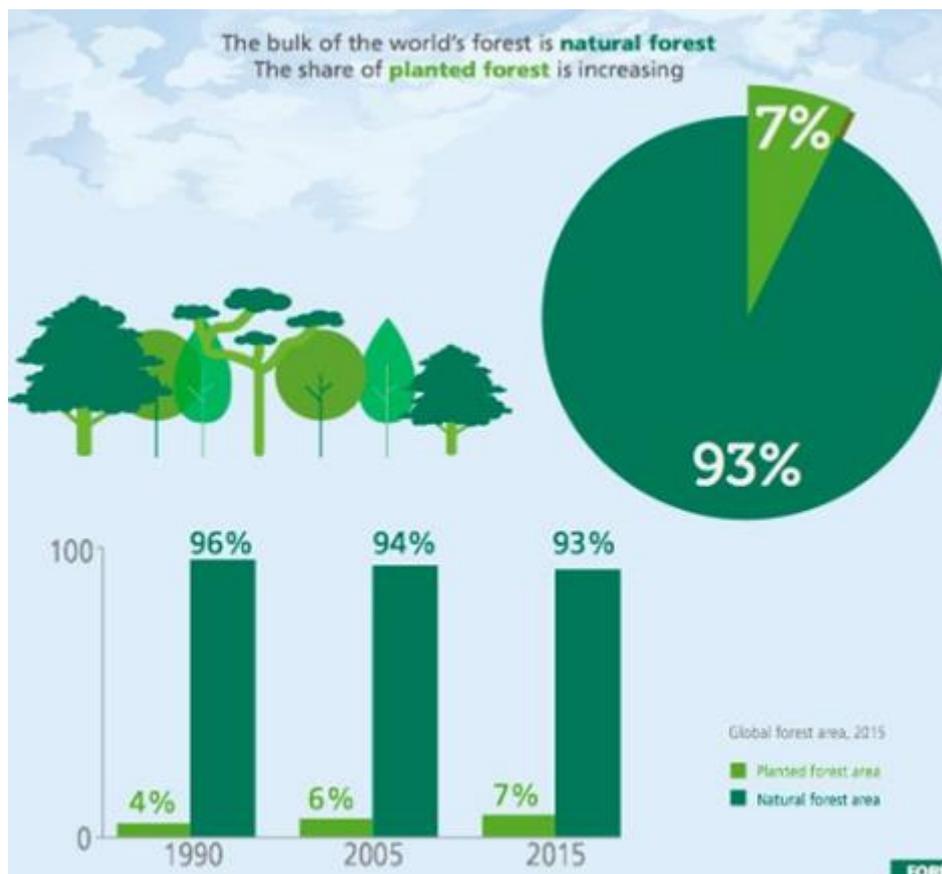


## The global impact of forest tree breeding is low, but unknown

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**Introduction** Forest tree breeding has the potential to improve forests and facilitate reforestation and create forests where it is desirable. There are many forest tree breeding programs around the world. Many of them can be described as rather successful. The impact of these efforts on reforestation is growing. On agricultural crops breeding has been an important part of the “Green revolution”, which drastically increased production, and was an incitement widening breeding application to forest trees. The current impact of forest tree breeding globally is not infinitesimal and expected to raise. The effort looks surprisingly low compared to the potential the “experts” (like me) claim, but apart from that the realised benefits seem unknown. Greenies often express worries about aspects of the management of forests, e.g. exhausting the genetics. The quantitative use of forest tree breeding is of interest when describing the forests of the world, and it becomes more relevant with time as more forest becomes improved.

**Current global descriptions of the impact of forest plantation** FAO has issued a report “Global Forest Resources Assessment 2015”, also analysing changes in the past 25 years, presented at <http://www.fao.org/forest-resources-assessment/en/> Scientists and experts have described the results from different aspects <https://doi.org/10.1016/j.foreco.2015.06.018> Currently 93% of the forests are described as natural and 7% as planted. 1990 96% of the forest was natural and 4% planted. The plantation effort seems to have declined the last decade. See figure



**Global impact of forest tree breeding** In the global assessment no hit was found for “seed orchard”. “Genetic”, in meaning genetic improvement, occurred only once in the text, and just as an example, far from a global estimate. But the percentage affected by forest tree breeding cannot be higher than the non-natural forest and is expected to be considerable lower than the percentage “planted” forest, as much planting is done by non-improved seeds and all trees in a planted forest are not planted. The increase in planted forests the last 25 years from 4% to 7% is almost certainly accompanied by an increase of the impact of forest tree breeding. Not only the area but also the percentage of planted forest affected by forest tree breeding is most likely raising. It seems not possible for FAO to evaluate the impact of forest tree breeding from the national reports collected. FAO does not seem to plan for questions to countries making such evaluation possible in the next Forest Resource Assessment 2020.

**Is seven percent “planted” forest little?** It ought to be considered that large areas ought to be regarded as not available for planting for economic or other reasons. The forest may be too far away in undeveloped territory, the potential production may be low, the cost of extracting timber high, the risk of injuries high. There may be environmental considerations. Certainly, a large part of the world forest area is not available for planting. I have little information about what is reasonable available, just intuitively see 7 % as low. Considering that forest is a sustainable resource, which will be more needed when fossil resources get more limiting. Deforestation has been and is a problem and plantation may remedy part of that. Part of the “planted” forest is reforestation of other land than forest, so the percentage of natural forest replaced by planted forest is less than percentages given.

## **Impact of forest tree breeding in some countries and organisations**

**OECD** has data of the material produced

(<http://www.oecd.org/tad/code/forestreproductivematerial.htm>). Only 25 countries participate in the OECD Scheme on forest reproductive material, thus a small share of the world. The OECD Scheme for the Certification of Forest Reproductive Material aims to encourage the production and use of forest tree seeds or plants that have been collected, processed, raised, labelled and distributed in a manner that ensures their trueness to name. Thus, the attention on the market, the customer should know what is marketed. It is much less attention on the quantities sold and almost no interest on the areas covered by the dissimilar materials. They do not offer statistics suitable for concluding the percentage of participating countries forests actual share of different reproductive materials.

**European Union** has the FOREMATIS database (<http://ec.europa.eu/forematis/>) That is only a small share of the world's countries and many of them overlap with OECD. It is possible to see reproductive material, which has been approved, but not the area of forests they have been used for.

**China** is by far the country in the world with most planted forest, around a quarter (79/291 <http://www.fao.org/3/a-i4895e/i4895e06.pdf> fig 6) and there are indications that many plantations utilize genetically improved reproductive material. China is certainly the country in the world, which uses most genetically improved reproductive material.

**Seed orchard use?** As far as I know, there are no acceptable good national estimates of cumulative seed orchard use or even estimates of annual increase of area with genetically improved reproductive materials. Estimates of national areas of forest cumulatively planted e. g. by seed orchard sources are not easy. It is still more difficult with the “genetic quality” of these areas. E.g. it depends on definitions. There are problems e.g. how trees for agroforestry and different “land-races” will be considered. I am arguing that the reproductive material the world should use is something, which is less advanced than tested clonal seed orchards, but more advanced than

approved seed collection areas, see

<http://daglindgren.upsc.se/Meetings/Antalya06/Turkey06LindWeiLowInput.pdf>.

**Asking the experts?** I wrote to around fifteen, who I believe are as close to expertise of global use of genetically improved material as you can come. The seven responses I got indicate that no expert nor organization know of a meaningful estimate covering more than a small share of the world. No summarizing estimate of the area in a country originating from e.g. seed orchards was given in the expert replies (although NZ and Sweden were close).

I could probably without assistance have presented a national estimate for Sweden for the current cumulative area as well as that 1990 for Swedish forest planted/seeded by seed orchard material. Thus, to me it does not seem an impossible task to make global rough estimates, given the will and interest.

**If the Forest Resource Assessment had been more interested in genetics?** No comparative world-wide statistics can be obtained unless FAO makes the inquiries. The definitions must be uniform over the estimates and only FAO has the power to formulate that. There are no national estimations, as those able to do them are insufficiently motivated. If FAO inquired, national efforts to get the figures would be stimulated and probably also strengthen the interest for getting genetically better forests. Evaluation of the results could preferably be done by experts in special reports, as done with this FRA, but these experts need uniform base data for their estimations.

**Genetic improvement and seed orchards will be counted as carbon release by EU!**- EU requires that the increased harvests Swedens long term use of seed orchards is counted as a pollution!

<http://daglindgren.upsc.se/Froplantager/GlobalLowImpactBreedingWeb.pdf> !

#### **More about FAO and genetic improvement.**

Once upon a time FAO (1993) was interested in seed orchards. A good description about seed orchards at the FAO web: Guidelines on Establishment and Management Practices

[www.fao.org/docrep/006/ad223e/AD223E05.htm](http://www.fao.org/docrep/006/ad223e/AD223E05.htm) In some parts of the world countries are eager to plant to save nature and push reforestation <http://www.digitaljournal.com/news/environment/india-has-planted-nearly-66-million-trees-in-12-hours/article/496657> FAO issues other reports, e.g. Forestry for a low-carbon future (2016) [http://www.fao.org/3/a-i5857e.pdf?utm\\_source=twitter&utm\\_medium=social+media&utm\\_campaign=faoforestry](http://www.fao.org/3/a-i5857e.pdf?utm_source=twitter&utm_medium=social+media&utm_campaign=faoforestry) , where genetic

improvement is hardly mentioned, it would have been worth some discussion in this long FAO book! Contrasting biodiversity seems to get 50 times more focus.

There is a FAO related body, which seems to intend an international question form also including some tree breeding related statistics <http://www.fao.org/3/a-mr075e.pdf> In a 16 pp abstract of first report <http://www.fao.org/3/a-i3827e.pdf> two rows relate to genetics "Develop and reinforce national seed programmes to ensure the availability of genetically appropriate tree seeds in the quantities and of the quality needed for national plantation programmes." Some sort of need is recognized, although with yet very low impact on FAO documents.

First at the web 170608, link <http://daglindgren.upsc.se/Froplantager/GlobalLowImpactBreedingWeb.pdf> , since 170724 also at <http://downto.dagli.se/?p=232> there comments can be made, but 170807 yet no comment.