Comparative Study of Cut Roses for the British Market Produced in Kenya and the Netherlands

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Introduction

- The work was conducted by a team at Cranfield University, which is experienced in analysing the production of both field and protected crops in Britain.
- Previous work by the team has used the methods of Environmental Life Cycle Assessment (LCA) to produce Life Cycle Inventories of food crop production (Williams et al., 2006).
- This report compares production and delivery of roses from two specific production centres, one at Oserian and Kenya and the other near the Hook of Holland.

Methods

- The principles of LCA are to quantify all the resources used and emissions to the environment that occur in the production of a commodity, known as the functional unit.
- Production inputs are traced back to primary resources, e.g. the energy in vehicle fuels is traced back to crude oil in the ground and vehicle use includes the energy used in the production and maintenance of the vehicles over their lifetime.
- The emissions of interest in this report are CO_2 and Global Warming Potential (GWP).
- While CO_2 is the main greenhouse gas concerned with global warming, agriculture and horticulture are particular sources of methane (CH_4) and nitrous oxide (N_2O).
- Other gases are related to CO_2 using factors that quantify the ability of the gas to absorb solar radiation (radiative forcing) over a timescale of 100 years (GWP_{100}).

Air freight

- A major term in the Kenyan operation is air freight.
- We did not have an inventory for fuel usage and associated emissions, but developed one from the Defra *Guidelines for Company Reporting on Greenhouse Gas Emissions* (Defra 2005) and data from the National Air Emissions Inventory (www.naei.org.uk). These provided average values for CO_2, CH_4 and N_2O emissions per tonne-km (t-km) of air-freight and represent the direct combustion of fuel alone.
- These were inflated by a factor 1.1 to account for tracing the fuel back to crude oil (in line with other major fuels). Energy and known greenhouse gas (GHG) emission were increased by a further 10% to allow for aircraft manufacture and maintenance (this is rather less than for agricultural vehicles for which the factor is more typically in the range 20 to 30%).
- Of greater concern, however, is the potential effect of the high altitude of aviation emissions on the effect of CO_2 in radiative forcing. The AEA study for Defra on food miles (Watkiss, 2005) used a factor of 2.7 to account for this effect. This factor was included in comparisons as CO_2A and $GWP_{100}A$.

Results

- The production at Oserian and delivery to the World Flowers RDC of the functional unit of 12,000 cut rose stems incurs 53,000 MJ primary energy and emits 2,200 kg CO_2 (without including any allowance for the altitude of emissions). 7,800 MJ (15%) is fossil. The equivalent from one Dutch operation uses 550,000 MJ primary energy (>99% fossil) and emits 35,000 kg CO_2.
- The main energy inputs in the Dutch house are 800,000 m^3 natural gas and 1,200 MWh electricity per ha. These are broadly similar to those used for tomato production in Britain.
- The annual yields of marketable stems were almost 70% higher per ha in the Kenya when compared with the Dutch.
- CO_2 represented 90 to 96% of the Global Warming Potential (GWP_{100}) from the two systems.

- Including the altitude effect on CO_2 impact, Dutch CO_2 emissions were about 5.8 times larger than Kenyan CO_2A emissions (Table 1). Including the altitude effect (albeit tentatively) with other GHG to give estimates for $GWP_{100}A$, the Dutch emissions were about 6.0 larger then the Kenyan ones (Table 1).

Table 1 Relative emissions of CO_2 and global warming potentials between Dutch and Kenyan production centres analysed

Emission	Relative magnitude of $\left(\frac{\textit{Dutch emissions}}{\textit{Kenyan emissions}}\right)$	Altitude effect included
CO_2	16	N
CO_2A *	5.8	Y
$GWP_{100}A$ *	6.0	Y

* CO_2 emitted from air freight increased by 2.7 to allow for the larger impact of high altitude emissions.

Discussion

- It certainly appears that the Kenyan operation uses substantially less primary and fossil energy and emits smaller quantities of GHG than from the Dutch operation for which data were supplied.
- The values for airfreight are the average ones used by Defra, but may differ from the ones incurred by the actual operators between Kenya and Europe.
- The Dutch operation uses combined heat and power (CHP), which certainly makes better use of natural gas than for heating alone. It is possible that a different combination of gas use, electricity production and export could provide substantial reductions in primary energy use and CO_2 emissions.
- Improved management and /or varieties could, of course, also reduce CO_2 emissions from Kenyan production.
- The roses produced are similar, although not identical and have not been examined by the Cranfield team.
- Because the systems have been analysed using an LCA approach, the values found for energy use and CO_2 emissions are higher than would be found if only the immediate fuel used and emissions released were quantified.
- It should be remembered that LCA does the same for all processes, but it does not mask, say, highly energy demanding sub-processes that other analyses could ignore.
- The uncertainties of comparable agricultural or horticultural production systems that we have previously analysed have been highly correlated with each other, so that small differences could still be statistically significantly different. In this case, the production and delivery systems are more diverse. The errors are estimated to be ± 30% of the values reported here.

References

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