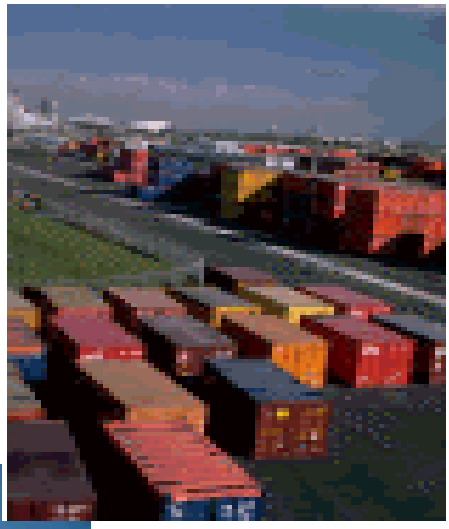
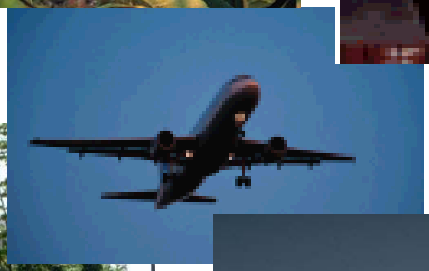
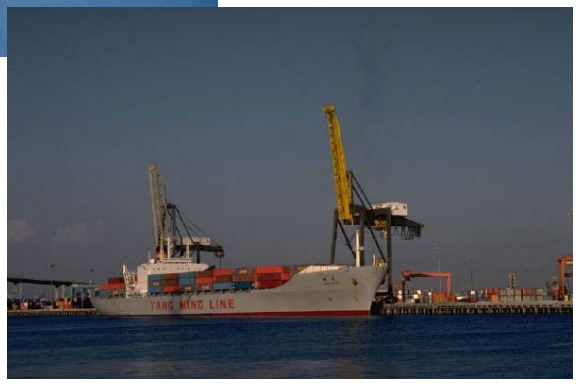
ED50254 Issue 7

The Validity of Food Miles as an Indicator of Sustainable Development

Final Report produced for DEFRA







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Executive Summary

Study Objectives

Over the last fifty years, there have been dramatic changes in the food production and supply chain in the UK. The most striking changes have been:

- Globalisation of the food industry, with an increase in food trade (imports and exports) and wider sourcing of food within the UK and overseas;
- Concentration of the food supply base into fewer, larger suppliers, partly to meet demand for bulk year-round supply of uniform produce;
- Major changes in delivery patterns with most goods now routed through supermarket regional distribution centres, and a trend towards use of larger Heavy Goods Vehicles (HGVs);
- Centralisation and concentration of sales in supermarkets, with a switch from frequent food shopping (on foot) at small local shops to weekly shopping by car at large out of town supermarkets.

These trends have led to a large increase in the distance food travels from the farm to consumer, known as "food miles". Indeed, since 1978, the annual amount of food moved in the UK by HGVs has increased by 23%, and the average distance for each trip has increased by over 50%.

The rise in food miles has led to increases in the environmental, social and economic burdens associated with transport. These include carbon dioxide emissions, air pollution, congestion, accidents and noise. There is a clear cause and effect relationship for food miles for these burdens – and in general higher levels of vehicle activity lead to larger impacts. Growing concern over these impacts has led to a debate on whether to try to measure and reduce food miles.

Against this background, DEFRA have commissioned this study to assess whether a practical and reliable indicator based on food miles can be developed, and whether this would be a valid indicator of progress towards the objectives of the government's Sustainable Farming and Food Strategy and the proposed Food Industry Sustainability Strategy. The study has undertaken four key tasks:

1. To compile a **food miles dataset** covering the supply chain from farmer (both UK and overseas) to consumer for 1992, 1997 and 2002.
2. To assess the **main trends** leading to increases in food miles around the UK and overseas.
3. To identify and quantify the **economic, environmental and social impacts** of food miles.
4. To develop a **set of key indicators** which relate food miles to their main impacts on sustainability.

The main criteria for the validity of a progress indicator based on food transport include:

- It should be based on easily available statistics which are updated annually;
- Any data gaps can be filled with reasonable estimates;

- It should be possible to structure a food miles indicator so that the indicator is directly correlated with food transport (and the associated negative externalities) and any exceptions can be dealt with;
- The indicator should have strong links to the aims and outcomes of the proposed Food Industry Sustainability strategy, such that progress towards the aims of the strategy will have a noticeable effect on food transport km (and levels of negative externalities);
- The indicator will have a reasonably quick response to policy measures;
- It will be accepted as a valid indicator by all stakeholders;
- It is consistent with the other indicators for the Food Industry Sustainability strategy.

Study Findings

The four key findings of the study are summarised below.

1. **A single indicator based on total food kilometres is an inadequate indicator of sustainability**. The impacts of food transport are complex, and involve many trade-offs between different factors. A single indicator based on total food kilometres travelled would not be a valid indicator of sustainability. To capture the complexities of the issue, we recommend **a suite of indicators** which reflect the key adverse impacts of food transport (see below).

2. **Data is available to provide and update a meaningful set of indicators on an annual basis**. A spreadsheet system for collating the data and calculating the indicators accompanies the report. The key transport stages (HGV and LGV transport in the UK, car shopping trips for food and international sea and air freight) are covered by good quality DfT and HM Customs and Excise statistics gathered annually. Areas where the data quality is poor are either of less policy interest to DEFRA (road transport overseas), or currently have a negligible role in UK food transport (rail, inland waterway). A summary of the data sources and quality is provided in Table E2.

3. **Food transport has significant and growing impacts.** Food transport accounted for an estimated 30 billion vehicle kilometres in 2002, of which 82% are in the UK. Road transport accounts for most of the vehicle kilometres, split between cars, HGVs and LGVs (see figure E1).

    - Food transport accounts for **25% of all HGV vehicle kilometres in the UK**.
    - Food transport produced **19 million tonnes of carbon dioxide** in 2002, of which 10 million tonnes were emitted in the UK (almost all from road transport), representing 1.8% of the total annual UK CO_2 emissions, and 8.7% of the total emissions of the UK road sector.
    - **Transport of food by air has the highest CO_2 emissions per tonne, and is the fastest growing mode.** Although air freight of food accounts for only 1% of food tonne kilometres and 0.1% of vehicle kilometres, it produces 11% of the food transport CO_2 equivalent emissions (see figure E2).

4. **The direct environmental, social and economic costs of food transport are over £9 billion each year, and are dominated by congestion.** Using standard government methodology, the social cost of congestion, associated with

food transport is estimated at £5 billion. This is over 50% of the social costs associated with food transport, and arises from the use of HGVs, LGVs, and cars are associated with food transport in the UK. Accidents lead to social costs of £2 billion per year (Table E1). Greenhouse gas emissions, air pollution, noise, and infrastructure cost a further £2 billion. The total costs are very significant compared with the gross value added of the agriculture sector (£6.4 billion), and the food and drink manufacturing sector (£19.8 billion) in 2002. It should be noted that these cost estimates depend on the assumptions and methodology used. For example, the congestion costs are marginal costs, as the impact of an extra kilometre travelled depends on the existing level of traffic. The use of average costs, although not recommended, would give lower values. Also, the costs reflect only immediate impacts. For congestion, these impacts are short term and reversible, whereas climate change impacts are long term and irreversible. It should be stressed that not all impacts are included in this assessment (for example noise, infrastructure and congestion costs from air transport are not quantified).

Figure E1. UK food vehicle-kilometres by transport mode (2002)

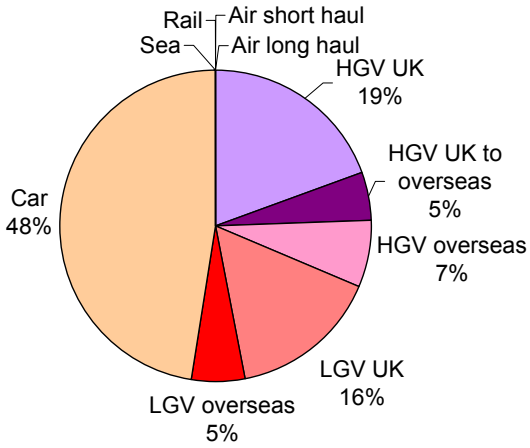

Figure E2. CO_2 emissions associated with UK food transport (2002)

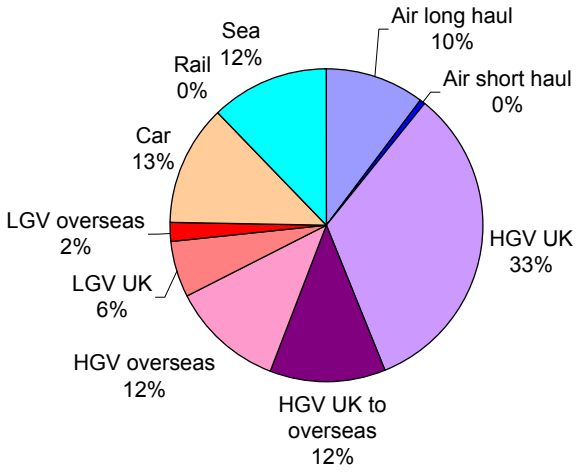

Table E1: Social cost estimates for UK-generated food transport (2002)

£M	CO_2	Air quality	Noise	Congestion	Accidents	Infrastructure	Total costs
UK HGV	120	165	123	1359	327	387	2480
UK LGV	21	48	27	1056	148	4	1303
UK car	46	24	42	2576	965	9	3662
UK to overseas road	43	54	39	52	115	141	443
Overseas HGV	42	58	43	90	304	272	809
Overseas LGV	7	18	9	54	147	3	239
Rail	0	15	0	0	0	0	16
Deep sea	43	32	0	0	26	nq	106
Short sea	3	22	0	0	3	nq	32
Air long haul	38	1	nq	nq	nq	nq	39
Air short haul	2	0	nq	nq	nq	nq	2
Total	**364**	**439**	**283**	**5187**	**2036**	**815**	**9123**

nq=not quantified

Table E2: Summary of data sources, assumptions and data quality for food transport dataset components

Data component	Data sources and assumptions	Data quality	Estimated % of CO_2 emissions	Estimated % of vehicle km	Timing of data
UK HGV	Annual Continuing Survey of Road Goods Transport (CSRGT) from DfT – data compiled from monthly surveys of thousands of transport operators.	Good. Can disaggregate food types but not imports and exports.	33%	19%	May
UK LGV	DfT survey of private and company van use (2004).	Good.	6%	16%	August
UK car	Annual DfT survey of personal travel. Car travel for food shopping is identified separately.	Vehicle km well defined. Urban/rural split for food shopping not available – the split for all car travel purposes is used.	13%	48%	September
UK sea, rail, inland waterway, air	DfT statistics available for total UK sea and rail freight, but not split out by food transport.	Little data which separates out food from other freight, but insignificant	Very low	Very low	N/a
International air	HM C&E database for non-EU countries. Assumed insignificant for EU countries – expert opinion is that most food commodities from the EU travel by road or ship (cheaper and just as fast).	Good for non-EU countries. Not available for EU countries but thought to be insignificant.	11%	0.1%	March
International HGV	HM C&E database gives total tonne km for road and sea. Split between road and sea depends on assumptions.	Good for total tonne-km. Assumptions for split between road and sea are reasonably well informed.	12%	5%	March
International sea	HM C&E database gives total tonne km for road and sea. Split between road and sea depends on assumptions.	Good for total tonne-km. Assumptions for split between road and sea are reasonably well informed.	12%	0.04%	March
International rail, inland waterway	Not available.	Not available but thought to be insignificant.	Low?	Low?	N/a
Overseas HGV	Estimate based on country size and handling factor	Poor. May be an underestimate, but of less policy interest to DEFRA.	12%	7%	N/a
Overseas LGV	Estimate based on overseas HGV estimate and ratio of HGV to LGV food transport in the UK.	Poor, but of less policy interest to DEFRA.	2%	5%	N/a
Overseas rail, air, inland waterway	Not available.	Not thought to be very significant.	Very low?	Very low?	N/a

How to measure food miles: complexities and trade-offs

The relationship of food transport to overall sustainability is complex. We have established that the transport of food has significant direct environmental, economic and social impacts. Therefore, in like for like systems, where food supply chains are identical except for transport distance, reducing food transport will improve sustainability. However, differences between food supply systems often involve trade-offs between various environmental, social and economic effects. These must be taken into account when designing an indicator to measure the impacts of food transport, and when formulating associated policies. Some of the main issues are summarised below.

1. **Transport mode.** The impacts of food transport are highly dependent on the transport mode. Air transport has a very high climate change impact per tonne carried, whereas sea transport is relatively efficient. Transport by HGV accounts for most of the infrastructure (road maintenance), noise and air pollution costs, yet shopping for food by car accounts for a high proportion of the congestion and accident impacts. For this reason, we propose a set of key indicators which focus on the main direct impacts of food transport, taking account of transport mode, rather than a single aggregate indicator of total food miles (see below).

2. **Transport efficiency.** There is a trade-off between transport distance, vehicle size and transport efficiency. The current dominant system of food supply in the UK involves large HGVs travelling long distances between suppliers and shops via centralised distribution centres. However, this system enables very efficient loading of vehicles, which reduces the impacts per tonne of food. More local sourcing can greatly reduce the distance travelled by food, but the reduction in transport impacts may be offset to some extent by the use of smaller vehicles or lower load factors. We recommend further research into this issue.

3. **Differences in food production systems**. The impact of food transport can be offset to some extent if food imported to an area has been produced more sustainably than the food available locally. For example, a case study showed that it can be more sustainable (at least in energy efficiency terms) to import tomatoes from Spain than to produce them in heated greenhouses in the UK outside the summer months. Another case study showed that it can be more sustainable to import organic food into the UK than to grow non-organic food in the UK. However, this was only true if the food was imported by sea, or for very short distances by road. Finally we considered whether there could be a net energy saving from centralised mass-production of food (ready meals) compared to home cooking. On the whole, we found that any exceptions related to food production systems did not relate to a significant proportion of food transport, and were also often covered by other indicators and policies (e.g. the DEFRA targets for increasing UK supply of organic produce, and government policies to increase the energy efficiency of UK food production).

4. **Wider economic and social costs and benefits.** The term "food miles" has come to signify more than the transport of food and the direct physical impacts of this transport. A number of other economic and social issues are bound up in the food miles debate. Firstly, issues surrounding the international trade of food are part of the debate on globalisation. It is clear that transport and trade of food has the potential to lead to economic and social benefits, for example through economic gains for both developed and developing nations, reduced prices for consumers and increased consumer choice. However, the realisation of these benefits depends on a number of complex political, social and economic factors, such as global trade rules and trends in commodity markets. At the individual

level, food trade and the consolidation of food supply chains can lead to both winners and losers. Secondly, there are issues related to UK agriculture and rural communities. Food miles are often discussed in the context of decreasing farm gate prices, the disappearance of local shops and detrimental effects on rural economies and farming communities in the UK.

Our analysis indicates that the wider environmental, social and economic effects associated with different food supply chains are complex and very system specific. Consideration of these effects does not lead to a clear case for a move to either higher or lower food miles systems. What is clear is that the complex trade-offs between different social, environmental and economic costs and benefits cannot be evaluated, and policies cannot be formulated, unless food miles and their impacts are monitored and measured. It is also clear that policies directed at reducing food transport should consider these wider effects, and be integrated with policies and initiatives in other key areas, such as rural development, trade, international development, agriculture, transport and environment. A correctly structured food miles indicator would allow continuous analysis of the trade-off between different environmental, social and economic factors.

Key Indicators and Trends

Based on an analysis of the key impacts of food transport, the most important trends, and the complexities and trade-offs involved, we propose a set of four "key indicators" (Table E3). These indicators focus on the direct impacts of food transport, such as congestion, accidents and pollution. Wider economic and social issues such as local sourcing of food are not addressed directly by this indicator set.

Table E3. Key indicators.

Indicator	Notes
Urban food km in the UK, split by car, LGV, HGV.	Urban food km account for most of the accident and congestion costs. The impact of air pollution is also much higher in urban areas. At present, this indicator relies on the assumption that the urban/rural travel ratio is the same for food transport as for all other transport. An alternative proxy for congestion and accident costs would be car food km.
HGV food km	This covers HGV transport both in the UK and overseas. HGV transport is responsible for the majority of infrastructure, noise and air pollution costs.
Air food km	Air freight of food is rapidly growing and has a higher environmental impact than any other transport mode.
Total CO_2 emissions from food transport	Emissions of CO_2 from the transport sector are highly significant and are growing. This indicator includes estimated CO_2 from transport fuel use both in the UK and other countries. Currently excludes CO_2 and other greenhouse gas emissions from refrigeration during transport, although it would be desirable to include this in future.

In addition to the four headline indicators above, we also identified other areas where supplementary indicators are desirable, to capture some of the complexities and trade-offs discussed above. However, for most of these areas, related indicators or policies already exist as part of other government strategies. For example, the UK share of the organic food market is covered in DEFRA's action plan for organic food and farming, live animal transport is covered by the animal health and welfare strategy, and ethical trading is an indicator in the food industry sustainability strategy.

Table E4 compares the four key indicators and some supplementary indicators (including exports) for 1992, 1997 and 2002. The data shows that:

- **Urban food vehicle km** are estimated to have increased by 27% since 1992, due largely an increase in shopping for food by car. This has been driven by an increase in car ownership together with changes in shopping patterns (from frequent visits to local shops towards weekly visits to large out-of-town supermarkets).

- **HGV food tonne km have increased dramatically in the UK, but this has not been accompanied by an increase in HGV food vehicle km because of efficiency improvements.** HGV tonne kms have increased by 36% since 1991 and by over 100% since 1974. This is due to concentration of food sales in supermarkets, concentration of the food supply base, and associated changes in food delivery patterns. However, this rise in tonne kilometres has been partially offset by a switch to larger vehicles and improvement in load factors, resulting in a proportionally lower increase in vehicle km. HGV food vehicle km increased by 8% between 1992 and 1998, but then declined by 7% to 2002, giving a net increase of only 1% from 1992 to 2002. It is not clear how long this trend can be sustained. When opportunities for further improvements in load factor are fully exploited, HGV food vehicle km could begin to rise again if there are continuing increases in food movements.

- **Overseas HGV transport associated with UK food supply has declined slightly since 1992**. This is due to a recent trend to increase food trade with nearer EU countries (France, the Netherlands and Ireland) at the expense of Spain, Italy and Greece, which has decreased HGV vehicle km for the international stage of transport. However, as the overall level of food imports have increased, the road transport associated with food production *within* overseas countries has increased steadily (although there is a high uncertainty in these estimates), partially offsetting this trend. We estimate that overseas HGV transport associated with UK food supply has decreased by 8% overall since 1992. Future changes in food sourcing, perhaps due to EU enlargement for example, could reverse this trend.

- **Air freight has increased by 140% since 1992,** although it still accounts for only 0.1% of total vehicle km. However, it now accounts for 11% of CO_2 –equivalent emissions. The increase in air freight is largely due to increased globalisation of food supply, together with a relative decrease in the real cost of air freight compared to other transport modes.

- **CO_2 emissions from food transport increased by 12% from 1992 to 2002**. In contrast, air pollutant emissions (e.g. PM_{10}, NO_X) have decreased over this period, despite the increase in overall vehicle kilometres, because of the introduction of European emission standards for road vehicles.

Use of the indicator set

It is envisaged that the indicator set would be updated yearly, following publication of the key underlying datasets (HM Customs and Excise data and the DfT CSRGT surveys for HGVs and LGVs).

Because of the complex relationship between food transport and sustainability, great care must be exercised in interpreting any changes observed in the indicators or in the setting of any associated targets. It will be important to establish the underlying causes and statistical significance of such changes and to consider all the economic, social and environmental implications before drawing conclusions or formulating policy responses.

Again we emphasise that this indicator set focuses on the direct adverse impacts of food transport: congestion, pollution and accidents. It is not designed to directly measure wider economic and social impacts, or to detect trends such as changes in food sourcing and food retailing, although policy initiatives in these areas may well have detectable impacts on the indicators.

Study Conclusions and Research Priorities

Food transport has been increasing steadily over the last few decades. This has direct negative impacts on sustainability (congestion, accidents, road maintenance costs, greenhouse gas emissions, noise and air pollution), and these impacts are significant at a national level. Many of these impacts are not included in existing indicator sets (e.g. international air and shipping).

Food miles have a complex relationship to sustainability, and there can be trade-offs between environmental, social and economic factors. For this reason, a single indicator based on total food miles is not appropriate. A correctly structured indicator will enable the key impacts of food transport to be targeted, and allow appropriate policies to be formulated to ensure that a balance is maintained between economic, social and environmental sustainability.

Adequate data exists to compile an annual food transport indicator. The proposed indicator suite is consistent with the approach and objectives of DEFRA's Sustainable Farming and Food Strategy and the proposed Food Industry Sustainability Strategy.

Several recommendations for further work have been identified:

Dataset improvements

1. Improvement of the estimates of urban food transport (currently food transport cannot be distinguished from other transport on urban / rural roads);
2. Improved estimates of load factors for international air and sea transport;
3. Improved estimates of the burden arising from SO_2 and NO_x emissions from shipping;
4. Improvement of estimates of overseas transport using national datasets from other countries if available;
5. Inclusion of estimated CO_2 and other emissions associated with refrigeration during transport;
6. Possible identification of indicators on a regional basis.

Validity of indicator

7. Further assessment of the statistical validity of the indicator (e.g. confidence limits for the four main headline indicators);
8. Further investigation of the wider social and economic impacts of a reduction in food transport;
9. Research into the change in transport efficiency or energy efficiency which might result from a switch towards more locally produced food, (including the investigation of the potential for increases in local delivery traffic), and measures to improve this efficiency.

Policies

10. A study of potential policies to reduce the impacts of food transport.

Table E4: Trends in Key Indicators 1992-2002 (Headline indicators in bold)

Including exports		**Total**			**In UK**			**Overseas**		
		1992	**1997**	**2002**	**1992**	**1997**	**2002**	**1992**	**1997**	**2002**
Total tonne kilometres	billion tonne km	203	222	234	39	49	50	164	173	183
Total vehicle kilometres	billion vehicle km	27	29	30	21	23	25	5.7	5.5	5.3
Urban road food km	million vehicle km				9,847	11,015	11,778			
Car	*million vehicle km*				*5,178*	*6,108*	*6,975*			
LGV	*million vehicle km*				*2,974*	*2,974*	*2,974*			
HGV	*million vehicle km*				*1,696*	*1,932*	*1,828*			
HGV food km	million vehicle km	9,325	10,026	9,425	5,391	6,145	5,812	3,933	3,881	3,613
	million tonne km	*62,745*	*75,270*	*76,871*	*36,278*	*46,131*	*47,400*	*26,467*	*29,139*	*29,471*
Air food km	million vehicle km	11	22	27	0	0	0	11	22	27
Total CO_2 emissions	million tonnes	16.9	18.7	19.1	8.9	9.9	9.7	7.9	8.7	9.2
Total PM_{10} emissions	thousand tonnes	9.5	7.3	5.3	5.6	4.1	2.5	3.8	3.1	2.8
Total NO_x emissions	thousand tonnes	206	201	158	105	102	72	101	98	85
Total SO_2 emissions	thousand tonnes	51	42	41	8.81	2.51	0.25	43	40	41
Live animal food km	million tonne km				870	884	764	NK	NK	NK
Imports of indigenous foods	million tonnes				13.55	14.20	16.15			
Retail sales of ethically traded foods	million £				0	13	63			
% of indigenous organic food grown in the UK	%				NK	NK	62%			

NK=Not known