Department for Environment Food and Rural Affairs

Comparative Life Cycle Assessment of Food Commodities Procured for UK Consumption through a Diversity of Supply Chains

Textes complets sur :
http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=15001

Extrait :

Tomatoes

Introduction

The main differences between UK and Spanish tomato production are due to the much greater requirement for heating in the UK, which results in significant gas and electricity consumption, versus the longer transport distance involved for imports from Spain. Heat is required to provide an optimal growing environment throughout the year in the UK with obvious peak demands during the winter and early spring. Some heating is used in to reduce humidity levels and thus to avoid condensation and so help to minimise fungal diseases (so reducing the need for fungicides). All fully-commercial UK production is under glass, while in Spain the bulk of production for the UK market is in polyethylene-covered houses of varying sophistication. Nearly all conventional UK production is based on hydroponic systems using either substrates (of which there are a range) or nutrient film systems, whereas Spanish systems tend to be more varied and soil is still widely used as the growth medium for conventional commercial crops.

In the UK, greenhouses are mainly heated with natural gas, either by stand-alone boilers or combined heat and power (CHP) units, although other fuels are also used in some parts of the country. A few sites have been developed where local, industrial waste heat and CO_2 is used. The CO_2 from combustion is fed into glasshouses throughout the growing period to enhance photosynthesis and crop productivity. The addition of CO_2 is most critical during the summer months when the crop is most actively photosynthesising and natural CO_2 concentration can reach a critical level where it becomes the limiting factor for photosynthesis and yield potential will be restricted. This increased yield will slightly reduce the energy input per tonne of product.

The Spanish season generally complements the UK one for some tomato products, although with some overlap in the late spring to early summer and a shorter over-lap in the autumn. The typical Spanish export season for these lines is approximately November to June and the UK production from March to October. Other tomato lines are produced in Spain (and/or other Mediterranean countries) year-round and provide an alternative source of supply during the traditional domestic season. Recent investment in modern structures with sophisticated heating and lighting systems means that growers in the UK and Holland can now supply tomatoes year-round, although the analysis presented here relates to the principal long-season production system with April-October fruit production. Winter production in Northern Europe is still limited and the bulk of UK supply at this time of year comes from Spain, the Canaries, Morocco, Italy and Israel.

Results

Models of typical tomato production systems in the UK and Spain suggest that per tonne of loose tomatoes delivered to the RDC, PEU and GWP of UK produce were *4 and *3 greater respectively than for Spanish produce. The additional energy associated with transport from Spain was moderate at *c*. 3.6 GJ/t compared with totals of 9.6 and 36.2 GJ/t for Spanish and UK production respectively. Abiotic resource use was *c*. 35% greater for UK production, mainly due to energy consumption and the greater resources needed to build the permanent glass houses. In contrast, the eutrophication and acidification potentials of Spanish produce were both *c*. *2 greater. Pesticide and land requirement and were also greater for Spanish production by factors of *7 and *5 respectively, while water use was 35% greater.

The estimate of 2.24 t CO_2 per t for UK production is similar to the estimates reported by Biel et al. (2006) for glasshouse production in Sweden (2.72 t CO_2 per t), Denmark (3.65 t CO_2 per t) and the Netherlands (2.91 t CO_2 per t) at the wholesalers. The greater estimate for Dutch production included transport to Sweden. Greater energy use was required in Denmark for greenhouse heating as a result of using electricity from a significant proportion of coal-fired power stations. Our estimate would be expected to be smaller than these earlier ones due to increase in energy efficiency from practices such as CHP.

Per tonne of vine tomatoes delivered to the RDC, the PEU and GWP of UK produce were *6 and *5, respectively, greater than for Spanish produce. Again the difference arises mainly due to the much greater use of gas for heating and electricity in the UK, but the values are larger than for loose tomatoes because of the production of more valuable varieties which yield less. Abiotic resource use was 70% greater for UK production, mainly due to the greater resources needed to build the permanent glass houses. The eutrophication and acidification potentials of Spanish produce were *c*. 80% and 20% greater respectively. Pesticide and land requirement were also greater for Spanish production both by factors of *3, while water use was 12% less.

The differences between UK and Spain are least for energy use and GHG emissions between baby-plum tomatoes because they are grown with more energy and in more sophisticated houses in Spain than are loose classic tomatoes. Pesticide use is greater in Spain, partly because disease pressure is greater over the winter months and the typical level of Spanish greenhouse technology restricts the use of cultural control techniques used in the UK. In addition, the increased threat from insect-vectored viruses and limited development of integrated pest control strategies also results in additional pesticide application in Spain. Overall UK yields are greater per unit area and hence less land is needed. For some categories like acidification and eutrophication, impacts were greater from production in Spain than the UK.

The soil-based production systems for which we had data did not use methyl bromide (MB) as a soil fumigant, but used chloropicrin or solarisation (covering soil and allowing it to heat by sunlight).

Leaching from more sophisticated systems in Spain is considered by some producers to be small, along with careful water use. Notwithstanding that claim, similar problems with the water supply exist in along the SE coastal strip as in Huelva for strawberry production, e.g. eutrophication, salination, lowering of the water table and the need to obtain increasing amounts of water by desalination. Note that desalinisation leads to increased energy intensity and emissions. Water availability in these areas is subject to multiple sources of demand and the problems that have been reported cannot all be attributed to tomatoes as other crops are grown in these areas and human and leisure activities are having an increasingly significant impact on water availability.

Use of combined heat and power for greenhouse production

The analysis has also compared UK tomatoes from CHP heated greenhouses against Spanish tomatoes. The benefits of CHP in reducing energy use and GHG emissions vary from about 32%, if substituting for combined cycle gas turbine generator (CCGT), to 91% if substituting for the current mains mixture. The benefits are greater for the lesser-yielding baby-plum tomatoes because the proportion of burdens attributable to energy is proportionately larger than for loose classic. There is clearly substantial uncertainty about quantifying the benefits of CHP, so the estimates presented here should be regarded as an illustrative estimate rather than a definitive statement. The improvements from using waste heat and CO_2 are larger than from using CHP (when compared with CCGT). Energy use and GHG emissions pre-farm gate were reduced by over 90% for all three types of tomatoes. In consequence while total GWP from using CHP would still be *3-*5 greater for UK production than Spanish, the use of waste heat could lead to UK produce of less GWP than that from Spain (Figure 2, Appendix 1).

Benefits for some burdens like eutrophication are negligible as the crop production rather than energy supply dominates these. It must be remembered that the true benefits of using waste heat and CO_2 depend on using unavoidable inefficiencies at the supplying industry (e.g. a sugarbeet processing plant). If an industrial source is run sub-optimally to supply heat and or CO_2, any such inefficiencies should be attributed to tomato production.

Trends in UK tomato production

There is a clear trend in UK tomato production to move away from stand-alone boiler heating and CO_2 supply. The examples at Wissington and Teesside lead the way in making use of otherwise wasted resources. There are clear cost advantages to this as well as environmental ones. It seems likely that more such developments will follow, but a main constraint is the availability of suitably flat land close to sources of waste heat and CO_2. Breweries and distilleries are possible sources. Newer installations also harvest rainwater and store runoff in reservoirs. This reduces the load on mains water and boreholes, which is particularly important as water resources in the drier South and East have become increasingly stretched.