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A CONTRIBUIÇÃO DE UMA PORÇÃO DE CARNE, PEIXES E OVOS PARA AS ALTERAÇÕES CLIMÁTICAS

THE CONTRIBUTION OF A PORTION OF MEAT, FISH AND EGGS FOR CLIMATE CHANGE

LA CONTRIBUCIÓN DE UNA PORCIÓN DE CARNE, PESCADO Y HUEVOS PARA EL CAMBIO CLIMÁTICO

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RESUMO

Introdução: A mudança nos padrões alimentares dos cidadãos implicará uma pegada ambiental maior em termos de emissões de gases de efeito estufa e uso de recursos naturais. Por exemplo, dietas ricas em leite e carne, especialmente de ruminantes, estão associadas ao aumento das emissões de metano da fermentação entérica, do dióxido de carbono da deflorestação para dar origem ao pasto e do óxido nitroso da produção de ração.
Objetivos: Para um consumo mais sustentável, o objetivo deste estudo foi quantificar e comparar a contribuição para as alterações climáticas de uma porção do que se come em geral, proveniente da Roda dos Alimentos, relacionados com carnes, aves, peixes e ovos, para alcançar uma dieta equilibrada e saudável.
Métodos: A Avaliação do Ciclo de Vida, baseada nas normas ISO 14040/44 (2006), foi a metodologia utilizada. A análise de inventário e, posteriormente a análise de impacte foram realizadas utilizando o software SimaPro 8.5. O método escolhido para a avaliação de impacte ambiental foi o IPCC 2013 GWP 100a.
Resultados: Os resultados mostram que uma porção de cavala (peixe) apresenta a pegada ecológica inferior seguida da porção de bacalhau, frango, lombo de porco, ovos, lagosta e bife de vaca, respetivamente.
Conclusões: A principal conclusão deste estudo é que a avaliação do impacte de ciclo de vida usando o método IPCC 2013 GWP 100a, pode ajudar as pessoas a escolherem os melhores alimentos para uma refeição mais amiga do ambiente, ajudando a mitigar as alterações climáticas.

Palavras-chave: ACV; Alterações climáticas; Roda dos Alimentos

ABSTRACT

Introduction: The shift in dietary patterns of citizens will have a larger environmental footprint, in terms of greenhouse gas emissions and the use of natural resources. For example, diets high in milk and meat, particularly from ruminants, is associated with increasing emissions of methane from enteric fermentation, carbon dioxide from deforestation for pasture, and nitrous oxide from feed production.
Objectives: For a more sustainable consumption the aim of this study was to quantify and compare the contribution to climate change of one portion of what you eat overall coming from the shelf of Food Wheel related with meat, poultry, fish and eggs to achieve a healthy, balanced diet.
Methods: Life Cycle Assessment, based on ISO 14040/44 standards was the methodology used. The inventory analysis and, subsequently, the impact analysis were performed using the software SimaPro 8.5. The method chosen for the environmental impact assessment was IPCC 2013 GWP 100a.
Results: The results show that a mackerel (fish) portion presents the lower ecological footprint followed by a portion of codfish, chicken, pork tenderloin, eggs, lobster and cow tenderloin, respectively.
Conclusions: The main conclusion of this study is that life cycle impact assessment, using the IPCC 2013 GWP 100a, is a method that can help the people to choose the best food for a meal that is more environmentally friendly helping to mitigate the climate change.

Keywords: Climate change; Food Wheel; LCA

RESUMEN

Introducción: El cambio en los patrones dietéticos de los ciudadanos tendrá una huella ambiental más grande, en términos de emisiones de gases de efecto invernadero y el uso de los recursos naturales. Por ejemplo, las dietas altas en leche y carne, particularmente de rumiantes, están asociadas con el aumento de las emisiones de metano de la fermentación entérica, el dióxido de carbono de la deforestación de los pastos y el óxido nitroso de la producción de alimentos.
Objetivos: Para un consumo más sostenible, el objetivo de este estudio fue cuantificar y comparar la contribución al cambio climático de una porción de lo que se come en general proveniente del estante de Rueda de Alimentos relacionado con carne, pollo, pescado y huevos para lograr una dieta saludable y equilibrado.
Métodos: La metodología utilizada fue la evaluación del ciclo de vida, basada en los estándares ISO 14040/44. El análisis de inventario y, posteriormente, el análisis de impacte se realizaron con el software SimaPro 8.5. El método elegido para la evaluación de impacte ambiental fue IPCC 2013 GWP 100a.
Resultados: Los resultados muestran que la porción de caballa (pez) presenta la huella ecológica más baja seguida de una porción de bacalao, pollo, lomo de cerdo, huevos, langosta y lomo de vaca, respectivamente.
Conclusiones: La principal conclusión de este estudio es que la evaluación del impact del ciclo de vida, utilizando el IPCC 2013 GWP 100a, es un método que puede ayudar a las personas a elegir el mejor alimento para una comida que sea más ecológica ayudando a mitigar el cambio climático.

Palabras Clave: ACV; Cambio climático; Rueda de Alimentos;

INTRODUCTION

1. THEORETICAL FRAMEWORK

Demand for food and other agricultural products are projected to increase by 50 percent between 2012 and 2050 (FAO 2017). These projections suggest growing pressures on agricultural land, water, forests, capture fisheries, and biodiversity. Between now and 2050, the additional land needed for agricultural production is estimated at just under 100 million ha. Producing more with less, while preserving and enhancing the livelihoods of small-scale and family farmers, is a key challenge for the future.

Climate change and natural and human-induced disasters pose multiple concerns (FAO 2017): damage and losses to production; the degradation of land, forests, water, fish stocks and other natural resources; declining rates in productivity growth; and added pressures on already fragile agricultural livelihoods and ecosystems. Climate change may also affect nutritional outcomes through its impacts on micronutrient content of certain foods and food safety. In addition, high temperatures and extreme weather events create a more favorable environment for food-borne pathogens that reduce the body's ability to absorb nutrients.

The 2030 Agenda for Sustainable Development (UN 2015) demands, as the first steps toward eliminating all forms of exclusion and inequality everywhere, an end to poverty, hunger and malnutrition, and universal access to health care, all with strong attention to gender issues; it seeks a global shift to sustainable consumption and production. This Agenda, contains a legal instrument, the Paris Agreement (UNFCCC 2015) on climate change, which commits all nations to taking steps to prevent global temperature from rising 2°C above pre-industrial levels (and pursuing efforts to limit the temperature increase to 1.5 °C, recognizing that this would significantly reduce the risks and impacts of climate change).

The shift in dietary patterns will have a larger environmental footprint, in terms of greenhouse gas emissions and the use of natural resources (FAO 2017). The shift to diets high in milk and meat, particularly from ruminants, is associated with increasing emissions of methane from enteric fermentation, carbon dioxide from deforestation for pasture, and nitrous oxide from feed production. Higher consumption of processed foods requires additional use of water and energy, which has negative environmental impacts, if these resources are not sustainably managed. Food systems that link farmers to cities can have an enormous impact on rural poverty alleviation and agricultural development. Options include connecting small-scale producers and supermarket supply chains through contractual arrangements with mutually beneficial terms, and giving new impetus to the development of local food systems.

The Food Wheel, Figure 1, shows how much of what you eat overall should come from each shelf to achieve a healthy, balanced diet (DGC/ FCNAUP 2003).

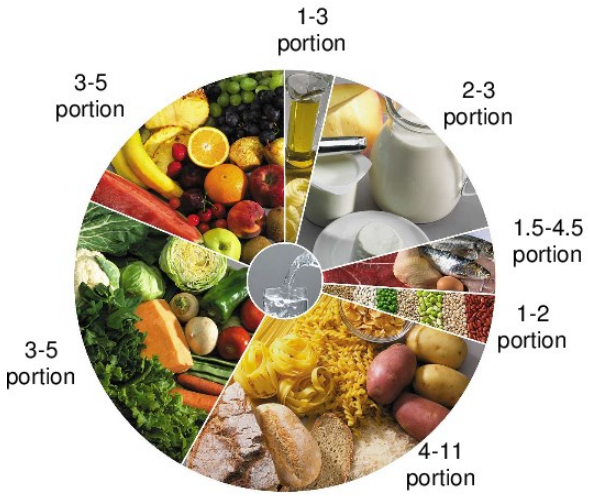

Figure 1 - The new Food Wheel (source: DGC/ FCNAUP 2003)

For a more sustainable consumption the aim of this study was to quantify and compare the contribution to climate change of one portion of what you eat overall coming from each shelf of Food Wheel, using the Life Cycle Assessment methodology. Life Cycle Assessment (LCA) is a method for compilation and evaluation of the inputs, outputs and the potential environmental impact of a product system throughout its life cycle (International Standard Organisation 2006 a). LCA has been applied to a wide range of products and services in general (Ferreira and Domingos 2011) and in agricultural and forestry products in particular (Ferreira et al. 2014, Ferreira et al. 2016, Ferreira et al. 2018, Werner et al. 2007).

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2. METHODS

The LCA study was performed with the methodology recommended in ISO 14040:2006 standard (International Organization for Standardization 2006b). It was divided into four phases: goal and scope definition; inventory analysis; impact assessment; and interpretation of results.

2.1 Goal and scope of the study

As said before the main goal of this study was to quantify and compare the contribution to climate change of one portion of what is eaten overall coming from each shelf of Food Wheel.

Function of the system and functional unit

The function of the system being studied is to produce the food included in the same shelf of the Food Wheel, the part of the life cycle referred to as cradle-to-gate that means from soil to kitchen. Therefore, the functional unit (FU) assumed was 1 portion of food.

System boundary

Figure 2 - is a simplified way of showing the system boundary for the product system being studied

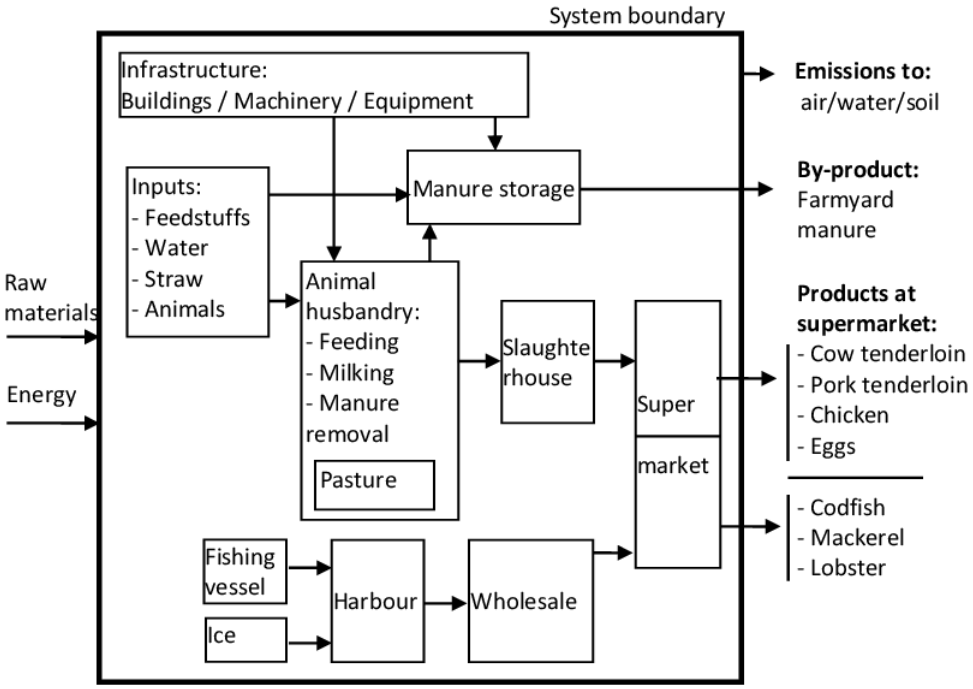

Figure 2 Cradle-to-gate product system for an animal and fish production system at supermarket (adapted from Nemecek and Kagi (2007))

Animal production in agriculture, animals processed into meat in slaughterhouses and trade (wholesale and supermarket) are the processes included in the system boundary of cow tenderloin, pork tenderloin, chicken and eggs.

The following processes are included in various fishing categories: fishing processes (steaming to and from the fishing site, fishing operation and eventual cool storage of fish on board) and processing in fish industry. The catch is usually a mix of various species (codfish, mackerel, lobster, etc.) depending on local conditions in the sea, time of the year, equipment applied etc.

Allocation procedure

Allocation procedures are needed when dealing with systems involving multiple products and recycling systems. The ISO 14044:2006 (International Organization for Standardization 2006b) suggest using system expansion whenever possible and where it is not possible to use system expansion allocation can be used instead. Allocation of environmental impacts between the product and co-products can be based on mass, gross energy or economic value. For the products considered in this study, where it was not possible to use system expansion, the allocation based on economic value was used as it can be verified later.

2.2 Inventory analysis

The life cycle inventory analysis and, subsequently, the life cycle impact assessment have been performed using the SimaPro 8.5 software and associated databases and methods (PRé 2017).

Data type/data collection

Meat, fish and eggs is a shelf of the food wheel and some of them are represented in Figure 3. A portion of raw meat or fish corresponds to 30 grams and a portion of egg is 55 grams that means 1 egg (DGS/DGC 2014). The recommended and equivalent daily of meat or eggs are 1.5-4.5 portion. The lower number is intended for children (1 to 3 years old) and the higher number for younger's and active men.

Figure 3 - One portion of raw meat or fish (30 gr) and egg (55 gr) in the Food Wheel (adapted from DGS/DGC 2014)

Datasets for the products and processes included in the system boundaries were taken from LCA Food DK Project (Nielsen et al. 2003), except for eggs, where an adaptation of Agri-footprint version 4.0 (economic allocation) project (Blonk Agri-footprint BV 2017a) was used, because they don´t exist in the LCA Food DK Project, as shown in Table 1.

Table 1 - Datasets for the system in study

Process/Product in supermarket	Equivalent process	Source
Cow tenderloin	Beef tenderloin (oksemørbrad), fresh, in superm (of project LCA Food DK)	SimaPro 8.5 (LCA Food DK Project)
Pork tenderloin	Pork tenderloin (svinemørbrad), fresh, in superm (of project LCA Food DK)	SimaPro 8.5 (LCA Food DK Project)
Chicken	Chicken, fresh, in supermarket (of project LCA Food DK)	SimaPro 8.5 (LCA Food DK Project)
Eggs	Consumption eggs, laying hens >17 weeks, at farm/NL Economic (of project Agri-footprint - economic allocation) + Truck 16 t (from farm to supermarket	SimaPro 8.5 (Agri-footprint (economic allocation) project) adapted
Codfish	Cod, fresh, in supermarket (no quotas) (of project LCA Food DK)	SimaPro 8.5 (LCA Food DK Project)
Mackerel	Mackerel, fresh, in supermarket (no quotas) (of project LCA Food DK)	SimaPro 8.5 (LCA Food DK Project)
Lobster	Lobster, fresh, in supermarket (no quotas) (of project LCA Food DK)	SimaPro 8.5 (LCA Food DK Project)

Beef tenderloin (oksemørbrad), fresh, in superm – in this process the cattle meat is produced in Danish dairy farms and slaughtered in a local slaughterhouse. Tenderloin is considered an expensive cattle meat. The value of different parts of the cattle varies and the environmental impacts associated with each type of cattle meat has been determined by price allocation.
Pork tenderloin (svinemørbrad), fresh, in superm - in this process pigs are produced in Danish agriculture and slaughtered in a local slaughterhouse. The value of different classes of pork varies and the environmental impacts associated with each class of pork have been determined by price allocation.
Chicken, fresh, in supermarket – Chicken meat is produced by slaughtering the chicken produced in Danish agriculture.
Consumption eggs, laying hens >17 weeks, at farm/NL Economic + Truck 16 t - This process describes the eggs production in an average laying hen system in the Netherlands and their transport to supermarket. The system produces eggs as well as chickens which are slaughtered for meat. This requires allocation of the environmental impact to the products. The allocation type chosen was economic allocation (Blonk Agri-footprint BV 2017b).
Cod, Mackerel and Lobster fresh, in supermarket – Cod fishery is the most important process but a variety of other fish (codfish, mackerel, lobster, etc.) are caught as side catch during Danish cod fishery and the environmental impacts associated exclusively with codfish have been determined by system expansion. The other categories of fishery (mackerel, lobster, etc.) have side catches as well and the environmental exchanges associated with these "secondary side catches" have also been eliminated by system expansion.

2.3 Life cycle impact assessment (LCIA)

The method chosen for environmental impact assessment was IPCC 2013 GWP 100a (Pré 2017, IPCC 2013) which was developed by the Intergovernmental Panel on Climate Change. It contains the climate change factors of IPCC with a timeframe of 100 years. The Global Warming Potential (GWP) is defined as the time-integrated radiative forcing (RF) due to a pulse emission of a given component, relative to a pulse emission of an equal mass of CO_2 (Figure 8.28a and formula in IPCC (2013) report). In table 8.A.1 of that report (pp. 731), the updated GWP values are shown for common GHG in different time horizons, together with those for the alternative metric global temperature change potential (GTP).

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3. RESULTS AND DISCUSSION

Figure 4 represents the comparative contribution to climate change of a portion (30 gr) of different kind of meat and fish and a portion (55 gr) of egg (1 egg) in supermarket.

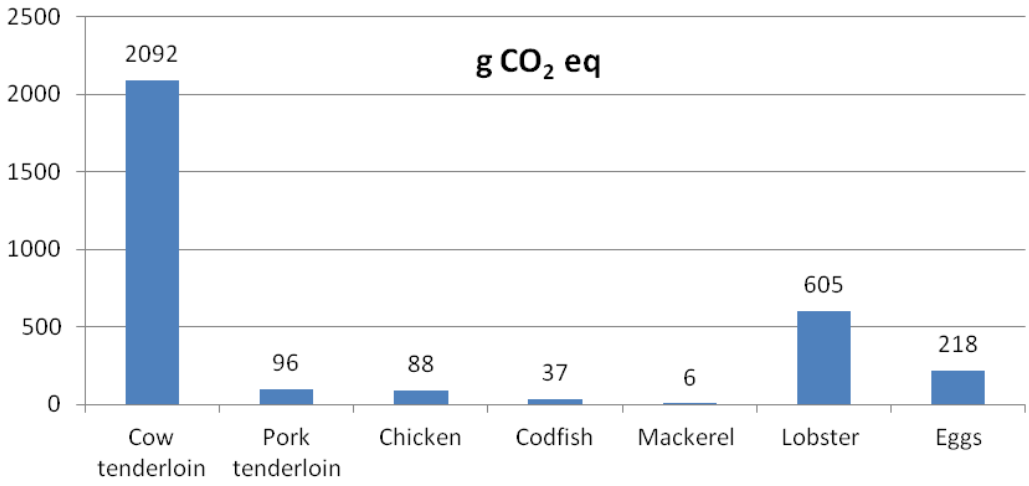

Figure 4 - The contribution of a portion of meat and fish (30 gr) and 1 egg (55 gr) to climate change (IPCC 2013 GWP 100a method)

Figure 4 shows that a portion of cow tenderloin is the one that most contributes to climate change (2092 gCO_2 eq / portion) and in opposite side, a portion of mackerel (6 gCO_2 eq / portion) is about 350 times more environmental friendly than a portion of cow tenderloin. A portion of chicken or pork tenderloin is either more environmental friendly than one egg. It should be noted that the datasets for eggs were taken from Agri-footprint project while all others came from LCA Food DK Project, as mentioned before.

Cattle farm on sandy soil, is the process that most contributes (89.3%) to climate change of a portion of cow tenderloin and fertilizer (N) represents 18.8 % of that. Pig farm on sandy soil account for 43.4% of climate change of a portion of pork tenderloin and grower pig contribution is about 22.5%. Chicken farm accounted for almost 80% of climate change of a portion of chicken where live stock feed (wheat) represents 46.7% of that. Diesel combusted in fishing vessel is the process that most contributes for climate change of a portion of codfish (78.3%), mackerel (65.6%) and lobster (82.7%). Transport process by road (truck) only has a significant contribution for climate change of mackerel where it represents 19.5% of total impact.

CONCLUSIONS

For a more sustainable consumption Life Cycle Assessment methodology was applied to quantify and compare the contribution to climate change of one portion of what you eat overall coming from the shelf of Food Wheel related with meat, poultry, fish and eggs to achieve a healthy, balanced diet.

The main conclusion of this study is that life cycle impact assessment, using the IPCC 2013 GWP 100a, is a method that can help the people to choose the best food for a meal that is more environmentally friendly helping to mitigate global warming. It has been shown that eat a portion of mackerel is the best option for the shelf of Food Wheel related with meat, fish and eggs and a portion of meat (cow tenderloin) is about 350 times worse in terms of global warming. Eat an egg is more environmentally friendly than eat a portion of cow tenderloin or lobster but it is worse, for global warming, than eat a portion of pork tenderloin or chicken or other fish species considered in this study.

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