MTT Discussion Papers 1 • 2013

Inter-household variations in environmental impact of food consumption in Finland

Xavier Irz and Sirpa Kurppa

MTT Discussion Papers 1 · 2013

Inter-household variations in environmental impact of food consumption in Finland

Xavier Irz[1)] and Sirpa Kurppa[2)]
[1)] *MTT Agrifood Research Finland, Latokartanonkaari 9, FI-00790 Helsinki, Finland*
[2)] *MTT Agrifood Research Finland, Myllytie 1, FI-31600 Jokioinen, Finland*

Corresponding author: Xavier Irz, xavier.irz@mtt.fi

Abstract:

The environmental impact of food consumption depends on the type of foods consumed and the amount of food wasted. It follows that dietary change represents one means of directing food systems towards greater environmental sustainability. The difficulty, however, lies in developing ways of motivating people to modify what they purchase and eat, as many constraints potentially hinder changes in behaviour, including established habits, limited income, lack of information on environmental impact, cognitive limitations, or the difficulty of accessing environmentally friendly foods. In order to understand those constraints better, and identify potential target groups for intervention, we have analysed the environmental impact of food consumption at household level in Finland, paying particular attention to lower socio-demographic groups.

The data originates from the Finnish Household Budget Survey 2006, which gives a detailed record of the foods (259 aggregates) consumed by over 4000 households. The food quantity data are matched to indicators of greenhouse gas emissions and eutrophication, as well as a food composition database. Tests of differences in means of the environmental indicators identify the socio-demographic groups that are statistically different in terms of their environmental impact of food consumption. The total environmental impact is decomposed further into a diet composition effect (i.e., what foods households consume) and a quantity effect (i.e., how much food households consume).

Results indicate that the environmental impact varies widely across households, and that this heterogeneity relates both to the types and quantities of foods consumed. We find significant differences in impacts among socio-demographic groups. For instance, household income is strongly and positively associated with greenhouse gas emissions from food consumption (i.e., relatively better off households have a relatively larger climate change impact). Educational level is also positively associated with greenhouse gas emissions, although the relationship is not as strong as with income. On the other hand, differences in environmental impact for household types defined in terms of occupational status are small. Overall, and on the basis of the two indicators considered, the lower socio-demographic groups have a relatively smaller ecological footprint of food consumption than households belonging to relatively higher groups.

The results suggest that there is no decoupling of household income growth and environmental impact of food consumption. The relatively better-off and better educated should be targeted for behavioural change in order to promote sustainable food consumption in Finland. Further research is needed to identify the causal mechanisms underlying the associations that we describe and assess how various policies (e.g., labelling regulation, environmental education) would affect the ecological footprint of the Finnish diet.

Key words: consumption, sustainability, environmental impact, food, diet, nutrition, Finland, eutrophication, climate change, greenhouse gas emissions, consumption, household, footprint, socio-demographic, socio-economic, demographic, heterogeneity, variability, variation

1. Introduction

It is becoming increasingly clear that, in Finland as elsewhere, the food choices that consumers make have important implications for the environment. Hence, lifecycle analysis of different food products has demonstrated that the greenhouse gas emissions associated with individual foods (Kramer et al., 1999) and simple meals (Carlsson-Kanyama, 1998) vary widely. Other dimensions of the environmental impact of food consumption have been established in a similar way, including: freshwater eutrophication, ozone depletion, abiotic resource depletion, human toxicity, ecotoxicity, photochemical oxidant formation, and terrestrial acidification (Xue & Landis, 2010; Tukker et al., 2011). Further, it is also well documented that, in the rich developed world, consumers waste a large proportion of the food that they purchase, with obvious adverse environmental consequences (Gustavsson et al., 2011).

The main conclusion emerging from this work is that in most industrialized countries, living within environmental limits probably means large changes in food consumption, even though the notion often remains the “elephant in the room” when policy discussions take place (Lang, 2012). Nevertheless, a move away from animal-based diets to plant sources of dietary energy and nutrients is increasingly advocated as a way of pursuing environmental and health goals synergistically (Baroni et al., 2006).

If progress has been made in defining sustainable food consumption patterns, the way to get consumers to adjust their behaviours accordingly remains unclear. There is therefore a need to develop policy instruments to motivate people to modify what they purchase and eat, as many constraints potentially hinder changes, including established habits, limited income, lack of information on environmental impact, cognitive limitations, or the difficulty of accessing environmentally friendly foods. Thus, as a modest first step in trying to better understand the environmentally-relevant food choices that consumers make, we analyse the variation in environmental impact of food consumption within the population of Finnish households and seek to relate it to observable socio-demographic characteristics. This will contribute to building an understanding of why some households make environmentally friendlier food choices than others, and how policies to reduce the environmental impact of food consumption could be designed and targeted.

2. Data

The food consumption data originates from the last round of the Finnish Household Budget Survey, which was carried out in year 2006. The survey gives a detailed description of each respondent household’s use of money, demographic and social structure, sources of revenue, and purchase of foods for consumption at home (henceforth denoted FAH for “Food-at-home” and by opposition to FAFH for “Food-away-from-home”). The FAH data, which is available in terms of both expenditure and physical quantities, was recorded by each household in a diary over a two-week period and backed up by actual sales receipts. The final sample includes 4007 households, with a detailed description of food and drink consumption according to the Classification of Individual Consumption by Purpose (COICOP). In particular, the physical quantities of 259 foods and drinks are recorded.

Some characteristics of the data should be kept in mind when interpreting the results:

- Most importantly, the survey data does not give any information on the physical quantities of food consumed outside of the home, i.e. in work canteens, restaurants, cafes, schools, hospitals etc. Consequently, FAFH was excluded from the analysis.
- Similarly, the purchase of alcoholic drinks for consumption at home is only recorded in value terms, and those products were therefore left out of the analysis.
- However, compared to the dietary surveys that could also be used to assess the micro-level environmental impact of food consumption, one advantage of the HBS is that it covers the foods that are purchased but not consumed by households, i.e. food wastes.
- The survey, though representative, excludes individuals living in institutions such as hospitals, retirement homes, nursing homes, and prisons.

In order to calculate the environmental impact of food consumption, a coefficient per unit of consumption of each of the 259 foods was defined on the basis of previous work at MTT. We selected the CO_2 equivalent of each food as an indicator of global warming and the PO_4 equivalent as an indicator of eutrophication. The coefficients used are reported in Appendix 1. The consumption data was also matched to the Fineli food composition database by choosing one representative food for each COICOP food category. This allows us to convert the consumption data into dietary energy and various nutrients.

In the case of 22 food codes, it was not possible to find coefficients to calculate the CO_2 and PO_4 equivalents and those food codes were therefore excluded from the analysis. Most of the removed foods (e.g., mustard) seem to be quantitatively unimportant in the Finnish diet. This is confirmed by calculating that the excluded groups account for barely more than 5% of total food energy.

3. Environmental impact for the whole household population

3.1 Total environmental impact of food consumption: level and variability

A difficulty with the HBS dataset is that its observations relate to different groups of individuals (e.g., adults, children) which are therefore not immediately comparable. The analysis therefore starts by presenting the results separately for different household types, namely adult males living alone, adult females living alone, couples without children, and all other household types. Table 1 and Figures 1 & 2 present the summary statistics and distributions of the two environmental indicators, expressed on a per capita per day basis.

Focusing on the indicator of greenhouse gas emissions (GHGE), the CO_2 equivalent of food consumption is 3.34 kg per capita per day at the sample mean, with some important variation across household types – a point to which we will return when analyzing the environmental performance of different socio-demographic groups. Virtanen et al. (2011), using an input-output based methodology, estimated that food consumption in Finland produced on average 4.7 kg of CO_2 equivalent per capita per day, which is almost equal to what Girod & De Haan (2010) calculated for Switzerland. Hence, the order of magnitude of the calculated level of greenhouse gas emissions seems reasonable. However, Table 1 and Figure 1 also reveal that the environmental impact of food consumption as measured by the CO_2 equivalent varies widely even for a given household type (e.g., males living alone). In particular, the standard deviations reported in Table 1 are very large compared to the means, and we conclude that there is wide heterogeneity in the greenhouse gas emissions derived from food consumption of Finnish households.

The results for the indicator of eutrophication (Table 1 & Figure 2) indicate that the mean PO_4 equivalent due to the consumption of food is 3.70 grams per capita per day, and that the heterogeneity across households is even more pronounced than for the first indicator.

We subsequently seek to relate those inter-household variations to the socio-economic characteristics of the households.

3.2 Contributions of food groups to total environmental impact

Table 2 presents the contributions of each food group to the total environmental impact of food consumption. To ensure comparability, the analysis is based on the sub-sample of households composed of only one or two adults (no children). We note that total energy consumption (2353 kcal/cap/day) is in line with the estimates derived from the 2007 Finnish dietary survey[1] as well as food balance sheets[2]. Hence, in spite of the omission of foods consumed outside of the home, it appears that the HBS data covers the bulk of the food consumed by Finnish households[3].

The results confirm the relatively large environmental impact of consumption of animal products, since the meat and dairy groups jointly account for 29% of food energy but 58% of the CO_2 equivalent and 67% of the PO_4 equivalent. By contrast, cereal products account for one third of the calories consumed but only 14% of the CO_2 equivalent and 18% of the PO_4 equivalent. More surprising is the finding that the energy dense foods in the fat and sugar groups are responsible for relatively little environmental impact, since their share of food energy is significantly larger than their shares of CO_2 and PO_4 equivalents. Further, on the basis of the two indicators that we have selected, consumption of fruits and vegetables does not appear particularly environmentally friendly; although there is some variation within the group (roots and potatoes have a lower environmental impact than other vegetables).

Those results point to the importance of energy density in the determination of environmental impacts: consumption of fruits & vegetables may cause relatively little environmental impact when assessed per weight unit but, because of a relatively low energy density, the picture changes when assessing environmental impacts per kilocalorie. Further, because energy density is also recognized as a negative indicator of nutritional quality, the results suggest that trade-offs between healthiness and environmental friendliness of diets cannot be excluded. Indeed, and although more analysis of that question is required in a Finnish context, it is worth mentioning that a French study recently

[1] Pietinen et al. (2010) report, after excluding under-reporters, average daily energy intakes of 2517 kcal for men and 1891 kcal for women.

[2] The food balance sheet 2006 published by Tike reports a level of consumption of energy from food & drinks (excluding alcoholic drinks) worth 2792 kcal per capita per day. This figure is inclusive of food wastes, which are unknown but are thought to represent up to one third of total food energy.

[3] This is also consistent with the average number of meals eaten outside of the home reported by Raulio et al. (2010) for year 2008: 153 per person. While it was not possible to obtain the original source of this figure and related definition of a meal, a reasonable assumption is that people eat three meals a day. On that basis, meals eaten outside the home account for 14% of all eating occasions.

concluded that “substituting fruit and vegetables for meat (especially deli meat) may be desirable for health but is not necessarily the best approach to decreasing diet-associated greenhouse gas emissions.” (Vieux et al., 2012).

Finally, more directly in relation to the specific objectives of this project, the significant variations in environmental impacts across food groups imply that inter-household differences in diet composition could be a key factor driving the heterogeneity of the environmental impact of food consumption described in the previous section.

3.3 Sources of variability in environmental impact

Another element of preliminary analysis considers the decomposition of environmental impacts into a quantity effect, reflecting how much food households consume, and a quality effect, reflecting the type of foods that households consume. Given that the calorific needs of individuals are largely set by biology and level of physical activity, the quality component represents the main variable of adjustment that policies could seek to influence. Further, the quality versus quantity distinction is particularly relevant given the nature of the data, which records food purchases rather than dietary intakes, and exclude some sources of calories such as FAFH. As a result, it is likely that the amount of food consumed per capita varies considerably within the sample, with an influence on the environmental impact of household food consumption. In order to evaluate that influence, Figure 3 presents a scatter plot of CO_2 equivalent and energy from food consumption for each household. Figure 4 represents the same relationship in logarithmic terms, which reduces the variability in the data. Visual inspection of the graphs as well as well as the slopes of the regression lines (in red) confirm a strong positive relationship between total food energy and green house gas emissions. Although not presented, the same result holds for the indicator of eutrophication.

In order to understand further the relative importance of the quantity (i.e., total energy) and quality (i.e., diet composition) effects mentioned above, we apply a simple variance decomposition method to the problem at hand. Denoting by *I* the value of the environmental indicator (e.g., CO_2 equivalent) and by *E* total energy, the decomposition starts from the identity:

$$I = \frac{I}{E} * E \qquad (1)$$

The ratio on the right hand side of (1) measures the environmental intensity of food consumption. Meanwhile, *E* simply measures how much food is consumed. Taking logarithm one obtains:

$$\ln(I) = \ln(\frac{I}{E}) + \ln(E) \qquad (2)$$

This identity lends itself to the following variance decomposition:

$$Var(\ln(I)) = Cov(\ln(\frac{I}{E}); \ln(I)) + Cov(\ln E; \ln(I)) \qquad (3)$$

The contribution of diet composition to the total variability in environmental impact, or quality effect, is therefore measured by: $Cov(\ln(\frac{I}{E});\ln(I))/Var(\ln(I))$. The contribution of total energy consumption, or quantity effect, is $Cov(\ln(E);\ln(I))/Var(\ln(I))$ and the two terms naturally sum to unity[4].

The results, presented in Table 3, show that the majority of the variability in environmental impact is attributable to differences in food energy consumption. For instance, focusing on greenhouse gas emissions (i.e., CO_2 equivalents), we find that differences in food energy consumption account for 86% of the variability in environmental impact across households when considering the entire sample. This conclusion also holds when considering sub-groups of households with similar structures (e.g., males living alone). While fairly intuitive, the result reinforces the view that reducing food wastes is important in limiting the environmental impact of food consumption. Further, part of the result is probably an artefact because the data does not measure dietary intakes but food purchases for consumption at home. Hence, when limiting the sample to consider only observations compatible with a reasonable range of energy consumption[5], the calculations give more encouraging results. Hence, for all household types but one (denoted “other household types” in Table 3), diet composition accounts for more than half of the variability in environmental impact when energy per capita is restricted to lie between 1500 and 3500 kcal per capita per day. This suggests that there is potential room to reduce the environmental impact of food consumption by influencing the composition of diets.

The results for the indicator of eutrophication differ substantially in that the contribution of dietary composition to the variability in environmental impact is more pronounced. Hence, even when food energy per capita is not restricted, the quality effect is worth 27% to 46%, depending on the type of households considered.

4. Household socio-demographics and environmental impact of food consumption

4.1 Empirical Approach

The association between environmental impact of food consumption and socio-demographics is analysed separately for each variable. The statistical significance of the difference in means across socio-demographic groups is established on the basis of a Welch-test, which represents an extension of the standard ANOVA F-test to allow for unequal variances across subgroups. The results are presented for both the $C0_2$ equivalent and the PO_4 equivalent, where the different groups are identified on the basis of the following socio-economic characteristics:

- Household structure. As previously mentioned, because of the household-level of the recorded data, the analysis focuses on three types of households only: adult males living alone, adult females living alone and adult male-female couples without children. Hence,

[4] Those contributions are equivalent to the concept of beta in finance, which measures the contribution of each individual asset to the variability of an entire portfolio (Fujita & Ramey, 2009).
[5] In Table 3, this corresponds to the rows denoted ”Energy pc 1000-4000 kcal” and”Energy pc 1500-3500 kcal”.

all households with children, with more than two individuals, or with two individuals not defining themselves as a couple are excluded.

- Education, which is categorized into three levels according to the highest level of education achieved by the reference person of the household. The lower level corresponds to primary education (perusaste), the middle level to secondary education (keskiaste), and the upper level to any form of higher education (alin korkea-aste, alempi korkeakouluaste, ylempi korkeakouluaste, tutkijakoulutusaste).

- Income, which is divided into five quintiles on the basis of total income adjusted for the size of the household. The adjustment involves dividing household income by the number of consumption units in the household as defined by the OECD to account for economies of scale in consumption (e.g., larger households can share some fixed or semi-fixed costs). The five quintiles are defined for the whole sample.

- Age. Households are divided into six categories (=< 30, 31-40, 41-50, 51-60, 61-70, >70) according to the age of the reference person.

- Occupational status. Given the focus of the project on lower socio-economic groups, we distinguish only three types of households on the basis of the occupational status of the household's reference person: long-term unemployed; retired; and other (e.g., employed).

In a second step, the analysis is extended by reproducing the comparison of socio-demographic groups for the intensity of environmental impact, which is measured by expressing each environmental indicator per unit of food energy (1000 kcal). This gives insights into whether differences are driven by differences in dietary composition (i.e., quality) or total energy intake (i.e., quantity).

4.2 Results for greenhouse gas emissions

The associations between socio-demographics and greenhouse gas emissions resulting from household food consumption are summarized in Tables 4 to 5 as well as Figures 5 to 8. The analysis establishes that there are important differences across socio-demographic groups.

First, focusing on the first two rows of Table 4, it is evident that the environmental impact of food consumption varies significantly with household structure, from a minimum for men living alone to a maximum for couples. Although the differences are statistically significant, they are also quantitatively small (12% between couples and men living alone) and Table 5 further indicates that those differences are not driven by differences in diet composition (P-value = 16%). There is therefore no support for the perhaps intuitive view that men living alone adopt diets particularly rich in animal proteins and, as a consequence, are responsible for a disproportionately large environmental impact. Since diet composition is largely similar across household types, it leaves the total quantity of food (total dietary energy) as the main cause of differences in greenhouse gas emissions reported in Table 4. Given that males have higher energy requirements than females, ceteris paribus, the result that GHGE are larger for females and couples than for males is somewhat surprising until it is remembered that the data does not measure total dietary intakes but consumption of food at home, which excludes food consumed in restaurants, cafeterias and other catering establishments. A plausible explanation is therefore that men living alone simply eat out more frequently than women living alone, while couples are most likely to prepare food at home. This explanation is consistent with the view that both cooking and eating are social activities, hence more enjoyable for couples, while the more limited cooking skills of men may lead them to eat outside of home more often. Unfortunately, the data does not allow us to explore this issue further but the significant differences across household types as defined by their structure vindicate the decision to present the other results separately for males living alone, females living alone, and couples without children.

The strongest differences in GHGE across socio-demographic groups are found for the income variable. Table 4 and Figure 5 show that, regardless of household structure, household income is positively and significantly associated with greenhouse gas emissions. Further, comparing the first and fifth income quintiles, it is clear that differences are relatively large: the CO_2 equivalent of food consumption of those belonging to the fifth quintile is 37% (for couples) to 52% (for men living alone) higher than for comparable households belonging to the first income quintile. Table 5 and Figure 6 present the corresponding results once the environmental indicator is expressed per unit of food energy. The association is again positive, but the magnitude of the income gradient is then much smaller (13% to 20% comparing the first and fifth quintiles, depending on the household type considered). Hence, there is both a diet composition dimension and a quantity dimension to the positive association between income and GHGE, although the quantity dimension dominates. The result cannot be explained by referring to the exclusion of FAFH from the analysis, since one would expect income to be positively associated with eating out. The logical conclusion is therefore that relatively better-off households choose products with higher climate change effect and, assuming that energy requirements do not vary with income, that they also waste more food.

Table 4 and Figure 7 shows that GHGE from food increases with educational level, although the relationship is only statistically significant for couples without children and the pooled sample (i.e., all three types). Further, the magnitude of the difference is not very large: those in the highest educational category are responsible for nine to 19 percent more greenhouse gas emissions from food consumption than those belonging to the lowest educational category (depending on household structure). Here, however, Table 5 and Figure 8 indicate that the association is stronger and more statistically significant once expressed per unit of food energy. Hence, it is the diet composition effect that dominates with those in the higher educational categories choosing relatively less environmentally-friendly products. However, even when looking at the intensity of the environmental impact, the magnitude of the educational gradient is quite small.

Differences in greenhouse gas emissions of household food consumption according to the age of the reference person are more difficult to characterize. Table 4 and Figure 9 show that those differences are large and usually statistically significant, but that the pattern is non-linear and inverse U-shaped: CO_2 equivalent per capita initially increases with age, reaches a peak, and eventually declines in the latter part of life, although the timing of the peak varies according to the type of household. It happens in their 50s for males living alone, in their 60s for females living alone, and in their 40s for couples. The results in terms of the intensity of greenhouse gas emissions (Table 5 and Figure 10) are clearer for men living alone and couples, as CO_2 equivalent per unit of food energy decreases with age for those household types. For females, although there is initially an increase in the intensity of impact with age, it is not very large and could simply result from sampling error. Hence, we conclude that relatively older households tend to select food items with lower climate change impact, but that in the first part of adult life, the diet composition effect is offset by a large quantity effect (i.e., older households consume more food than relatively younger ones). Given that energy requirements tend to decrease with age (Mifflin et al., 1990), it is likely that the positive association between purchase of food energy and age of the household reflects the greater frequency of the meals eaten away from home for younger households, but we cannot exclude that older households also waste relatively more food than younger households.

Finally, GHGE are compared according to the occupational status of the household's reference person. Differences in total greenhouse gas emissions (Table 4 & Figure 11) are not statistically significant, except within the sub-sample of couples without children. In that case, the emissions of households belonging to the "other" category are, on average, 17% larger than those of households whose reference person is unemployed. Table 5 and Figure 12 report the results after controlling for food energy. The differences in environmental impact across occupational statuses are in that case more statistically significant, but the main opposition lies between pensioners (relatively low impact) and the other households. This means that pensioners tend to adopt diets whose composition is environmentally friendlier than other households, although a quantity effect of opposite sign offsets most of this diet composition effect. Whether controlling for energy or not, there does not seem to be large and systematic differences between the unemployed and the "other" category of households.

4.3 Results for eutrophication

The results for the eutrophication indicator are presented in Tables 6 in terms of levels and Table 7 in terms of intensity. They share many similarities with those presented above in relation to the indicator of climate change, but there are also non-trivial differences.

Household structure is associated in a statistically significant manner with PO_4 equivalent from food consumption, although the differences are relatively small (Table 6) and almost disappear when controlling for total food energy (Table 7). As before, a logical explanation for the relatively lower impact of male households is that they eat out more than females living alone or couples without children.

As was the case with GHGE, PO_4 equivalent is associated in a positive, statistically significant, and quantitatively important way to income. The relationship is not perfectly monotonous for some of the subsamples of households (e.g., males living alone) but households belonging to the fifth income quintile generate, on average, more eutrophication externality than households in any of the other four income quintiles, regardless of the household type considered. The difference in PO_4 equivalent resulting from food consumption varies from 33% to 50% between the lowest and the highest income quintiles, depending on household type. The income gradient is much less clear when the externality is expressed per unit of food energy (Table 7), and the adverse eutrophication effect of income therefore results mainly from the higher consumption of food energy by relatively better-off households. Unlike what was found with respect to greenhouse gas emissions, the diet composition effect does not seem to play a significant role.

For all three types of households as well as the pooled sample, education is positively associated with the eutrophication impact of food consumption, although the statistical significance of the relationship is limited for males living alone (P= 9%) and very low for females living alone (P=76%). The lack of statistical significance reflects the limited difference in impacts between the educational categories as well as the relatively small sample size for some household types (females and males living alone). When the eutrophication indicator is expressed per unit of food energy (Table 7), the variations in environmental impacts across educational groups achieve greater statistical significance, with the main difference lying between the lowest educational group and the other two groups. Although the estimates vary across household types, the household in the lowest educational category are responsible for roughly 20% less PO_4 equivalent than households in the highest educational category, holding total energy constant. Hence, the least educated households select food items that are responsible for less eutrophication, on average, than the other households. This food composition effect dominates the food quantity effect, which is not very pronounced along that social dimension.

Age of the household reference person relates in a significant but complex (inverse U-shaped) manner to the indicator of eutrophication. The relationship is much clearer when removing difference in purchases of food energy: Table 7 shows that, as households become older, they select diets with less environmental impact, and that the differences can be large. For instance, considering couples, households whose reference person is over 70 years of age produce, on average, 53% more PO_4 equivalent than households whose reference person is under the age of 30.

Finally, the eutrophication externality does not vary widely according to the occupational status of the household's reference person. The statistical tests in Table 6 show no significant differences in mean PO_4 equivalent between households whose reference person is unemployed, retired, or else. The differences across groups achieve statistical significance when considering the intensity of the eutrophication impact (Table 7), but this is mainly due to the pensioners group, which tends to adopt diets with relatively less environmental impact than other household groups. The data reveals little difference in terms of eutrophication impact between the "unemployed" group and the "other" (mainly employed) group.

4.4 Robustness of the results

First of all, the CO_2 and the PO_4 equivalent values used in this comparison are all strong approximations for the various food raw materials, and for the food products, especially. Impact of economic allocation in counting the values for different components of animal meat is very clear. Thus consumption of cheaper portions of animal carcase leads to relative lower environmental impacts. On one hand, animal carcase is a whole and there is a good reason to allocate environmental impacts evenly through the whole carcase. But on the other hand, cheaper portions often include bones and other parts that are of lower nutritional value or partially even not value at all and it would be unfair to charge such portions with the same environmental impacts as the highly valuable portions. In terms of sustainability, it would be anyhow important to use the whole carcases of animals as intensively as possible.

In addition, legitimate concerns about the robustness of the previous analysis arise from two separate issues. The first one is the typically high degree of colinearity of the socio-demographic variables – for instance better-off households also tend to be relatively older, better educated and employed – which makes it difficult to isolate drivers of behaviour. The second issue stems from the omission of all the foods consumed outside of the home in canteens and restaurants, as those are likely to be correlated to socio-demographic variables (e.g., employment status and work lunches). Both issues relate to the nature of the available data and are therefore impossible to correct entirely, but we present as a robustness test a simple regression analysis relating greenhouse gas emissions from food consumption to the socio-demographic variables used previously as well as expenditure on food eaten in canteens and restaurants (the only information available on FAFH).

Table 8 displays the results for the subsample of one- and two-adult households and shows that, as expected, there is a negative association between greenhouse gas emissions and FAFH (i.e. households spending more in restaurants probably eat less at home and the CO_2 equivalent of their FAH consumption is consequently lower). However, the results confirm that, even after controlling for FAFH, the associations between greenhouse gas emissions and socio-demographic variables reported previously still hold (e.g., positive association with income and education, inverse U-shaped relationship with age, and weak influence of occupational status). More research is however needed in order to indentify the causal mechanisms underlying those associations.

5. Discussion & conclusion

The results suggest that even in a sector such as food that becomes relatively smaller in the process of economic growth, decoupling of household income and environmental impact is not occurring. At a macro level, this implies a rather negative view of economic growth and reinforces the idea that, in the food sector, rising living standards are part of the problem rather than the solution. Although our analysis of that issue is only partial since only household consumption is considered, it is not consistent with the hypothesis of an environmental Kuznets curve in the food area, i.e. the notion that environmental impact increases in the early stages of development followed by declines in the later stages (Rothman, 1998). On the other hand, the finding that the relatively better-off adopt relatively less environmentally sustainable diets implies that it is the households which are not very constrained by economic circumstances that should be targeted for behavioural change. Those relatively unconstrained households are likely to be particularly responsive to interventions and policies.

The positive association between education and environmental impact contrasts with the educational gradient on the health side, i.e. the fact that the less educated tend to adopt less healthy behaviours and achieve worse health outcomes (Cutler & Llera-Muney, 2010; Lahelma et al., 2006). It suggests that limitations in information processing are not a key obstacle to the adoption of relatively environmentally friendlier consumption patterns, although this may change as more information about the environmental impact of food consumption becomes available. Indeed, given that the environmental impact of food consumption has only received full attention from the media and policy circles in recent years, it is possible that some of the empirical regularities that we document no longer hold as consumers become more environmentally aware. This is an interesting hypothesis that should be tested once the 2012 round of the Household Budget Survey becomes available for research next year.

While the results confirm that consumption of animal products is responsible for a disproportionally large environmental impact, we also find that the energy density of plant-based diets relates inversely to its environmental impact. Although further investigation of that issue is required, the finding suggests that the synergies between environmental and health goals should not be taken for granted but, instead, investigated carefully on a case per case basis. Indeed, the finding that education relates negatively to environmental impact but positively to nutritional health is an additional warning that the two dimensions of sustainability do not necessarily go hand in hand.

Additional research is needed in order to identify the causal mechanisms underlying the associations described here, a task made difficult in cross-sectional datasets due to the multi-colinearity of socio-demographic variables and conflation of the resulting effects. For instance, better-off households also tend to be relatively older, better educated and employed, making it difficult to pinpoint a single driver of consumption behaviour. Further, the omission of the food eaten outside of the home from the analysis represents an important limitation of the approach and its significance should be explored further. Finally, the development of whole diet models capturing the whole range of substitutions among foods that consumers make in response to policies (e.g., taxes, promotion of norms) is necessary to assess the full health, environmental, and economic effects of those policies.

References

Baroni, L., Cenci, L., Tettamanti, M. & Beratti, M. (2006). Evaluating the environmental impact of various dietary patterns combined with different food production systems, European Journal of Clinical Nutrition, 61: 279-286.

Carlsson-Kanayama, A., Ekström, M. P., Shanahan, H. (2003). Food and life cycle energy inputs: consequences of diet and ways to increase efficiency, Ecological Economics 2-3: 293-307.

Carlsson-Kanayama, A. (1998). Climate change and dietary choices — how can emissions of greenhouse gases from food consumption be reduced? Food Policy 23(3-4): 277-293.

Cutler DM & Llera-Muney A (2010) Understanding differences in health behaviours by education. Journal of Health Economics 29, Issue 1, 1-28.

Fujita, S. & Rmaey, G. (2008). The cyclicality of separation and job finding rates. Federal Reserve Bank of Philadelphia, Working Paper 07-19/R.

Girod, B. & De Haan, P. (2010). More or better? A model for changes in household greenhouse gas emissions due to higher income. J. Ind. Ecol. 14, 31-49.

Gustavsson, J. et al. (2011). Global food losses and food wastes: extent, causes and prevention. Food and Agriculture Organisation, Rome, Italy.

Kramer, K. J., Moll, H. C., Nonhebel, S. & Wilting, H. C. (1999). Greenhouse gas emissions related to Dutch food consumption, Energy Policy 27(4): 203-216.

Lahelma, E., Karisto, A., Mannila, S. & Notkola, V. (2006). Social structure and culture. In Koskinen, S., Aromaa, A., Huttunen, J., Teperi, J. editors, Health in Finland (p. 22-24), KTL & Stakes, Finland.

Lang, T. (2012). Food matters: an integrative approach to food policy. Keynote address, third meeting of the OECD Food Chain Analysis Network, 25-26 October, OECD Conference Centre, Paris, http://www.oecd.org/site/agrfcn/.

Mifflin, M.D., St Jeor, S. T., Hill, L. A., Scott, B. J., Daugherty, S. A. & Koh, Y. O. (1990). A new predictive equation for resting energy expenditure in healthy individuals. The American Journal of Clinical Nutrition 51 (2): 241–7.

Pietinen, P., Paturi, M., Reinivuo, H., Tapanainen, H. & Valsta, M. (2010). FINDIET 2007 Survey: energy and nutrient intakes. Public Health Nutrition 13(6A): 920-924.

Raulio, S., Roos, E. & Prättälä, R. (2010). School and workplace meals promote healthy food habits. Public Health Nutrition 13(6A): 987-992.

Rothman, D. S. (1998). Environmental Kuznets curves—real progress or passing the buck? A case for consumption-based approaches, Ecological Economics 25: 177-194.

Tike (2008). Ravintotase – Balance Sheet for Food Commodities 2006 and 2007. Tike, Information Centre of the Ministry of Agriculture and Forestry, Helsinki.

Tukker A., Alexandra Goldbohm R., de Koning A., Verheijden M., Kleijn R., Wolf O., Pérez-Domínguez I. &Rueda-Cantuche J.M. (2011). Environmental impacts of changes to healthier diets in Europe. Ecological Economics, 70 (10): 1776-1788

Vieux, F., Darmon, N., Touazi, D. & Soler, L.G. (2012). Greenhouse gas emissions of self-selected individual diets in France: Changing the Q23 diet structure or consuming less? Ecological Economics 75: 91-101.

Virtanen, Y., Kurppa a, S., Saarinen, M., Katajajuuri, J.-M., Usva a, K., Mäenpää, I. Mäkelä, J., Grönroos, J. & Nissinen, A. (2011). Journal of Cleaner Production 19: 1849-1856.

Xue, X. & Landis, A. E. (2010). Eutrophication potential of food consumption patterns. Environmental Science and Technology 44: 6450-6456.

Table 1: Summary Statistics

Indicator	Observations	Mean	Median	SD
CO2eq (kg per capita per day)				
Males alone	356	3.29	2.94	1.97
Females alone	574	3.59	3.30	2.29
Couples without children	1494	3.70	3.48	1.85
Other household types	1583	2.91	2.81	1.31
All households	4007	3.34	3.12	1.78
PO4eq (g per capita per day)				
Males alone	356	3.47	3.36	3.67
Females alone	574	4.15	3.78	3.15
Couples without children	1494	3.95	3.81	3.01
Other household types	1583	3.35	3.27	1.76
All households	4007	3.70	3.49	2.71

Table 2: Contributions of food/drink groups to total energy, CO_2 equivalent and PO_4 equivalent (sample: households with only one or two adults, no children).

Food group	Energy (kcal)	CO2eq (g)	PO4eq (mg)	Energy (share of total)	CO2eq (share of total)	PO4eq (share of total)
Cereals	763	502	699	32%	14%	18%
Rice	30	25	32	1.3%	0.7%	0.8%
Other	733	478	666	31%	13%	17%
Meat	296	914	1162	13%	25%	30%
Fish	53	140	-520	2%	4%	-13%
Dairy	393	1191	1463	17%	33%	37%
Fluid milk	146	455	520	6%	13%	13%
Other	247	737	943	10%	20%	24%
Fat	198	101	113	8%	3%	3%
Fruit	117	185	397	5%	5%	10%
Vegetable	163	338	194	7%	9%	5%
Roots	10	6	3	0.4%	0.2%	0.1%
Potato	101	39	57	4%	1%	1%
Other	52	293	133	2%	8%	3%
Sugar	277	88	108	12%	2%	3%
Other foods	15	23	13	1%	1%	0%
Hot drinks	5	19	3	0.2%	0.5%	0.1%
Cold drinks	73	111	293	3%	3%	7%
All	**2353**	**3614**	**3924**	**100%**	**100%**	**100%**

Table 3: Contribution of diet composition and total food energy to variability in environmental impact

Sample	Contribution to variability			
	CO_2eq		PO_4eq	
	Diet Composition	Total Energy	Diet Composition	Total Energy
Males alone				
Energy pc unrestricted	16%	84%	46%	54%
Energy pc 1000-4000 kcal	43%	57%	77%	23%
Energy pc 1500-3500 kcal	67%	33%	85%	15%
Females alone				
Energy pc unrestricted	11%	89%	27%	73%
Energy pc 1000-4000 kcal	44%	56%	69%	31%
Energy pc 1500-3500 kcal	64%	36%	85%	15%
Couples without children				
Energy pc unrestricted	18%	82%	45%	55%
Energy pc 1000-4000 kcal	33%	67%	74%	26%
Energy pc 1500-3500 kcal	54%	46%	88%	12%
One- and two-adult households (three previous types combined)				
Energy pc unrestricted	16%	84%	40%	60%
Energy pc 1000-4000 kcal	37%	63%	74%	26%
Energy pc 1500-3500 kcal	59%	41%	87%	13%
Other household types				
Energy pc unrestricted	14%	86%	33%	67%
Energy pc 1000-4000 kcal	29%	71%	65%	35%
Energy pc 1500-3500 kcal	48%	52%	77%	23%
All				
Energy pc unrestricted	14%	86%	37%	63%
Energy pc 1000-4000 kcal	33%	67%	70%	30%
Energy pc 1500-3500 kcal	54%	46%	84%	16%

Table 4: Comparison of mean greenhouse gas emissions (kg of CO_2 equivalent per capita per day) across socio-demographic groups

Characteristic	Household Type			
	Males alone	Females alone	Couples without children	All three types
	n=356	n=574	n=1494	n=2424
None	3.29	3.59	3.70	3.61
P for diff	-	-	-	**0.017**
Education				
Lower	3.09	3.50	3.53	3.45
Middle	3.28	3.51	3.74	3.60
Upper	3.70	3.82	3.85	3.83
P for diff	0.110	0.353	**0.012**	**0.008**
Income				
Q1	2.95	3.08	3.05	3.04
Q2	3.15	3.50	3.31	3.34
Q3	3.10	4.17	3.78	3.76
Q4	3.51	3.78	3.69	3.68
Q5	4.48	4.95	4.19	4.28
P for diff	**0.001**	**0.000**	**0.000**	**0.000**
Age				
<30	3.11	2.54	2.79	2.78
30-39	2.94	3.30	3.35	3.24
40-49	3.59	3.80	4.23	3.97
50-59	3.63	4.23	4.17	4.12
60-69	3.51	4.36	4.01	4.03
>=70	3.05	3.57	3.23	3.33
P for diff	0.248	**0.000**	**0.000**	**0.000**
Occupation				
Unemployed	3.27	3.35	3.22	3.27
Pensioner	3.22	3.78	3.62	3.61
Other	3.34	3.40	3.77	3.63
P for diff	0.860	0.139	**0.042**	0.335

Table 5: Comparison of mean greenhouse gas emission intensity (kg of CO_2 equivalent per capita per day per 1000 kcal of food energy) across socio-demographic groups

Characteristic	Household Type			
	Males alone	Females alone	Couples without children	All three types
	n=356	n=574	n=1494	n=2424
None	1.63	1.56	1.61	1.60
P for diff	-	-	-	0.163
Education				
Lower	1.43	1.47	1.53	1.50
Middle	1.79	1.60	1.65	1.66
Upper	1.65	1.66	1.64	1.65
P for diff	**0.000**	**0.003**	**0.000**	**0.000**
Income				
Q1	1.59	1.46	1.51	1.51
Q2	1.59	1.53	1.55	1.55
Q3	1.56	1.68	1.54	1.57
Q4	1.73	1.70	1.62	1.65
Q5	1.82	1.75	1.71	1.72
P for diff	0.285	**0.001**	**0.000**	**0.000**
Age				
<30	1.93	1.57	1.73	1.73
30-39	1.72	1.58	1.71	1.68
40-49	1.71	1.66	1.73	1.71
50-59	1.62	1.71	1.66	1.66
60-69	1.43	1.63	1.56	1.56
>=70	1.31	1.44	1.43	1.42
P for diff	**0.000**	**0.005**	**0.000**	**0.000**
Occupation				
Unemployed	1.68	1.82	1.56	1.68
Pensioner	1.44	1.48	1.50	1.49
Other	1.75	1.63	1.68	1.68
P for diff	**0.000**	**0.004**	**0.000**	0.000

Table 6: Comparison of mean eutrophication impact (g of PO_4 equivalent per capita per day) across socio-demographic groups

Characteristic	Household Type			
	Males alone	Females alone	Couples without children	All three types
	n=356	n=574	n=1494	n=2424
None	3.47	4.15	3.95	3.92
P for diff	-	-	-	**0.015**
Education				
Lower	3.04	4.03	3.57	3.61
Middle	3.50	4.21	4.10	4.02
Upper	4.18	4.26	4.18	4.20
P for diff	0.094	0.763	**0.004**	**0.001**
Income				
Q1	3.57	3.63	3.30	3.50
Q2	3.05	4.14	3.61	3.67
Q3	2.18	4.85	4.12	3.98
Q4	3.82	4.20	3.83	3.89
Q5	5.19	5.43	4.41	4.57
P for diff	**0.002**	**0.004**	**0.000**	**0.000**
Age				
<30	3.64	2.99	3.38	3.32
30-39	2.76	4.25	3.97	3.73
40-49	4.27	4.36	4.68	4.51
50-59	3.29	4.92	4.17	4.19
60-69	3.24	4.81	4.21	4.22
>=70	3.51	4.11	3.43	3.68
P for diff	0.489	**0.000**	**0.000**	**0.000**
Occupation				
Unemployed	4.27	4.15	3.89	4.11
Pensioner	3.16	4.30	3.75	3.83
Other	3.57	3.99	4.08	3.99
P for diff	0.375	0.526	0.117	0.428

Table 7: Comparison of mean intensity of eutrophication impact (g of PO_4 equivalent per capita per day per 1000 kcal of food energy) across socio-demographic groups

Characteristic	**Household Type**			
	Males alone	**Females alone**	**Couples without children**	**All three types**
	n=356	n=574	n=1494	n=2424
None	1.79	1.77	1.67	1.71
P for diff	-	-	-	0.115
Education				
Lower	1.57	1.62	1.46	1.52
Middle	1.90	1.91	1.77	1.82
Upper	1.96	1.82	1.78	1.81
P for diff	**0.046**	**0.013**	**0.003**	**0.000**
Income				
Q1	1.92	1.64	1.63	1.70
Q2	1.61	1.79	1.64	1.68
Q3	1.43	1.97	1.69	1.71
Q4	1.83	1.90	1.64	1.70
Q5	2.17	1.83	1.71	1.76
P for diff	**0.041**	0.134	0.905	0.924
Age				
<30	2.25	1.89	2.11	2.08
30-39	1.82	2.07	2.05	2.00
40-49	1.99	1.94	1.80	1.88
50-59	1.69	1.81	1.61	1.65
60-69	1.36	1.74	1.58	1.59
>=70	1.50	1.59	1.38	1.47
P for diff	**0.000**	**0.026**	**0.000**	**0.000**
Occupation				
Unemployed	2.10	1.99	1.86	1.98
Pensioner	1.43	1.62	1.46	1.50
Other	1.99	1.91	1.81	1.86
P for diff	**0.003**	**0.008**	**0.000**	**0.000**

Table 8: Results of regression of greenhouse gas emissions on socio-demographic variables and FAFH

	Coefficient	P value
Constant	1.35	0.000
Education (reference = lower)		
Middle	0.357	0.001
Upper	0.154	0.167
Normalised income	0.000021	0.000
Age	1.011	0.000
Age^2	-0.124	0.000
Occupation (reference = other)		
Unemployed	-0.247	0.319
pensioner	-0.040	0.757
FAFH per capita	-0.00014	0.005
R-squared	8.9%	

Figure 1: Distribution of greenhouse gas emissions across households

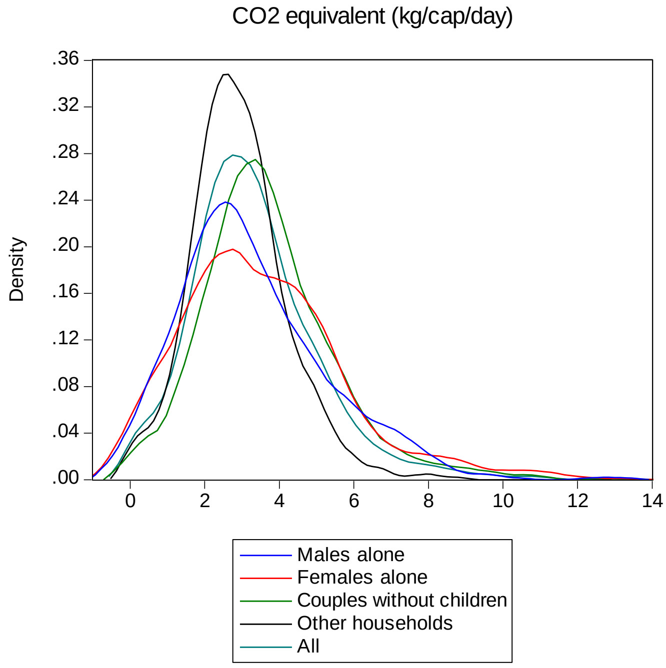


Figure 2: Distribution of eutrophication effect across households

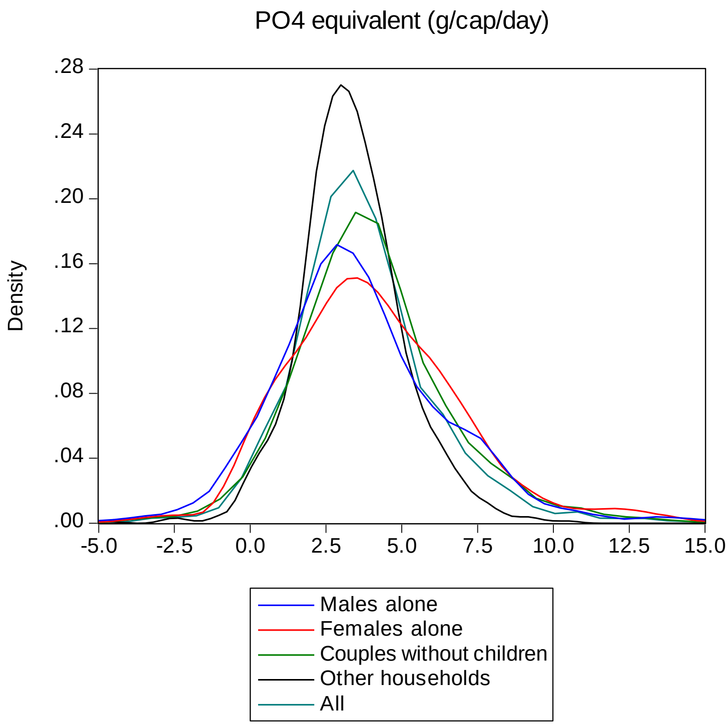


Figure 3: Relationship between greenhouse gas emissions and total food energy

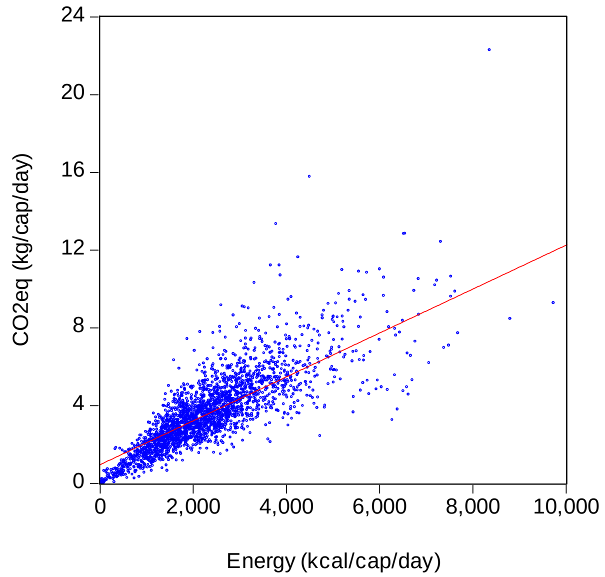


Figure 4: Relationship between greenhouse gas emissions and total food energy (logarithms)

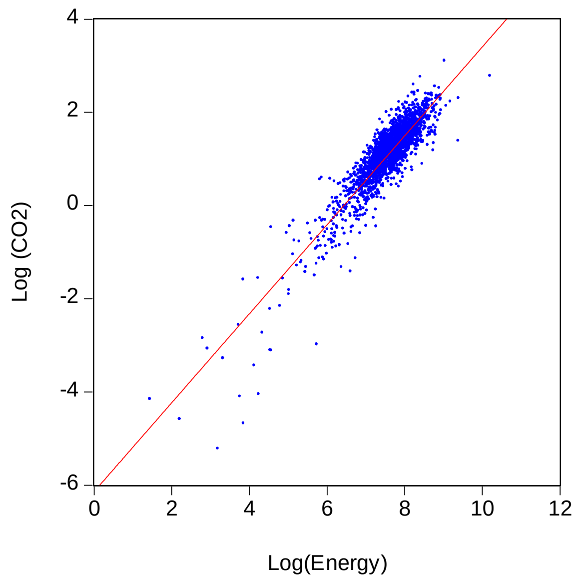


Figure 5: Level of greenhouse gas emissions versus income class

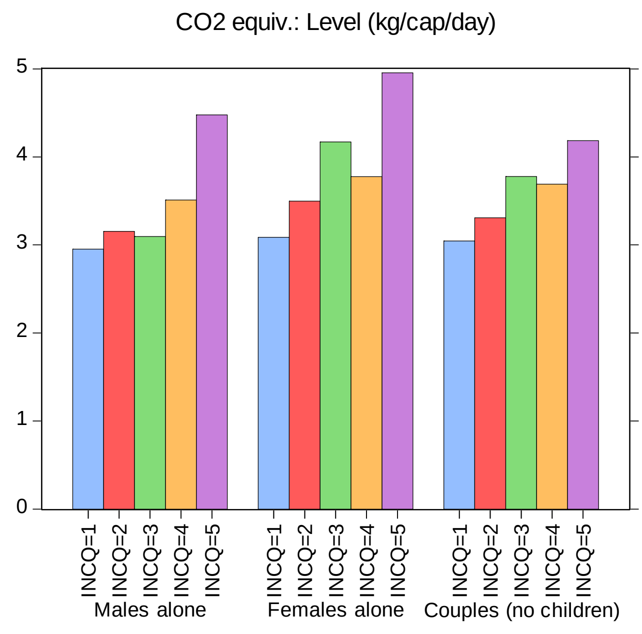


Figure 6: Intensity of greenhouse gas emissions versus income class

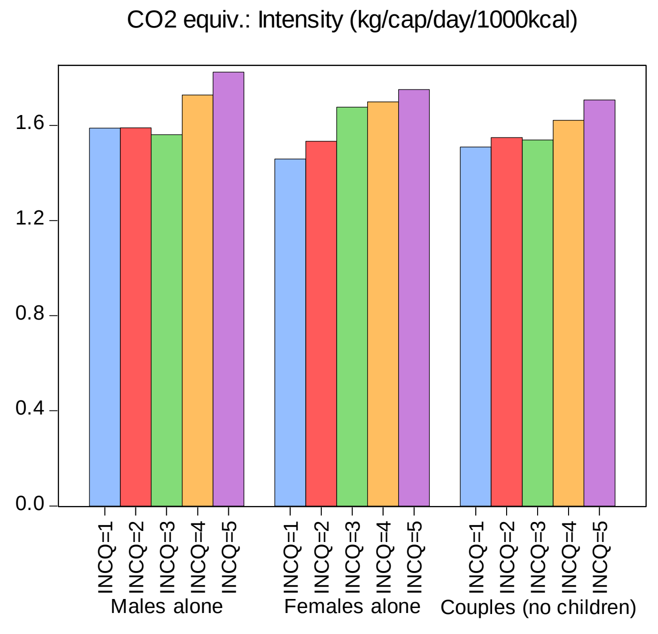


Figure 7: Level of greenhouse gas emissions versus educational level

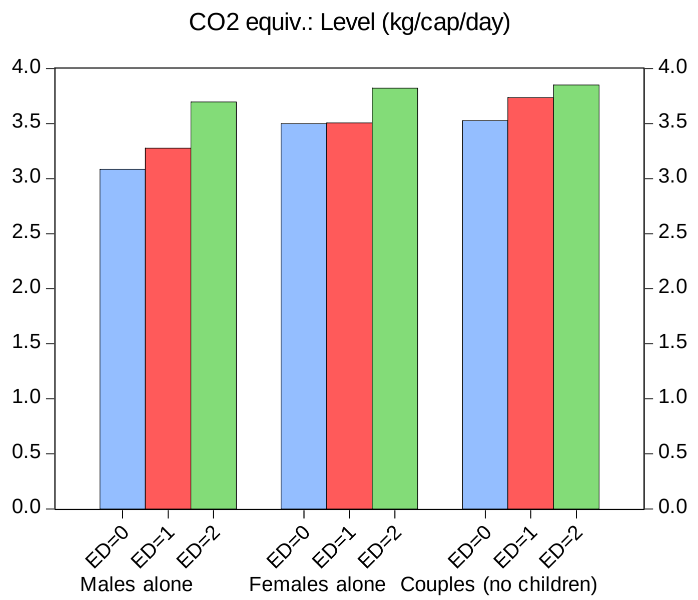


Figure 8: Intensity of greenhouse gas emissions versus educational level

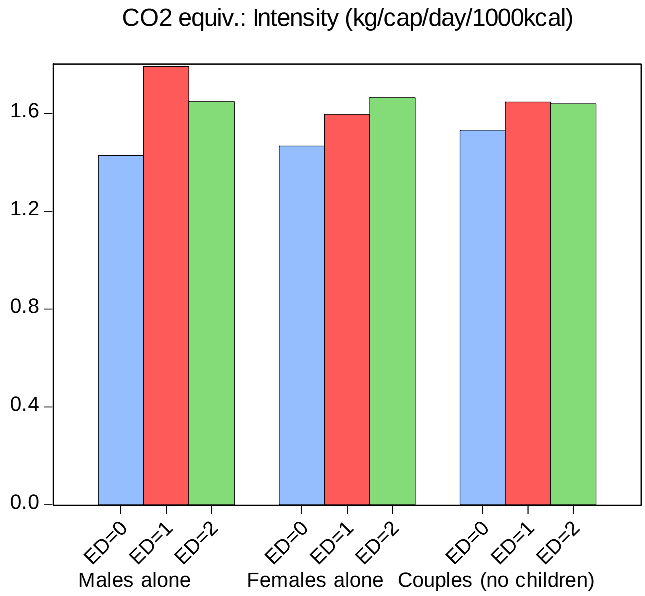


Figure 9: Level of greenhouse gas emissions versus age

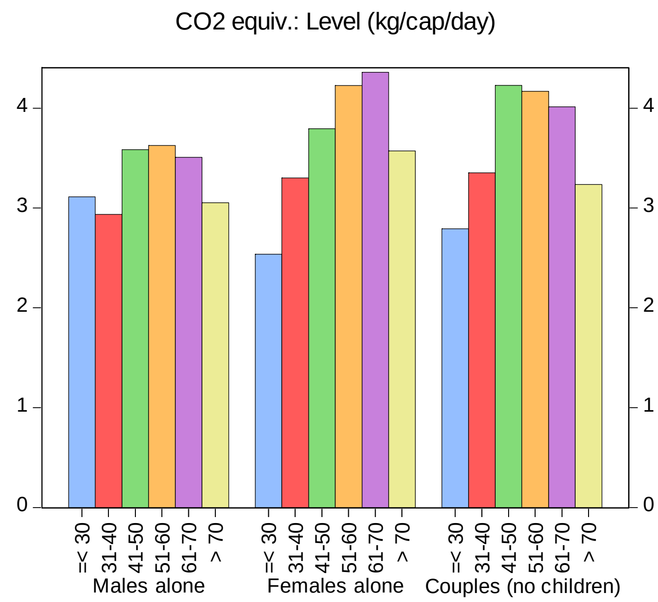


Figure 10: Intensity of greenhouse gas emissions versus age

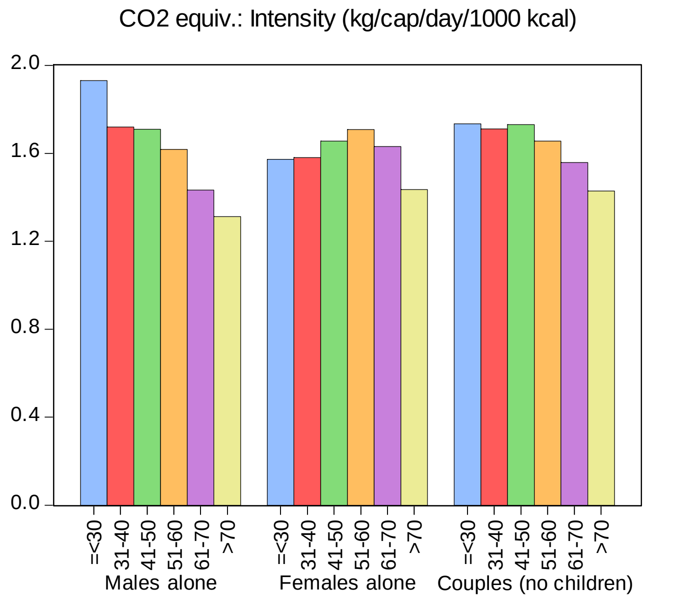


Figure 11: Level of greenhouse gas emissions versus occupational status

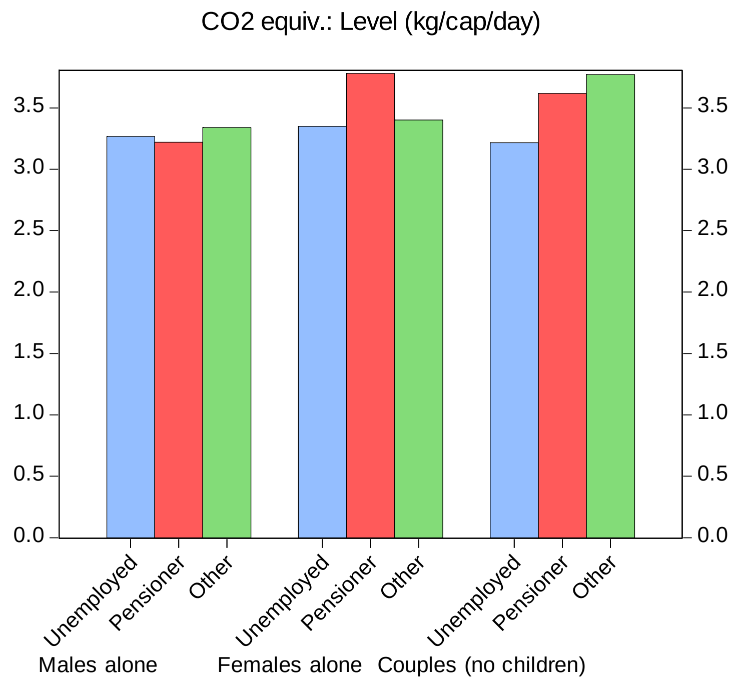
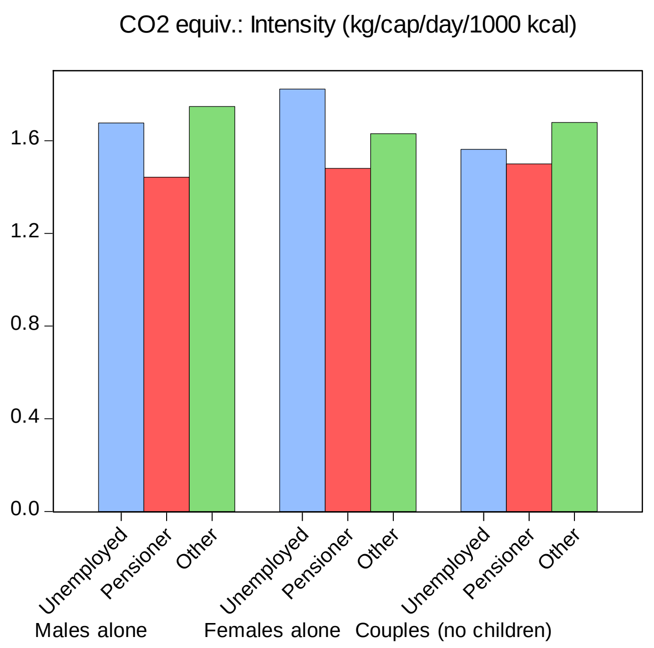


Figure 12: Intensity of greenhouse gas emissions versus occupational status



Appendix 1: Coefficients used to calculate the environmental indicators

HBS code	Definition	CO_2 equiv. (kg/kg)	PO_4 equiv (g/kg)	HBS code	Definition	CO_2 equiv. (kg/kg)	PO_4 equiv (g/kg)
M0111101	Rice, rice flakes and flour	2.9	3.8	M0114508	Other cheeses	12.5	15.8
M0111102	Liver casserole	NA	NA	M0114509	Grated cheese	12.5	15.8
M0111103	Other rice products	2.9	3.8	M0114510	Curd cheese	2.7	3.1
M0111201	Crisp bread and rye crackers	2.4	3.2	M0114511	Flavoured curd, cheese soup, etc.	1.4	1.6
M0111202	Rye bread	1.2	1.6	M0114514	Cheese n.e.c.	12.5	15.8
M0111203	Wheat bread	1.3	1.6	M0114601	Cream and cooking cream	1.8	2.0
M0111204	Other bread	1.3	1.6	M0114602	Sour milk and kefir	1.4	1.6
M0111205	Bread n.e.c.	1.3	1.6	M0114603	Crème fraiche, curdled and sour cream, etc.	1.8	2.0
M0111206	Rusks and bagels	2.6	3.3	M0114605	Puddings	1.4	1.6
M0111207	Biscuits and wafers	1.3	3.3	M0114701	Eggs	2.8	5.7
M0111208	Tortillas, pita bread, taco shells, etc.	1.3	3.2	M0115101	Butter	4.8	6.5
M0111301	Macaroni, spaghetti and other pasta	1.0	1.8	M0115102	Butter-vegetable oil mixture	3.5	5.0
M0111302	Noodles and lasagne sheets with sauce	1.3	3.2	M0115202	Fat spreads containing a plant stanol ester	2.1	3.4
M0111303	Meat-macaroni casserole and other pasta	3.5	3.9	M0115203	Soft margarine	2.1	0.2
M0111401	Pizzas and pizza slices	19.0	18.9	M0115204	Cooking margarine	2.1	3.4
M0111402	Hamburgers, hot dogs, etc.	2.0	2.1	M0115205	Coconut and peanut butter, etc. edible fats	NA	NA
M0111403	Filled crepes, tortillas, etc.	0.9	1.4	M0115206	Butter spread	4.8	6.5
M0111501	Rice, potato, carrot, etc. pies	1.3	1.6	M0115301	Olive oil	1.5	10.3
M0111502	Pasties and meat pasties, etc.	3.5	3.9	M0115401	Other edible oils	0.8	3.9
M0111503	Ready-made sandwiches and baguettes	0.9	1.4	M0116101	Oranges	0.3	2.0
M0111601	Sweet bun loaf	1.1	2.5	M0116102	Mandarins	0.3	2.0
M0111602	Danish pastries and buns	1.1	2.5	M0116103	Other citrus fruits	0.3	2.0
M0111603	Doughnuts	1.1	2.5	M0116201	Bananas	0.9	2.0
M0111604	French pastries, cakes and sweet pies	1.1	2.5	M0116301	Apples	0.6	2.0
M0111701	Pre-prepared dough, pizza dough, etc.	1.1	2.5	M0116401	Pears	0.6	2.0
M0111801	Wheat flour	0.8	1.8	M0116501	Peaches, plums, etc. pitted fruit	0.6	2.0
M0111802	Barley flour	0.6	1.3	M0116601	Grapes	0.4	1.5
M0111803	Rye flour	0.8	2.0	M0116602	Black currants	0.5	3.0
M0111804	Potato flour, barley and corn starch	NA	NA	M0116603	Red and white currants	0.5	3.0
M0111805	Wholemeal wheat flour	0.6	1.5	M0116604	Strawberries	0.5	2.6
M0111806	Other flours and mixed flour	1.1	2.5	M0116605	Other garden berries	0.5	3.0
M0111807	Oat groats, flakes and grains	0.7	1.6	M0116606	Blueberries	0.1	0.0
M0111808	Semolina	1.1	2.5	M0116607	Lingonberries and cranberries	0.1	0.0
M0111809	Rye groats, flakes and grains	0.8	2.0	M0116608	Cloudberries and other wild berries	0.1	0.0
M0111810	Barley groats, flakes and grains	0.6	1.3	M0116609	Frozen mixed berries and berries n.e.c.	1.0	2.0
M0111811	Wheat flakes, germs, grains and brans	0.8	1.8	M0116701	Kiwi fruit	NA	NA
M0111812	Other groats, grains and seeds	5.1	6.4	M0116702	Melons	0.4	0.4
M0111813	Corn flakes and other ready-to-eat breakfast	2.0	1.9	M0116703	Other fresh fruits	0.3	2.0
M0111814	Muesli and other grain-fruit mixtures	2.0	1.9	M0116704	Fruit n.e.c.	0.6	2.0
M0111815	Pop corn and other snacks of grain	NA	NA	M0116801	Nuts and almonds	2.3	2.0
M0111901	Powdered baby gruels and porridges	NA	NA	M0116802	Raisins and currants	1.8	6.0
M0111902	Ready-made baby gruels and porridges	1.1	1.7	M0116803	Other dried fruit and berries	2.2	8.0
M0111903	Other ready-made gruels, porridges, etc.	1.2	1.4	M0116901	Fruit and berry preserves	11.1	2.0
M0111904	Easter pudding	0.8	2.0	M0116902	Infants' juices and purees	1.0	1.5
M0112101	Meat of bovine animals, boneless	19.8	24.8	M0116903	Ready-to-eat berry and fruit soups and puddings	0.5	1.5
M0112102	Meat of bovine animals, with bone	13.2	16.5	M0117101	Chinese cabbage	0.3	0.4
M0112103	Seasoned beef, uncooked	13.2	16.5	M0117102	Lettuce	4.5	1.2
M0112201	Meat of swine, boneless	7.6	9.6	M0117103	Fresh herbs	0.3	0.8
M0112202	Pork chops	5.1	6.4	M0117104	Spinach, celery and other leaf and stem vegetables	0.1	0.4
M0112203	Ham, uncooked	5.1	6.4	M0117201	Cabbage	0.3	0.4
M0112204	Other meat of swine with bone	5.1	6.4	M0117202	Cauliflower	0.3	0.4
M0112205	Seasoned pork, uncooked	5.1	6.4	M0117203	Broccoli, red cabbage, Brussels sprouts and other	0.3	0.4
M0112301	Meat of sheep and goat	13.1	14.0	M0117301	Tomatoes	3.5	1.1
M0112401	Poultry	3.6	4.0	M0117302	Cucumbers	3.8	0.8
M0112501	Salami	7.6	9.6	M0117303	Pepper	0.9	2.0
M0112502	Luncheon meat	2.8	3.9	M0117304	Fresh peas and beans	0.3	1.5
M0112503	Other sausages, cold cuts	5.1	6.4	M0117305	Courgette,	0.4	0.4
M0112504	Liver pâté and pastes	7.6	9.6	M0117401	Carrots	0.2	0.1
M0112505	Frankfurters	4.9	5.9	M0117402	Beetroot	0.2	0.1
M0112506	Ring sausages	4.9	5.9	M0117403	Swedes and turnips	0.4	0.2
M0112507	Other cooking sausages	4.9	5.9	M0117404	Other root crops	0.4	0.2
M0112508	Sausages n.e.c.	4.9	5.9	M0117405	Onion	0.2	0.3
M0112601	Cold cuts of pork	5.1	6.4	M0117406	Fresh champignons	1.0	1.0

HBS code	Definition	CO_2 equiv. (kg/kg)	PO_4 equiv (g/kg)
M0112602	Other grilled, smoked, cooked and cured	4.2	5.5
M0112603	Cold cuts of poultry	3.6	4.0
M0112604	Other grilled, cured, etc. poultry	3.6	4.0
M0112605	Other cured meat	4.9	5.9
M0112606	Meat in aspic	NA	NA
M0112701	Meat preserves	5.1	6.4
M0112702	Other preserved meat preparations	NA	NA
M0112703	Cabbage rolls	1.4	1.9
M0112704	Meat cabbage and meat potato casseroles,	1.4	1.9
M0112705	Meat balls, ground beef patties	7.6	9.7
M0112706	Chicken balls, ground turkey patties, etc.	3.6	4.0
M0112707	Ready-to-eat and frozen soups of meat	1.4	1.9
M0112708	Chicken, ham, etc. meat salads	1.7	1.8
M0112709	Blood pancakes, blood sausages, etc.	3.5	16.7
M0112710	Ready-to-eat meals of meat	1.4	1.9
M0112711	Other meat preparations	5.1	6.4
M0112801	Meat of reindeer	1.5	0.1
M0112802	Other meat and game	1.5	0.1
M0112803	Liver and kidneys	3.5	16.7
M0112804	Blood, tongue, bone, knuckle, etc.	3.5	16.7
M0112805	Minced meat	8.6	11.4
M0112806	Mixed meat for Karelian stew	13.2	16.5
M0112807	Meat n.e.c.	5.1	6.4
M0113101	Baltic herring	1.0	-28.0
M0113102	Small whitefish	1.5	-12.0
M0113103	Salmon	4.4	38.0
M0113104	Rainbow trout	4.4	38.0
M0113105	Other fresh fish	2.7	-46.0
M0113106	Coley	3.5	5.0
M0113107	Baltic herring fillets	1.0	-28.0
M0113108	Other fish fillets	2.7	-46.0
M0113109	Fish n.e.c.	3.6	4.4
M0113201	Fresh crayfish, shrimps, squid, etc.	38.0	4.0
M0113301	Salted fish	4.4	38.0
M0113302	Dried or cooked cod	3.5	5.0
M0113303	Smoked and grilled fish	4.7	38.0
M0113304	Cooked, smoked, etc. seafood	38.0	4.0
M0113401	Herring, Baltic herring and Anchovy	2.2	2.0
M0113402	Tuna fish preserves	4.0	7.4
M0113403	Other fish and seafood preserves	4.0	5.0
M0113404	Fish fingers, other breaded fish products	2.5	1.2
M0113405	Baltic herring casseroles, etc.	1.3	8.9
M0113406	Fish and seafood salads	2.0	2.7
M0113407	Ready-to-eat meals of fish	1.3	8.9
M0113408	Fish soup and other fish preparations	1.3	7.9
M0114101	Unpasteurized milk	1.4	1.6
M0114102	Whole milk	1.4	1.6
M0114201	Low-fat and semi-skimmed milk	1.4	1.6
M0114202	Skimmed milk	1.4	1.6
M0114203	Lactose free and low-lactose milk	1.4	1.6
M0114204	Infant formula	1.4	1.6
M0114205	Milk n.e.c.	1.4	1.6
M0114206	Flavoured milk drinks	1.4	1.6
M0114301	Milk powder	9.9	11.5
M0114401	Unseasoned curdled milk	1.4	1.6
M0114402	Flavoured curdled milk	1.4	1.6
M0114403	Plain yoghurt	1.4	1.6
M0114404	Flavoured and infant yoghurt	1.4	1.6
M0114405	Curdled milk n.e.c.	1.4	1.6
M0114406	Yoghurt n.e.c.	12.5	15.8
M0114501	Emmenthal	12.5	15.8
M0114502	Edam	12.5	15.8
M0114503	Cheese rich in fat	12.5	15.8
M0114504	Processed cheese	4.1	4.7
M0114505	Unripened cheese	12.5	15.8
M0114506	Cottage cheese	2.7	3.1
M0114507	Blue cheese	12.5	15.8

HBS code	Definition	CO_2 equiv. (kg/kg)	PO_4 equiv (g/kg)
M0117407	Other fresh mushrooms	1.0	1.0
M0117408	Frozen mixes of vegetables and root crops	1.0	2.0
M0117409	Vegetables n.e.c.	0.3	0.4
M0117501	Dried peas, vegetables and root crops	1.3	6.0
M0117601	Pickled cucumbers	0.1	0.1
M0117602	Pickled beetroots, etc.	0.1	0.2
M0117603	Other vegetable and root crop preserves	NA	NA
M0117604	Vegetarian patties	0.7	3.2
M0117605	Ready-to-eat meals of vegetables	0.7	3.2
M0117606	Vegetable and root crop salads	2.5	0.7
M0117607	Vegetable and root crop soups, casseroles, etc.	0.6	0.7
M0117608	Tofu, etc. soya products	0.8	1.2
M0117609	Oat, rice, coconut, etc. milks and creams	1.4	1.6
M0117701	Potatoes	0.2	0.3
M0117801	Mashed potato flakes	NA	NA
M0117802	Potato crisps, etc.	NA	NA
M0117803	French-fried potatoes, potato wedges	1.8	2.6
M0117804	Potato salad	1.0	1.1
M0117805	Potato casserole, mashed and canned potatoes,	0.2	0.3
M0118101	Lump sugar	0.7	1.0
M0118102	Granulated sugar	0.7	1.0
M0118103	Fruit sugar	0.7	1.0
M0118104	Other sugar	0.7	1.0
M0118201	Jams and purees	NA	NA
M0118202	Marmalades	0.7	1.0
M0118203	Honey	1.3	0.0
M0118301	Chocolate bars and confectionery	0.7	1.0
M0118401	Sweets, lozenges, etc. confectionery	0.7	1.0
M0118402	Chewing gums	NA	NA
M0118501	Ice-cream pins, cornets, soft ice cream, etc.	1.8	2.0
M0118502	Ice cream and sorbet packages, cakes, etc.	1.8	2.0
M0118503	Fruit-flavoured ice lollies	0.5	2.9
M0118601	Syrup	0.7	1.0
M0119101	Vinegar	3.0	1.5
M0119102	Mustard	NA	NA
M0119103	Ketchups	4.4	1.4
M0119104	Mayonnaises, salad dressings and barbecue sauces	1.8	2.0
M0119105	Gravies and sauce powders	NA	NA
M0119201	Garlic (fresh or dried)	0.2	0.3
M0119202	Salt	0.0	0.0
M0119203	Herbal salt	0.0	0.0
M0119204	Spices	0.0	0.0
M0119205	Culinary herbs	0.0	0.0
M0119301	Yeast	0.0	0.0
M0119302	Baking powder and baking soda	0.0	0.0
M0119303	Preservatives and sweeteners, etc.	0.0	0.0
M0119304	Dessert sauces, pudding powders, etc.	1.8	2.0
M0119305	Meat stock cubes and dehydrated meat bouillon	NA	NA
M0119306	Fish stock cubes and dehydrated fish stock soups	NA	NA
M0119307	Vegetable stock cubes and dehydrated vegetable	NA	NA
M0119308	Meat, fish, vegetable foods for infants	NA	NA
M0119410	Food products n.e.c.	NA	NA
M0121101	Coffee	0.7	0.1
M0121102	Instant coffee and ready-to-drink coffee drinks	0.7	0.1
M0121201	Tea	0.7	0.1
M0121202	Herbal tea	0.7	1.0
M0121203	Ice tea and other tea drinks	0.0	0.0
M0121301	Cocoa and ready-to-drink chocolate	0.7	0.1
M0122101	Mineral waters	0.5	0.1
M0122201	Soft drinks	0.5	0.1
M0122301	Juice drinks, juices and nectars	0.5	2.9
M0122302	Berry and fruit squashes	NA	NA
M0122303	Juices n.e.c.	0.5	2.9
M0122401	Vegetable juices	0.3	0.4
M0122402	Light beer and mead extracts	0.7	1.3
M0122403	Sports drinks and other non-alcoholic drinks	NA	NA

MTT Discussion Papers 1 • 2013

www.mtt.fi

ISSN 1795-5300