Danish Christmas tree production is climate-friendly

By Managing director Claus Jerram Christensen, Danish Christmas Tree Association

The Danish Christmas Tree Association - trees & greenery *has carried out a life cycle assessment (LCA) of Christmas trees produced in Denmark. The assessment concludes that conventional Christmas tree production, seen in isolation, removes the equivalent of 0.6 kg of CO_2 from the atmosphere and that consumer transportation is the most significant factor in respect of the overall climate impact. The impact on the climate corresponds to 2.6 kg of CO_2, when consumer transportation is included.*

A complicated affair

It is complicated and extensive to perform life cycle assessments or cradle-to-grave assessments, which it is called, too. You need to have an overview of and include all processes not only from (nursery) production, but also data from energy etc. to the extraction of the raw materials and materials that form part of the production. An example: We use RoundUp in conventional Christmas tree production, but where are the active substance (glyphosate) and additives produced? And what does the packaging weigh? What is it made of, and where on the globe is the packaging produced? The collection of such data for all production inputs is obviously time-consuming, and the further LCA-process encounters several methodological challenges in respect of delimitation. An example: should the manufacture of the tractors used in Christmas tree production be included in the LCA- assessment? Or are these assumed to be excluded from the assessment due to their long lifespan? In addition, relatively few pesticide and fertilizer types have been subjected to a complete LCA- assessment, which is why you often have to use these as a model for other pesticide and fertilizer types – the so-called proxies.

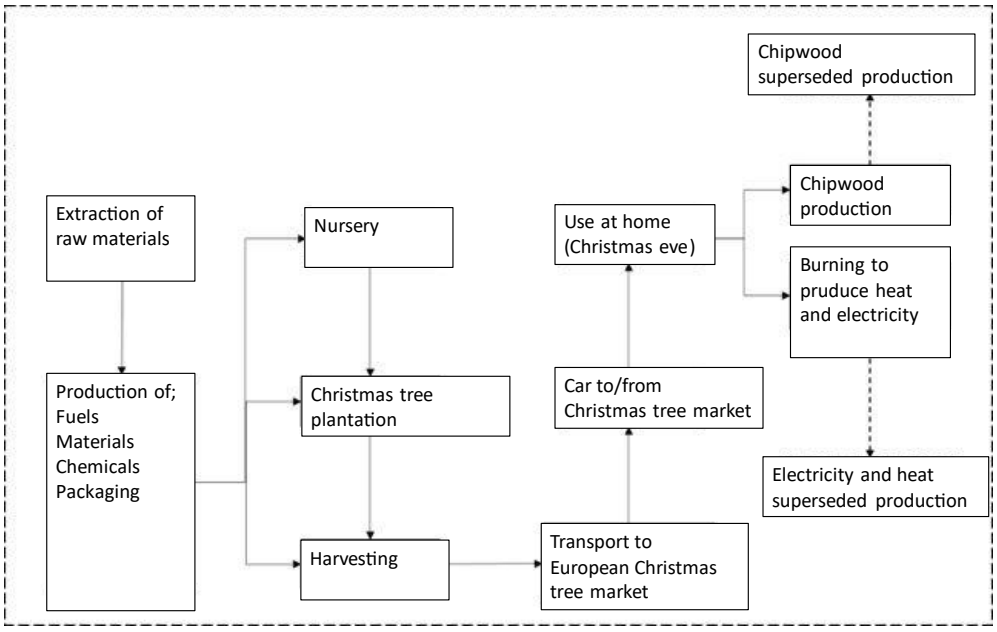

Figure 1. System delimitation for the LCA-assessment of Nordmann fir Christmas trees produced in Denmark. Arrows between processes may also indicate transportation.

The life cycle assessment carried out here thus includes the extraction of raw materials, materials and products used for the production of Christmas trees (both in the nursery and in the field), the transportation of raw materials and packaging (Figure 1). In addition, the use of pesticides, fertilizers and other inputs for the cultivation itself is included. Likewise, the most likely disposal scenario (EoL) is included for all materials used in production.

All phases of the tree's life are included in the model: the nursery phase (seedbed and possibly transplant bed), the cultivation phase (site preparation, planting, weed control, pest control, fertilizer and product improvement), the harvest phase (cutting, netting and palletizing) as well as the transportation phase (to the point of sale in Europe (distributed on countries according to export statistics) and consumer transportation) and finally the disposal phase.

Different scenarios

The LCA-assessment focuses on the production of one Danish Nordmann fir Christmas tree, and the main scenario is intensive, conventional production using pesticides and fertilizers. An LCA-assessment has also been carried out for organic production, using mechanical weed control, limited pest control (with approved substances for organic production) and organic fertilisers, as well as a scenario for intensive potting production with shorter rotations and irrigation (Table 1). In addition to the three cultivation scenarios, a scenario without consumer transportation has been made, as this parameter has proven very crucial in previous LCA-assessments (Ellipsos 2009 & ACTA 2018). It is emphasized that the inclusion of consumer transportation is common practice in LCA-assessments of Christmas trees, but its fairness or justification is debatable, just as the distance the consumer travels to pick up a Christmas tree is not insignificant.

Table 1 Overall differences between the three cultivation scenarios. The weight of a potted tree includes the pot.

	Main scenario: Conventional production	**Organic production**	**Potting production**
Nursery			
Weed control	Chemical/mechanical	Mechanical	Chemical/ mechanical
Fertilization	Fertilizers	Organic fertilizers	Fertilizers
Pest control	Yes	No	Yes
Main production			
Plant numbers (no./ha)	6,000	5,000	12,500
Marketable trees (no/ha)	4,500	4,000	12,000
Weed control	Chemical	Mechanical	Chemical
Fertilization	Fertilizers	Organic fertilizers	Fertilizers
Pest control	Chemical	Chemical– basic substances	Chemical
Leaderlength control	Chemical	Mechanical	Chemical
Irrigation	No	No	Yes
Tree weight (kg)	18	15	12
Height (m)	2.0	2.0	1.2

Environmental impacts

The assessment clarifies the Christmas tree's environmental impact within 19 different categories, but here results for climate change alone are shown below (Figure 2).

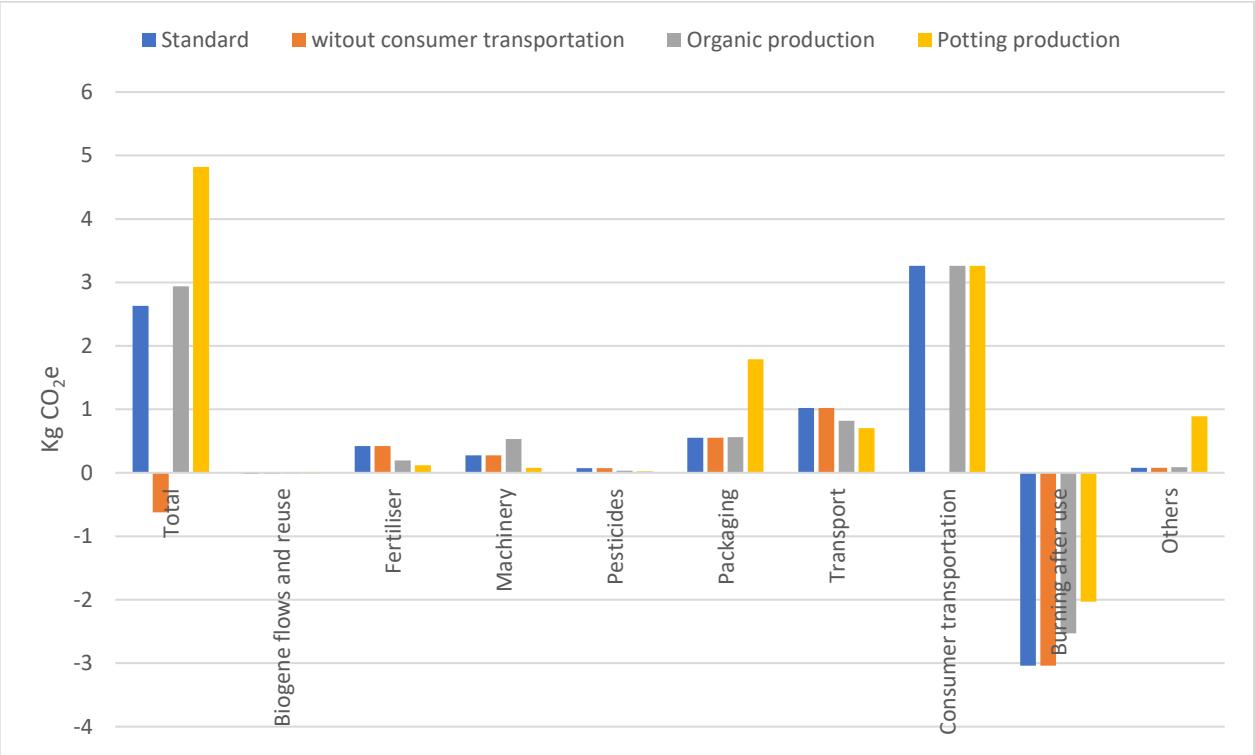

Figure 2 Environmental impacts of the Danish production of one Christmas tree for market in the four scenarios within: Climate change, fossil.

The results show that a Nordmann fir Christmas tree produced in Denmark has removed the equivalent of 0.6 kg of CO_2, when it has arrived at the point of sale in Europe. Including all inputs for cultivation and transportation to the points of sale in Europe, **the Christmas tree** is thus an **overall gain for the climate**. If the consumer picks up a Christmas tree (Danish or locally grown) at the points of sale and transports the tree over a distance of 2*10 km in a new smaller petrol car, the total climate impact corresponds to 2.6 kg CO_2. If a car is not used (e.g. in cities) or if an electric or hybrid car is used, it will not affect the climate to pick up a tree within a short distance of the consumer's place of residence.

The lowest climate impact is achieved through conventional cultivation (2.6 kg CO_2e) followed by organic production (2.9 kg CO_2e), where a higher diesel consumption for mechanical weed control is the primary reason for the slightly higher environmental impact. With a 4.8 kg of CO_2e, potting production accounts for the highest environmental impact, which mainly stems from irrigation (other) and a larger impact from packaging (pots) as well as the fact that the trees are smaller (lower CO_2 uptake) with consequent less displacement of fossil fuels when burning after use.

Certain effects are included in the assessment at a more general level, such as the alternative exploitation of land and the biomass inventory for the remaining roots and branches on the

production site. In particular, the carbon build-up in the root mass must be assumed to contribute positively to the Christmas tree's climate accounts, but this is not included in the study.

One should be careful comparing LCA-assessments, as the assumptions and level of detail may vary, but in the 2009-study from Ellipsos (2009), the natural tree (Douglas) is stated at 3.1 kg of CO_2e grown under Canadian conditions (read more about this study in the Danish magazine, Nåledrys 72/2010). In the later 2018-study by ACTA (the US trade association for plastic trees), a Fraser fir is stated at between 4.9 kg CO_2e and 7.8 kg CO_2 depending on the method of disposal. Both studies state 2 x 5 km as consumer transportation as opposed to the 2x10 km used in the present study.

Plastic trees

Plastic trees are not included in the LCA-assessment performed by the Danish Christmas Tree Association - trees & greenery, as it would require great insight into the entire production process for plastic trees. However, in the Canadian 2009-study, the climate impact of plastic trees is calculated at 48.3 kg CO_2e over the tree's expected lifetime of 6 years, corresponding to 8.1 kg CO_2e per year (Ellipsos, 2009). This means that in this study, a plastic tree must be kept for 21 years, before it is as climate-friendly as a natural tree. In the American study from ACTA, the climate impact is 17.9 kg CO_2e, and you must alone keep the plastic tree for four years to obtain the status of being as climate-friendly as a natural tree. As far as domestic sites are concerned, Concito is quoted for stating that the natural tree burdens the climate with the equivalent of 10 kg of CO_2, while the plastic tree burdens the equivalent of 50 kg of CO_2, (Berlingske, 2019) and according to Concito, you must thus keep a plastic tree for at least five years, before the plastic tree surpasses the natural tree in terms of climate accounts. In their model, Concito places great emphasis on the alternative exploitation of land for Christmas trees production, which they believe to be traditional forest implicating a greater CO_2 gain. However, this does not harmonize well with reality, where the majority of Christmas trees are planted on former agricultural land, and the estimate of 10 kg of CO_2 for the natural tree seems high compared to all other studies.

The above figures refer alone to the climate impact and do not include the effects from possible endocrine disruptors and/or toxic heavy metals that certain plastic trees may contain.

Christmas within the nuclear family

The Christmas tree is one of the purchases at Christmas that entails less stress on the climate account, where many of the gifts probably must be deemed to account for a high climate impact. Below, a typical Christmas dinner for a nuclear family of four is outlined – note that the food is not prepared (Table 2).

Table 2 Climate impact for selected products on Christmas Eve. All food figures stem from the large climate database compiled by Concito (https://denstoreklimadatabase.dk) all figures are calculated all the way to the supermarket (cradle-to-gate).

Subject	Quantity	Climate impact (kg CO_2e)
Pork, raw	1.5 kg	5,4
Potatoes, raw	1.0 kg	0,4
Red cabbage, raw	0.8 kg	0,2
Red wine	0.75 l	1,5
Soda	1 l	0,6
Coffee, ground beans	0.5 l	1,6
Rice pudding (Risalamande)	0.6 kg	1,2
Cognac (brandy)	0.01 l	0,1
Christmas tree	18 kg	- 0,6

In total, the above Christmas dinner amounts to 11.4 kg CO_2e without the Christmas tree, which reduces the total consumption to 10,8 kg CO_2e or 2.7 kg CO_2e for each person.

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