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Greenhouse gas emissions of imported and locally produced fruit and vegetable commodities: A quantitative assessment

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ARTICLE INFO

Keywords:
Climate change
Carbon dioxide equivalents
Life cycle assessment
Food production
Air transport

ABSTRACT

Today considerable efforts are being made in identifying means of further energy efficiencies within the UK food system. Current air importation of fruit and vegetables (FVs) generates large amounts of greenhouse gas (GHG) emissions part of which could be avoided. Local food production has been recognized as an environmentally feasible alternative production option and could help reduce GHG emissions, as required under the legally binding emissions targets stipulated by the UK Climate Change Act 2008.

Climate change impacts of FVs importation were determined for a selection of five indigenous FV commodities, namely: apples, cherries, strawberries, garlic and peas. Carbon dioxide equivalents (CO_2e) emissions associated with the production and transport stages were calculated using the sample of selected fruit and vegetables (SFVs). The latter stage includes three diverse geographic locations/regions for emissions comparison, namely the UK, Europe and non-European (NE) countries. On average (across the five SFVs), NE commodities, all in fresh/chilled state, were found to contain embedded (arising from production, air freighting and distribution within the UK) GHG emissions of 10.16 kg CO_2e/kg. This is 9.66 kg more CO_2e emissions compared to a kilogram of these commodities produced and supplied locally.

A scenario-based approach determined the level of emissions savings that could be achieved by local FVs production in the UK. The least dramatic change of SCENARIO-1 (25% reduction in NE SFVs imports by increasing their local production by the same amount) could save 28.9 kt CO_2e/year, while SCENARIO-2 (50% reduction in NE SFVs imports) and SCENARIO-3 (75% reduction in NE SFVs imports) could result in saving of 57.8 kt and 86.7 kt, respectively.

1. Introduction

Curbing green house gas (GHG) emissions is necessary to help mitigate the impacts of global warming. In recent years, air transport of food commodities has received much attention amongst academics and consumer groups due to extensive food miles and the associated GHG emissions. Commodities such as fruit and vegetables (FVs) are no exception and their current trend of air importation could account for significant

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http://dx.doi.org/10.1016/j.envsci.2014.12.018
1462-9011/

GHG emissions, which could be mitigated by increasing their local production.

Nowadays, FVs are transported over much longer distances than in the past due to an upswing in the global food trading (Sim et al., 2007; Cowell and Parkinson, 2003). This continuous circle of food transportation from one country to another contributes to climate change. Importation of FVs and their associated impacts on GHG emissions have been the focus of research in recent years (e.g. Canals et al., 2007; Sim et al., 2007; Garnett, 2003; Jones, 2002). In contrast, the arguments against global food system were challenged by Schlich and Fleissner (2005) who point to the 'Ecology of Scale' paradigm. Similarly, Edwards-Jones (2010) emphasized the importance of the embedded GHG emissions per kilogram of food commodity as a better indicator of the climate change impacts. Both direct and indirect impacts of aviation have been widely acknowledged (e.g. Lee et al., 2010; Sausen et al., 2005).

At present, the UK food system is responsible for almost a fifth of the UK's total GHG emissions (Garnett, 2008). However, this proportion is likely to be much higher as the emissions emitted outside the country due to international food trading are not considered in the national GHG inventory (Garnett, 2003). Moreover, while the negative impact of intercontinental air transportation has been recognized (Sim et al., 2007; Garnett, 2003; Jones, 2002), little has been done to acknowledge the emissions from production of food that is destined for export. It has been rightly suggested that the amounts of emissions from food production stage together with those generated by its importation should be attributed to the importer (Rueda-Cantuche and Amores, 2010; Fæhn and Bruvoll, 2009).

Although air transport of food represents just about 1% of UK's food tonne kilometres, TKMs (AEA, 2005), its total emissions are noteworthy compared to other means of transportation, representing 11% of the total UK food transport emissions (Garnett, 2006; AEA, 2005). At present, UK production of fruit and vegetables stands at about 9% and 62% of their respective current demands (Garnett, 2006). Their demand is primarily met by imports from the overseas countries where indigenous FVs can be grown outside the UK's growing season. Therefore, increasing the local FVs production, for example through development of local farms and orchards, offers a great potential to reduce reliance on their importation. More importantly, increasing local food production would allow achieving substantial emissions savings not only within the UK itself but also in exporting countries. There is mounting evidence that promoting the production of FVs within the UK can allow considerable CO_2e (carbon dioxide equivalent) emissions reduction, due to decreased food miles between commodities' points of production and consumption (DeWeerdt, 2009; Edwards-Jones, 2010; Garnett, 2003, 2006; Jones, 2002).

There is a great interest in locally produced food amongst UK consumers (Chambers et al., 2007); however, up to 70% of those living in urban areas believe they should have a choice of year-round availability of any food product (Canals et al., 2007). Such conflicting views demonstrate both the complexity and confused environmental consciousness amongst the UK consumers. Preference for year-round availability of certain foods is also maintained by consumer's life-style which, nowadays is characterized by convenience of time and food choice (Chambers et al., 2007).

The primary aim of this study was to assess the impact of SFVs on climate change when air-freighted to meet their demand in the UK. The study illustrates that local food production could lead to considerable CO_2e emissions savings not only due to the proximity of production but also due to its potential to reduce the impact of producing food in overseas countries. The specific objectives were to: (a) estimate the amounts of CO_2e emissions from production and transport stages which become embedded in the selected fruits and vegetables (SFVs), and (b) assess the emissions savings that could be achieved by shifting certain percentage of the air-freighted volume of the SFVs to UK's local food production by applying a scenario-based approach.

2. Methodology

A scenario-based approach was used to assess the extent of the CO_2e emissions savings that could be achieved by increasing the local production of fruits and vegetables. The following scenarios were considered: SCENARIO-1 which proposes a 25% reduction in NE import of SFVs (the gap in supply is assumed to be met by a similar increase in their local production) and SCENARIO-2 and SCENARIO-3 considered 50% and 75% reductions in the NE imports of SFVs to support the UK's local food production, respectively. Microsoft Excel spreadsheets were used for calculation of production and transport related annual amounts of CO_2e emissions for each SFVs, including the associated CO_2e savings that could arise from increasing their local production by similar amounts (as in SCENARIO-1, 2 and 3).

Five FV commodities selected were apples, cherries, strawberries, garlic and peas. Selection of the commodities fulfils a key prerequisite that all of them can be grown under the current UK climatic conditions and are commonly bought by UK consumers.

2.1. *Commodities volumes data*

The study uses secondary data obtained from the UK Trade Info (2014). The amounts of all SFVs imported to the UK were determined using appropriate commodity codes. The data were adjusted to establish SFVs volumes per transport mode for both, non-European (NE) and European countries. It should be noted that only commodities imported in fresh or chilled conditions were considered in this study. Only three busiest UK airports were taken into account for the NE imports, namely: London Gatwick, London Heathrow and London Standsted (DfT, 2011, p. 57). The commodities air-freighted from the European countries were not acknowledged here because the focus was primarily on assessing the impact of long-haul flights that are often used for commodities importation from NE countries. Both, the total and the air-freighted volumes of SFVs were identified from the database which featured all UK points of entry. This process also enabled to determine those volumes which were imported by 'other-than-air' transport. European volumes of SFVs were assumed to be transported by both, heavy goods vehicles