emissions increased). In countries like Zimbabwe, Congo, Sudan and Chad one cannot "buy" reduced deforestation with money. I made a "political analysis" of the big deforesters and estimated that a serious attempt to reduce deforestation perhaps could reduce emissions from deforestation by 30 % - or 2-3 % of total emissions (Persson 2017). More can probably be gained by starting to rehabilitate degraded and deforested areas. Perhaps also by using more wood in e.g. buildings.

- One serious problem seems to be that many are now being led to believe that reduced deforestation is the solution to the climate problem. If "we" give "developing countries" some money against deforestation, we can continue to live much like before. The problem is that this is not the case! In practice, efforts to reduce CO_2 emissions from forests can as mentioned only have a limited effect. We have to do most things at home. This applies not least to the USA.

- ENGOs and industrialized countries want developing countries to help reduce CO_2 emissions. Considering the environment and the future, they must without protests face problems such as not being able to develop their agriculture. The forests must be protected, it is claimed with emphasis. But industrial countries themselves resist tough actions. If petrol prices are raised, there might be gasoline riots in Sweden and France (and in USA it is impossible). For social and economic reasons, we (the developed countries) cannot begin to demand a reduction in coal mining in e.g. USA, Australia and Poland. That would be too big a problem for the society and workers. But farmers in Indonesia are we prepared to put on bare ground. In the EU, we provide support to combat deforestation in the tropics, but we also provide assistance to our farmers to keep the forests away. We want open landscapes, which means we have coal left in the atmosphere. The World's most densely wooded forests are likely to be found on the west coast of North America. No one, however, comes up with the idea of trying to preserve these forests for the purpose of binding coal for climate reasons. But the rainforest must be preserved!

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[38] One can possibly say "is obsessed with".

- In Indonesia 25 million people depend on the income from palm oil for their livelihood (Rival & Levang 2014). Maybe for the future of the planet, they will have to change this. But then they can demand that, for example, developed countries stop utilizing coal for a large share of its energy supply. They have the right to demand that also we in rich countries take global warming seriously!

- The main reasons for the disappearance of the tree canopy (and forest based CO_2 emissions), are mainly fires, forestry and agriculture. It is difficult to stop fires and if one succeeds it can sometimes make matters worse. In practice it is impossible to control all wild-fires. From what ENGOs publish, one can conclude that forestry is something extremely negative and reprehensible. But shouldn't e.g. WRI try to discuss the alternatives. If trees should not be felled, what are then the alternatives to wood? Should concrete and aluminum be used instead? Or grass? Should we stop using paper? Should poor people be prevented from using fuelwood? And it is of course reprehensible from the climate point of view that people are cutting down forests to grow food. Certainly, if people stopped eating, CO_2 emissions would decrease drastically. But is it an option that we starve to death? In theory forest does of course not need to be cleared to produce the food we need in the future. Productivity in agricultural land could (hopefully) be increased. But that would mean that industrial agriculture needed to be introduced fast on a large scale. This would mean that hundreds of millions of small farmers would become redundant and negatively affected. How to solve that problem? Should we in developed countries refuse to buy food-products from poor countries in order to protect the forests?[39] Are trees and rainforests more important than humans? There are many target conflicts that should be discussed.

- Even if deforestation stopped tomorrow it would mean little. Donald Trump would e.g. continue to try to support the fossil industry. It is somewhat dishonest to go out with the message that deforestation is a big cause of global warming. To try to blame colored people in the South. It would be more honest to inform that USA – or Trump - is a big problem. The best thing e.g. WRI could do would probably be to try to educate the American people about global warming. In the case of ozone America took the lead and something happened. In the case of global warming little will happen until USA take the lead. Or at least close to nothing will happen if USA is a denier[40].

- Now there are 8 billion people in the world. Soon we are 10 billion. Sometimes therefore deforestation seems inevitable. This fact deserves to be seriously

[39] Often that argument seems to be brought forward.

[40] China is now number one when it comes to emissions. But China will hardly take the issue serious until USA does.

considered. ENGO/WRI often seem to forget human existence. Deforestation is certainly often something negative, but sometimes it can be the least evil (e.g. in poverty reduction). Perhaps ENGOs should occasionally reflect on the human situation and not just think about the forest, biodiversity and emissions[41]. I think it is important to eradicate poverty and find some way to reduce the waste of the global upper class. In forests, the poorest of the poor often live. If we only look at poverty reduction, in many areas it would be best for local people if the forests were converted to e.g. oil palm plantations. When agriculture is developed in an area, this usually leads to poverty reduction. If the farmers gain purchasing power, the entire economy begins to develop. We saw this, for example when the green revolution came to Asia (Djurfeldt & Jirström 2003).

- Some ENGOs seem, as mentioned, to consider forestry as something almost criminal. Trees are being cut and this gives emissions (and reduces biodiversity). But humans have been in the "wood age" for millennia. To use wood one has to cut trees. In 1947 Egon Glesinger wrote the report "The coming age of wood". He analyzed how wood had been used during WWII in e.g. Sweden. It had been used for energy, animal feed, textiles, plastic and even on trial food for humans. Everything that can be made from oil can be made from wood (and in addition many other products). The age of wood was not coming, as Glesinger hoped, but instead we got the age of oil. Many now argue that we must go back to the age of wood. The age of oil is over. ENGOs seem on the other hand to argue that we in principle shall stop utilizing wood. Forests and trees shall mainly be used to store carbon and protect beetles. It is bad to cut trees. WRI can of course argue that a World without forestry is a better World. But if that is the view of WRI it should be proven or at least seriously discussed. Advantages and disadvantages have to be weight against each other. Forestry may after all sometimes be better than other alternatives, which can mean e.g. continued use of oil. If WRI says a it is also advisable to say b (in for a penny, in for a pound). Otherwise numerous questions will remain.

- According to WRI it is evidently very negative to clear forests. Since the stone-age we, humanity, have in our stupidity cleared nearly 50 % of forests (Bryant et al.1997). What was the alternatives? Take a decision 5000 years back to remain at the stone-age?

- ENGO´s often seem to forget that trees and vegetation come back (fig 7). It is in practice often difficult to stop trees from taking over an unused area. ENGO´s also often seem to forget that there is something called "increment"! In e.g. Sweden

[41] The famous Indian environmentalist Anil Agarwal never talked about "foresters". He always talked about the "stupid foresters". The reason was that foresters, according to him, were more interested in trees than in people. This was in the days of "social forestry". I fear Anil Agarwal now would have talked about the "stupid ENGOs" or the stupid WRI. Their interest in people is limited. Biodiversity and climate change is priority number one.

“loss” due to logging and natural causes is often about 100 million m^3, but increment is 120-130 million m^3. To just speak of “loss” is outright wrong. As always one has to give the whole story.

Fig. 7: Trees come back!!

- ENGO preaches "gloom and doom". The situation may seem so desperate that it might not be any idea to try to do something? I would argue that the situation is not as desperate as ENGOs often preaches in the case of forests. Perhaps something can be done. In many poor countries ("developing countries"), development has reversed for the better. We have also learnt a lot about the causes of deforestation. And we know something about what is needed to reduce deforestation. An important part of the solution, for example, should simply be to raise GDP/capita in poor countries. We are probably also forced to learn and accept that in poor and corrupt countries it is very difficult to do anything at all. What gives result is serious work and political will.

- Greta Thunberg is saying that we must listen to the scientists. What is coming from e.g. WRI, WWF or Greenpeace is, however, hardly science. It is more like information coming from one-issue sects. Greta has the advantage that IPCC seriously works with science. For many other subjects (like deforestation and biodiversity) science is often lacking. Also in scientific journals rubbish can be published. Many scientists have strong feelings about what is right and wrong.

Biodiversity "experts" can e.g. in my view be very one–eyed. They often value beetles more than humans.

- Information about the global forest situation is now coming from numerous organizations[42]. It is inevitable that the situation is confused. There is a need for something like an IPCC for forestry (or for land-use). If such an organization was established it would not be possible to spread fake facts and white lies like now.

- I rarely see a sensible article about forests and deforestation in the press. With a lot of one-eyed information published by sects one cannot really expect journalists to succeed in writing something of value. WRI seems to be a main source in most articles about global forest issues. That depends on a good information department. It is a responsibility! WRI can of course continue to spread doubtful information of rather limited value. Or WRI could change and begin to seriously discuss what can be done to improve the present forest situation.

- Hans Rosling (2018) wrote that the situation of man has improved drastically during the last decades. That may be true. But it isn't difficult to argue that the situation of the environment hasn't improved. One can e.g. point at climate change, biodiversity, water, agricultural soils and harmful chemicals. In my view forests may not be among the worst of problems. Forests can come back. But it is certainly advisable to protect the forests and reduce emissions of CO_2. But it is also necessary to reduce poverty. One billion people can be classified as poor. The most important thing now is not necessarily to save the rainforests. The most important thing is to try to save civilization. The forest will in the end survive in one form of another, but it is doubtful if the present civilization will. What to do? Try to create engagement by spreading white lies, or seriously trying to spread hard facts about the present disastrous situation to politicians and the general public?

- The World may be approaching a warming of 3-4 degrees and 10 billion people. Is it then sensible to live in a dream of the untouched wilderness? To have conservation of primary forests as the prime objective? Isn't it necessary to accept that drastic changes will be needed in the coming decades? All that is possible must be done to reduce the global warming (and deforestation). But all must also be done to wipe out poverty. How to find a sensible compromise between conflicting objectives? That seems to be more important than to spread the message that reduced deforestation is the solution to all ills. "We must all try to stop putting our heads in the sand".

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[42] E.g. FAO, WWF, UNFF, UNEP, UNFCC, UNCBD, IUCN, WRI, IIASA, JRC, IIED, ODI, CIFOR, Greenpeace, Conservation International, Sierra Club and IUFRO.

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