Data in brief 27 (2019) 104617

Contents lists available at ScienceDirect

Data in brief

journal homepage: www.elsevier.com/locate/dib

Data Article

# SHARP-Indicators Database towards a public database for environmental sustainability

Elly Mertens [a, *], Gerdine Kaptijn [a], Anneleen Kuijsten [a, b], Hannah van Zanten [c], Johanna M. Geleijnse [a, b], Pieter van 't Veer [a, b]

[a] Division of Human Nutrition and Health, Wageningen University, PO Box 17, 6700 AA Wageningen, the Netherlands
[b] TiFN, Wageningen, P.O. Box 557, 6700 AN Wageningen, the Netherlands
[c] Animal Production Systems Group, Wageningen University & Research, PO Box 338, 6700 AH Wageningen, the Netherlands

ARTICLE INFO

*Article history:*
Received 30 July 2019
Received in revised form 25 September 2019
Accepted 26 September 2019
Available online 7 October 2019

*Keywords:*
Environment
Greenhouse gas emission (GHGE)
Land use (LU)
Life cycle analyses (LCA)
Europe
Food
Diet

ABSTRACT

To initiate the achievement of an European-wide applicable public database for indicators of environmental sustainability of the diet, we developed the SHARP Indicators Database (SHARP-ID). A comprehensive description of the development of the SHARP-ID is provided in this article. In the SHARP-ID, environmental impact assessment was based on attributional life cycle analyses using environmental indicators greenhouse gas emission (GHGE) and land use (LU). Life cycle inventory data of 182 primary products were combined with data on production, trade and transport, and adjusted for consumption amount using conversions factors for production, edible portion, cooking losses and gains, and for food losses and waste in order to derive estimates of GHGE and LU for the foods as eaten. Extrapolations based on similarities in type of food, production system and ingredient composition were made to obtain estimates of GHGE and LU per kg of food as eaten for 944 food items coded with a unique FoodEx2-code of EFSA and consumed in four European countries, i.e. Denmark, Czech Republic, Italy and France. This LCA-food-item database can be linked to food intake data collected at the individual level in order to calculate the environmental impact of individual's diets. The application of this database to European survey data is described

DOI of original article: https://doi.org/10.1016/j.jclepro.2019.117827.
* Corresponding author.
*E-mail addresses:* elly.mertens@wur.nl (E. Mertens), pieter.vantveer@wur.nl (P. van 't Veer).

https://doi.org/10.1016/j.dib.2019.104617

in an original research article entitled “Dietary choices and environmental impact in four European countries” (Mertens et al., 2019).



Specifications Table

| | |
|---|---|
| Subject area | Nutrition sciences |
| More specific subject area | Diet-related environmental sustainability |
| Type of data | Figures and tables |
| How data was acquired | - Raw data on the environmental impact of all the food's life cycle stages were extracted from existing public databases and from recent publications.<br>- Life cycle inventory data of Agri-footprint and Ecoinvent were accessed using the software program SimaPro (Multi-user version 8.4.0.0).<br>- Raw data on the environmental impact of all the food's life cycle stages were compiled to calculate environmental impact of the food as consumed using Microsoft Excel. |
| Data format | Raw processed and analysed data, descriptive statistics<br>The raw data are available on a data repository. |
| Experimental factors | Data taken from published sources were processed to provide estimates of GHGE and LU for assessing the environmental impact of an individual diet. |
| Experimental features | No experimental work was carried out; calculations were based on published data. |
| Data source location | Foods included in the SHARP-ID were based on the reported food intake of the four European countries included in the SUSFANS project, i.e. Denmark, Czech Republic, Italy and France, resulting in a list of 944 food items coded with a unique FoodEx2-code. |
| Data accessibility | Estimates of environmental impact for a food, as coded by the FoodEx2, are available on a data repository with the following doi https://doi.org/10.17026/dans-xvh-x9wz. The associated file that includes all the calculations is available upon request for scientific applications. Contact point for further use is prof Pieter van ‘t Veer at the Division of Human Nutrition and Health, Wageningen University (pieter.vantveer@wur.nl). Reproduction and translation for non-commercial purposes are authorised, provided the source is acknowledged and the publisher is given prior notice and sent a copy. |
| Related research article | Mertens, E., A. Kuijsten, H.H.E. van Zanten, G. Kaptijn, M. Dofková, L. Mistura, L. D'Addezio, A. Turrini, C. Dubuisson, S. Havard, E. Trolle, J.M. Geleijnse, and P.v.t. Veer, Dietary choices and environmental impact in four European countries. Journal of Cleaner Production, 2019. **237**: p. 117827. |

**Value of the Data**

- The data serve to quantify the environmental impact of the diet in the consumer domain using highly-disaggregated food consumption data collected at the individual level. Using this consumption-oriented approach allows studying environmental impact of the diet with other diet-related aspects, like dietary quality, food preferences, food affordability, etc.
- The data permit comparisons of environmental impact of individual's diets within and between populations, if using comparable dietary assessment methods.
- The data provide a basis for new research undertakings that are directed to broadening the understanding of the interrelationships between environment, food, and health.

## 1. Data

The SHARP-Indicators Database (SHARP-ID) presented here constitute the basis for quantifying the environmental impact of an individual's diet, and this database has been applied to dietary survey data of four European countries [1]. This database provides for each single food item an estimate on greenhouse gas emissions (GHGE) and land use (LU) per kg of food as eaten. Food items included in the SHARP-ID were based on the reported food intake of the four European countries included in the SUSFANS project [1,2], i.e. Denmark, Czech Republic, Italy and France. Intake data of these four countries were coded using FoodEx2 Exposure Hierarchy of the European Food Safety Authority (EFSA) [3,4], resulting in a list of 944 food items coded with a unique FoodEx2-code for which environmental footprint of the food product's life cycle was assessed using attributional life cycle analyses (LCA). Table 1 shows the summary descriptive statistics of GHGE (in $kgCO_2eq$/kg food as eaten) and LU (in $m^{2*}$year/kg food as eaten) for different food groups. Starting from life cycle inventory data on primary products, estimates were obtained for GHGE and LU per kg of food as eaten by using appropriate conversions factors to reflect amount as consumed and including impacts from packaging, transport and home preparation. Life cycle inventory data were retrieved from Agri-Footprint 2.0 [5,6], Ecoinvent 3.3 [7], CAPRI [8], and supplemented by recent literature and technical reports (Fig. 1 and Table 2). Impacts of composite foods were estimated using the ingredients/primary products that make up the foods using recipes from the Dutch food composition table [9] or the first hit on internet. Conversion factors for production were taken from Bowman [10,11] and FAO [12], for edible part and for weight gain or losses during preparation from Bognar [13] and the Health Council of Belgium [14], and for food losses and waste from Broekema and Kuling, as documented in Ref. [15]. Impacts from packaging were retrieved from Ecoinvent 3.3 [7], using the most common packaging format, as reported by Ref. [16] (Table 3). Impacts from transport were retrieved from RVO [17], using information on trade and transport from FAOstat, BACI World Trade Database, GTAP and Geodis. Impacts from home preparation in energy use (MJ) were based on Foster [18] and Carlsson-Kanyama [19] (Table 4), and recalculated into GHGE ($CO_2eq$) using the methods of Mombarg and Kool [20].

## 2. Experimental design, materials, and methods

### 2.1. Environmental impact of primary productions

Life cycle inventory data of Agri-Footprint 2.0 [5,6], Ecoinvent 3.3 [7] and CAPRI [8] were used as an input for the SHARP-ID and provided information on greenhouse gas emissions (GHGE) and land use (LU) of primary food products, i.e. environmental impacts until the farm gate. GHGE was expressed in kilogram $CO_2$equivalents ($kgCO_2eq$) per kg primary product, with 1 $kgCH_4$ equal to 25 $kgCO_2$, and 1 $kgN_2O$ equal to 298 $kgCO_2$ (IPCC 2007). LU was expressed in $m^{2*}$year per kg primary product, and was calculated as 10000/yield. With SimaPro (Multi-user version 8.4.0.0), life cycle inventory data of Agri-footprint and Ecoinvent were accessed. Agri-footprint was used as a first data source, and was where needed supplemented by Ecoinvent and other data sources. For livestock products, i.e. all meat, milk and egg products, we used data from CAPRI, as these data cover an European average for these animal-sourced foods. Relevant recent literature and technical reports were used to fill data gaps, for example for fish products. For the FoodEx2-codes where no primary product data were available, extrapolations were made based similarities in cultivation and production method, and the producing country. Impacts between products and co-products were based on economic allocation for all foods, except for animal-sourced foods where nitrogen allocation was used because the nitrogen content serves as an indicator of the physical and causal relationship between products and emissions [8].

For composite foods, a break-down into their ingredients is needed before linking these to their corresponding primary products. Food items consisting of two or more primary products, for example grain-based products like bread, cookies and cakes, composite dishes like pizza, hamburger, goulash, soups and salads, and milk desserts like pudding and milkshake, etc. are regarded as a composite food; regardless whether they are prepared at home or manufactured. To calculate the environmental impact of a composite food, recipes taken from the Dutch food composition table [9] or the first hit on internet were used to break-down composite foods into its ingredients. Using the mass balance and the environmental impact of the ingredients, a weighted impact of the composite dish was calculated. In total, we used 42

**Table 1**
Average GHGE (in kg$CO_2$/kg food as eaten) and average LU (in $m^2$*year/kg food as eaten) for 17 food groups according to level 1 of the FoodEx2 Exposure Hierarchy. Values are means with their standard deviations.

| Food groups according to level 1 of the FoodEx2 Exposure Hierarchy | Number of food items | GHGE | | LU | |
|---|---|---|---|---|---|
| | | Mean | (SD) | Mean | (SD) |
| Grains and grain-based products | 139 | 3.9 | (5.9) | 5.8 | (6.0) |
| Vegetable and vegetable products | 109 | 1.8 | (3.7) | 0.8 | (1.9) |
| Starchy root or tubers and products | 14 | 0.8 | (0.4) | 0.8 | (0.6) |
| Legumes, nuts and oilseeds | 43 | 2.1 | (1.9) | 7.9 | (13.6) |
| Fruit and fruit products | 90 | 0.9 | (0.6) | 0.8 | (0.7) |
| Meat and meat products | 113 | 17.1 | (9.5) | 28.5 | (17.4) |
| Fish and fish products | 96 | 15.2 | (16.7) | 2.1 | (4.3) |
| Milk and dairy products | 111 | 11.5 | (6.6) | 11.5 | (7.0) |
| Eggs and egg products | 13 | 5.3 | (5.3) | 16.1 | (17.0) |
| Sugar and confectionary | 30 | 2.6 | (2.7) | 3.7 | (3.6) |
| Animal and vegetable fats and oils | 29 | 7.1 | (9.1) | 16.9 | (13.8 |
| Fruit and vegetable juices | 27 | 1.2 | (0.5) | 1.0 | (0.9) |
| Water and water-based beverages | 27 | 0.4 | (0.1) | 0.3 | (0.2) |
| Alcoholic beverages | 33 | 1.1 | (0.3) | 0.7 | (0.2) |
| Coffee, cocoa, tea | 30 | 1.5 | (3.4) | 1.6 | (4.7) |
| Composite dishes | 20 | 4.8 | (2.5) | 7.5 | (4.2) |
| Miscellaneous | 20 | 2.2 | (1.2) | 6.3 | (6.9) |

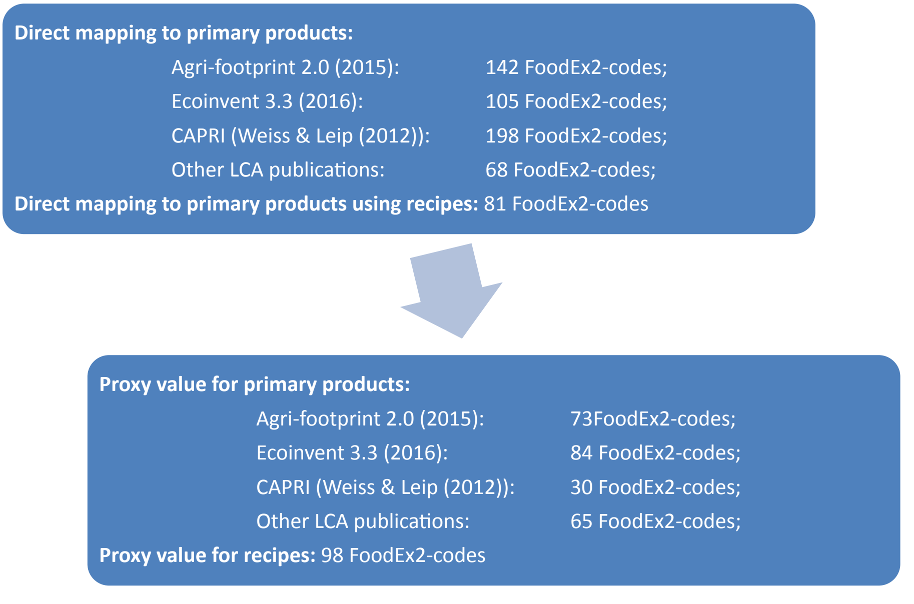


**Fig. 1.** Mapping foods to primary products from different life cycle inventory data sources.

different recipes, and a recipe was also used as a proxy for composite foods with comparable ingredient composition. All recipes for composite foods were assumed to be homogenous across Europe.

Fig. 1 shows the process of mapping food to primary products from different life cycle inventory data sources, and Table 2 shows for each food group of the FoodEx2-classification (at Level 1) their corresponding life cycle inventory data source used for quantifying environmental impact.

**Table 2**
Food groups of the foodEx2-classification (at Level 1) and their corresponding life cycle inventory data source used for quantifying environmental impact.

| Level 1 food groups of the FoodEx2-classification system | Number of foods | | | | | Main data sources |
|---|---|---|---|---|---|---|
| | Total | via direct mapping | via proxy | via recipes | via proxy recipes | |
| Grains and grain-based products | 137 | 48 | 9 | 25 | 55 | Agri-footprint |
| Vegetable and vegetable products | 109 | 44 | 65 | – | – | Agri-footprint, Ecoinvent |
| Starch roots or tubers and products thereof | 9 | 9 | – | – | – | Agri-footprint |
| Legumes, nuts and oilseeds | 42 | 25 | 17 | – | – | Agri-footprint, other publications |
| Fruit and fruit products | 90 | 35 | 45 | 8 | 2 | Ecoinvent |
| Meat and meat products | 107 | 81 | 26 | – | – | CAPRI, other publications |
| Fish and fish products | 93 | 41 | 52 | – | – | Other publications |
| Milk and dairy products | 110 | 102 | 3 | 3 | 2 | CAPRI, other publications |
| Eggs and egg products | 12 | 12 | – | – | – | CAPRI, other publications |
| Sugar and confectionary | 30 | 7 | 10 | 6 | 7 | Agri-footprint |
| Animal and vegetables fats | 29 | 17 | 6 | 2 | 4 | Agri-footprint, Ecoinvent, CAPRI |
| Fruit and vegetable juices | 27 | 13 | 14 | | – | Ecoinvent, Agri-footprint |
| Water and water-based beverages | 27 | 9 | 1 | 17 | – | Agri-footprint |
| Alcoholic beverages | 34 | 21 | – | 1 | 12 | Agri-footprint, Ecoinvent |
| Coffee, cocoa, tea<br>Agri-footprint, other publications | 30 | 27 | – | 3 | – | Ecoinvent, |
| Composite dishes | 38 | 10 | 2 | 13 | 13 | Agri-footprint, CAPRI, other publications |
| Miscellaneous, including food products for young population, non-standard diets, seasoning and sauces | 20 | 13 | 1 | 3 | 3 | Ecoinvent, Agri-footprint |

## 2.2. *Environmental impact from production until consumption*

### 2.2.1. *Conversion factors to reflect amount as consumed*

To calculate the environmental impact for foods as consumed, we applied conversion factors for production, for edible part, for weight gain or losses during preparation, and for food losses and waste at production and at consumption phase.

A production factor was applied for primary products that undergo further production processing to extend shelf life, to render palatability, edibility, safety, etc. Examples of this kind of products are wheat that is milled into flour, grapes that are dried to render raisins, fruits that are squeezed to render fruit juice. This kind of processing results in a mass change of the primary product (the production amount is not the same as the amount of retail), hence the need for a production factor. This production factor is usually higher than 1.0; with its magnitude depending on the primary product and its undergoing production process. Production factors, as documented by Bowman [10], were applied to convert a processed food item to its raw primary product as found at retail level; herby only accounting for mass differences [11]. Technical production factors for products derived from milk, such as cream, cheese and butter, were taken from FAO [12]; because production yields of products derived from milk tend to vary between countries, as these are highly dependent on the composition of the raw milk, for example cheese yield is related to casein and fat content of the milk. None of the production factors accounted for water and energy consumed, however the latter was taken into account in a later stage by adding preparation at home to the GHGE of that food item.

Conversion factors for consumption refuse (e.g.: skin, peel, core, pits, trimming), weight losses and gains during preparation were applied for products where the amount bought at retail differs from the

**Table 3**
Packaging and their associated foods.

| Packaging material | Foods |
|---|---|
| Average of glass bottle and can (for 0.3L drinks) | Beer |
| Average of glass bottle and can (for 0.3L drinks), and PET bottle (for 1L drinks) | Soft drinks, fruit juices and water |
| Glass bottle (for 150g jam) | Jam, peanut butter, chestnut puree, honey |
| Average of glass bottle (for 500g dressing) and HDPE container (for 1L ketchup) | All kind of sauces, dressing and syrups |
| Average of HDPE container and glass bottle (for 500mL oil) | Oils |
| Glass bottle (for 500mL oil) | All kind of alcoholic beverages other than beer |
| PE bag (for 500g of pasta) | Pasta, rice, bread, coffee, tea, milk powder |
| PP bag (for 400g of cereals) | Cornflakes, candies |
| Drink carton (for 1L milk) | Milk, plant-based alternative for milk |
| HDPE container (for 1L ice cream) | Ice cream, sorbet, composite dishes like soups, goulash |
| HDPE container (for 400g margarine) | Margarine, spreadable cheese, composite salad dishes |
| PS container (for 2dL yoghurt) | Yoghurt, quark, dairy desserts, soft cheeses |
| PS container (for 500g meat) | Meat, fish, tofu, hard cheese, nuts |
| Pulp tray (for 10 eggs) | Eggs, composite pizza-like dishes like |
| PS bag (for fruit, vegetables, potatoes) | Fruit, vegetables, potatoes |
| Average of aluminium and tin can (for 500g food) | Canned fruit and vegetables |
| Average of aluminium and tin can (for 150g food) | Canned meat and fish, condensed milk |

*Abbreviations: PET, PolyEthylene Terephthalate, HDPE, H*igh-Density PolyEthylene; PE, PolyEthylene; PP, PolyPropylene; PS, PolyStyrene.

**Table 4**
Environmental impact of home preparation.

| Way of home preparation | Foods |
|---|---|
| Boiling water | Coffee, tea, cocoa beverages |
| Boiling potatoes | Potatoes, soups, grains, vegetables, jams and juices, legumes, puddings |
| Frying | Fried dishes |
| Microwaving | Oat porridge |
| Oven baking | Bread products and cookies, dried eggs and dried vegetables |
| Roasting | Meat and fish products |

amount of consumed. Examples of this kind of conversion factors are the adjustment of bananas for its peel (using a factor for edible portion), cooked vegetables for their raw amount (using a factor for weight loss during cooking), cooked rice for uncooked rice (using a factor for weight gain during cooking). Conversion factors were taken from Bognar [13] and from the Health Council of Belgium [14]. For processed foods, these kind of conversion factors were already included in the production factor.

Percentage of food losses and waste, estimated by Broekema et al. (2015) and Kuling et al. (2015), as documented in Ref. [15], were applied to further adjust consumption amount to production amount. Food losses included losses during storage, processing, packaging and transport, and losses at the supermarket and at home (i.e. losses of the edible parts of the food, i.e. waste). Percentage of food losses were estimated at the level of food groups, and food groups not included were assumed to have an average food loss percentage.

### *2.2.2. Environmental impact of packaging*

For the packaging of food products, we included primary packaging (Table 3), but excluded secondary and tertiary packaging, such as carton boxes and pallets. The main reason for only including primary packaging was that this has the highest impact on the environment. Data on packaging were retrieved from Ecoinvent 3.0; using the most common packaging format for that food item, as reported by Ref. [16].

### *2.2.3. Environmental impact of transport*

Trade and transport data were obtained from FAOstat, BACI World Trade Database and GTAP using reference year 2011; these data provided information about the countries of trade and its corresponding amount, ratio imported domestically produced, and the ratio for mode of travel (air, water, land). Distances between trading countries were obtained from Geodist. Transport distances for imported food items were taken from the producing country of the raw primary product to the country that will manufacture/consume that raw primary product, and thus excluding transport within that country from retailers to home. For locally produced and locally consumed food items, distance for travelling by truck within an average European country was used. Emissions of transport by airplane, ship, and truck were taken from RVO [17]. Refrigeration of a vehicle adds 20% to the emissions; a chilled vehicle was assumed for all dairy, meat, vegetables (except for tubers) and fruit products. Chilled transport was not considered for composite dishes, processed foods, cacao, drinks, including sweet and alcoholic drinks, coffee and tea, and water, as they were assumed to be prepared at home and/or packaged in a tin/glass/can/bottle, and thus no need to be chilled.

#### 2.2.4. Environmental impact of food preparation

Values for home preparation were based on Foster [18] who based his values on Carlsson-Kanyama [19]; information was available for boiling, frying, oven baking, roasting and microwaving (Table 4). Energy use (MJ) was recalculated into GHGE ($CO_2$eq) using the methods of Mombarg and Kool [20], and under the assumption that half the energy use was from gas and half from electricity. No values were assigned to alcoholic beverages, animal and vegetable fats and oils, salads of composite dishes, unprepared eggs, fruits except for jams, fruit and vegetables juices and nectars, flours, unprocessed breakfast cereals, nuts, milk and dairy products except for puddings, plant alternatives for milk, seasoning, sauces and condiments, except for white and tomato sauce, confectionary and water-based sweet desserts, vegetables and vegetables products regularly consumed as raw, water and water-based beverages; because not home-prepared and/or counted by food products with whom it is consumed together, and/or consumed as raw.

### 2.3. Calculations of the final values of GHGE and LU, as included in the SHARP-ID

For each FoodEx2-code, total GHGE and LU per kg of food as eaten were calculated using the following formula, respectively:

GHGE = GHGE at farm gate x production factor x (1/edible factor) x (1/shrinkage, swelling factor) x (1/losses, waste factor) + packaging + transport + preparation at home

LU = LU at farm gate x production factor x (1/edible factor) x (1/shrinkage, swelling factor) x (1/losses, waste factor)

## Acknowledgments

The work has received funding from TiFN under Project agreement number 15SD01 (SHARP-BASIC) for the development of the SHARP Indicators Database (SHARP-ID).

## Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## References

[1] E. Mertens, A. Kuijsten, H.H.E. van Zanten, G. Kaptijn, M. Dofková, L. Mistura, L. D'Addezio, A. Turrini, C. Dubuisson, S. Havard, E. Trolle, J.M. Geleijnse, P.v.t. Veer, Dietary choices and environmental impact in four European countries, J. Clean. Prod. 237 (2019) 117827.

[2] M. Rutten, T.J. Achterbosch, I.J.M. de Boer, J.C. Cuaresma, J.M. Geleijnse, P. Havlík, T. Heckelei, J. Ingram, A. Leip, S. Marette, H. van Meijl, L.-G. Soler, J. Swinnen, P. van't Veer, J. Vervoort, A. Zimmermann, K.L. Zimmermann, M. Zurek, Metrics, models and foresight for European sustainable food and nutrition security: the vision of the SUSFANS project, Agric. Syst. 163 (2016) 45–57.

[3] European Food Safety Authority, The Food Classification and Description System FoodEx2 (revision 2), EFSA supporting publication, 2015, p. 90, 2015. En-804.
[4] EFSA (Eurepean Food Safety Authority), Use of the EFSA comprehensive european food consumption database in exposure assessment, EFSA J. 9 (9) (2011) 2097.
[5] BlonkConsultants, Agri-footprint 2.0—Part 1: Methodology and Basic Principles, Gouda, the Netherlands, 2015.
[6] BlonkConsultants, Agri-footprint 2.0—Part 2: Description of Data, Gouda, the Netherlands, 2015.
[7] B.P. Weidema, C. Bauer, R. Hischier, C. Mutel, T. Nemecek, J. Reinhard, C. Vadenbo, G. Wernet, Overview and Methodology: Data Quality Guideline for the Ecoinvent Database Version 3, Swiss Centre for Life Cycle Inventories, 2013.
[8] F. Weiss, A. Leip, Greenhouse gas emissions from the EU livestock sector: a life cycle assessment carried out with the CAPRI model, Agric. Ecosyst. Environ. 149 (2012) 124—134.
[9] NEVO, Recepten NEVO-Online 2016, 2016.
[10] S. Bowman, C. Martin, J. Carlson, J. Clemens, B.-H. Lin, A. Moshfegh, Food Intakes Converted to Retail Commodities Databases: 2003-08: Methodology and User Guide, 2013 (U.S. Department of Agriculture, Agricultural Research Service, Beltsville, MD and U.S. Department of Agriculture, Economic Research Service, Washington, D.C).
[11] S. Bowman, C. Martin, J. Friday, A. Moshfegh, B.-H. Lin, Converting food intakes to retail commodities: a novel approach to identify trends in food commodity usage by Americans, FASEB J. 24 (1 Supplement) (2010) 943—952.
[12] FAO, Technical Conversion Factors for Agricultural Commodities, 1996.
[13] A. Bognar (Ed.), Tables on Weight Yield of Food and Retention Factors of Food Constituents for the Calculation of Nutrient Composition of Cooked Foods (Dishes). Berichte der Bundesforschungsanstalt für Ernährung. BFE-R–02-03, Karlsruhe, Germany, 2002.
[14] Hoge Gezondheidsraad, Maten en Gewichten (Eds.), Handleiding voor gestandardiseerde kwantificering van voedingsmiddelen in België: revisie januari 2005 (HGR 6545-2), Minsterie van Sociale Zaken Volksgezondheid en Leefmilieu: Hoge Gezondheidsraad, 2005 (Brussels, Belgium).
[15] E. De Valk, A. Hollander, M. Zijp, Milieubelasting van de voedselconsumptie in Nederland. RIVM rapport 2016-0074, 2016.
[16] E. Pongráz, Chapter 9 the environmental impact of packaging, in: M. Kutz (Ed.), Environmentally Conscious Materials and Chemicals Processing, John Wiley & Sons Inc., Hoboken, New Jersey, 2007.
[17] RVO, GER-waarden en CO2-lijst - januari 2017, 2017 [cited 2017; Available from: https://www.rvo.nl/file/ger-waarden-en-co2-lijst-januari-2017.
[18] C. Foster, K. Green, M. Bleda, Environmental Impacts of Food Production and Consumption: Final Report to the Department for Environment Food and Rural Affairs, 2007.
[19] A. Carlsson-Kanyama, K. Bostrom-Carlsson, Energy Use Fo Cooking and Other Stages in the Life Cycle of Food: a Study of Wath, Spaghettie, Pasta, Barley, Rice, Potatoes, Couscous and Mashed Potatoes, Stockhoms Universitet, Stockholm Sweden, 2001.
[20] H. Mombarg, A. Kool, Telen met toekomst energie-en klimaatmeetlat: eindrapport, Plant Research International, 2004.