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The nutritional footprint – integrated methodology using environmental and health indicators to indicate potential for absolute reduction of natural resource use in the field of food and nutrition

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ABSTRACT

The field of nutrition will face numerous challenges in coming decades; these arise from changing lifestyles and global consumption patterns accompanied by a high use of resources. Against this background, this paper presents a newly designed tool to decrease the effect on nutrition, the so-called Nutritional Footprint. The tool is based on implementing the concept of a sustainable diet in decision-making processes, and supporting a resource-light society. The concept integrates four indicators in each of the two nutrition-related fields of health and environment, and condenses them into an easily communicable result, which limits its results to one effect level. Applied to eight lunch meals, the methodology and its calculations procedures are presented in detail. The results underline the general scientific view of food products; animal-protein based meals are more relevant considering their health and environmental effects. The concept seems useful for consumers to evaluate their own choices, and companies to expand their internal data, their benchmarking processes, or their external communication performance. Methodological shortcomings and the interpretation of results are discussed, and the conclusion shows the tools' potential for shaping transition processes, and for the reduction of natural resource use by supporting food suppliers' and consumers' decisions and choice.

1. Introduction

Today, total resource use is about 4–5 times higher than the suggested sustainable level, and scientists agree that changes have to be undertaken in all fields as soon as possible (Bringezu, 2011). The relation between the volume of natural resources used by the human economy and the degree of environmental effect has already been stated in the late 1960s (Ayres and Kneese, 1969). Today, the discussion on the topic of transition to sustainability (Schneidewind and Scheck, 2012) is often focussed on the fields of mobility, housing, nutrition and even leisure-time activity (Buhl, 2014; Kotakorpi et al., 2008; Leismann et al., 2013; Røpke, 2009) owing to their high share of the overall resource consumption. A fundamental change in the fields is required, which may lead to a transformation of our economic system, culture and lifestyle (Fuchs and Lorek, 2005; Geels, 2011; Rohn et al., 2013a,b). The Sustainable Development Goals (UNEP, 2013) focus on health and environmental indicators relating to specific targets and indicators for food, water, agriculture, but also on management systems, which encourage current behaviour and business implementation, which are insufficiently integrated and remain very abstract in every field of action. Consequently, a sustainable Material Footprint framework of '8 tons per person and year' owing to the different fields of consumption and depending on the situation and requirements of each household seems reliable within this examination (Lettenmeier et al., 2014). This paper will, therefore, focus on the food and nutrition sector which accounts for 29% of the global

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emission of greenhouse gases (GHG), and for a high use of water and land, and so a high resource use (Carlsson-Kanyama and Gonza, 2009; Giljum et al., 2009; Hoekstra and Mekonnen, 2012; Vermeulen et al., 2012). Additionally, it should be underlined that if nutrition is to develop towards sustainability, environmental and health aspects should be considered in relation to each other (Leitzmann and Wirsam, 2011). However, currently available conceptual drafts only consider one field of investigation and are limited to their field of scientific expertise. Reflecting this precondition, this paper will present the newly established approach, which integrates health and environmental indicators. In the first sections, this paper provides an overview of health and environmental aspects in relation to sustainable nutrition. In Section 3, a closer look is taken at the materials and methods used to compose the Nutritional Footprint. Section 4 then gives details on the calculation of the Nutritional Footprint of eight German lunch meals, and the reduction potential resulting from the results of the indicators. Finally, the final conclusions and outlook are presented in Section 5.

2. Background and theoretical framework

2.1. Objective – sustainability of nutrition

When allocating sustainable levels of natural resource consumption to different consumption fields, such as mobility, housing, and leisure-time activity, the field of nutrition which probably includes the most basic needs humans have, plays a special role; it might not be reduced to the same degree as other fields of action. For instance, Kotakorpi et al. (2008) show a smaller elasticity in the area of nutrition with a factor of 3, in comparison to a factor of 85 for mobility. Interestingly, the indication from the scientific evaluation of nutrition and public health science and environmental science generally point in the same direction; the reduction of consumption rates of meat products or the reduction of food waste are deemed important for the future in both fields (e.g. Bernstad and Jansen, 2011; FAO, 2013; Gustavsson et al., 2011).

However, the determination of absolute levels or benchmarks for sustainable production and consumption is complex and not unambiguous (e.g. Bringezu et al., 2009; Lettenmeier et al., 2012a, 2012b; Nissinen et al., 2007; Rohn et al., 2014), especially when attempting to implement general sustainability targets to a level of specific consumption components such as several meals or dishes (Macdiarmid et al., 2011; Risku-Norja et al., 2010). Thus, a footprint tool, which condenses the results of health-related and environment-related indicators into an easily communicable result and limits its results to one effect level is desirable.

This is one of the central issues of this paper, as the evaluation on the level of diets and meals is essential for making sustainable nutrition feasible. Arising from these indicators, the main objective in this paper is an initial methodical exploration of the dimensions of 'health' and 'environment', and a first methodological combination of both by using adequate indicators in one footprint tool.

2.2. Health indicators to be considered in the field of nutrition

The health characteristics of nutrition have been the main object of discussion for a long time, and various indicators have been used to describe them. For this study, we have analysed several indicators suitable for the assessment of health characteristics of a regular diet, the '*daily energy intake*', the indications of '*dietary fibre*', '*folate*' or '*iron*' or even the '*sodium intake*' and the indicator of '*saturated fat*'.

The basis of indicators and nutrition recommendations for several age groups is globally and nationally robust and is updated regularly; this is due to the long research history of nutrition science with intervention and in vitro studies although such knowledge is not exhausted. The choice presented has been made with the view of integrating the most common indicators (food energy) and the ones which are analysed have being relevant in the current debate in nutrition science (dietary fiber or vitamin B12). The indicators analysed are very different in their alignment and in their expressiveness. The indicator 'energy', one of the most often measured intake factors in nutrition surveys, displays the overall energy contained without any further differentiation. Other indicators such as 'saturated fat' display a negative effect while indicators such as 'dietary fibre' denote a positive effect on health of a food product.

The need for energy from food intake is individual and affected by different factors—physical activity (Leitzmann et al., 2009). The majority of consumers are familiar with kilocalories (kcal), and the indicator 'energy' can generally be seen as one of the most important indicators (Max Rubner-Institute, 2008a, 2008b). Nowadays, the availability of food products, which means food 'energy' is higher than it has ever been before, and obesity causes five percent of all deaths (Hill et al., 2012). The indicator of 'saturated fat' is relevant because a high intake of saturated fatty acids is responsible for a high cholesterol level, which can increase the risk of cardiovascular disease. These acids are mainly found in animal products such as meat, butter and cream (Mozaffarian et al., 2010; Skeaff and Miller, 2009). 'Sodium' is a relevant indicator as high salt input is a common problem worldwide, and the intake level in industrialised countries is significantly higher than the recommendations of WHO or national agencies. The content of 'dietary fibre' is a positive indicator in evaluating food products. The presence of dietary fibre increases the food volume without increasing the energy content, while binding relatively large amounts of water; this leads to directly increased satiety. Folate, iron and vitamin B12 are currently in the focus of nutrition science (Elzen et al., 2010; Koletzko et al., 2013; Waldmann et al., 2004).

2.3. Environmental indicators to be considered in the field of nutrition

The environmental characteristics of nutrition have not been a central object of scientific debate although they were considered more intensively for some years. In the discussion on agricultural and food systems and nutrition, several environment-related indicators are useful. After intensive exploration, four macro indicators with a high relevance for the environmental effect of food production and consumption have been identified from literature sources and in terms of applicability: *'Carbon Footprint'*, *'Material Footprint'*, *'Land use'* and *'Water Footprint'*. These indicators have several underlying types of methodology that may be applied; therefore, it was important to analyse these different types of methodology to reveal their respective relevance for the Nutritional Footprint.

The 'Carbon Footprint' is the overall amount of GHG associated with a product life cycle. From the different standards defining the Carbon Footprint, the ISO 14067 was chosen as the most recent guideline and the one, which allows consistent results (Goedkoop et al., 2009). The Carbon Footprint has become increasingly popular and is well accepted in scienctific and industrial fields (Schmidt, 2008), but as an output indicator related to just one environmental effect it has to be supplemented by using a comprehensive input indicator to analyse abiotic and biotic material flows in broader terms. With regard to this issue, the 'Material Footprint', which is based on the 'MIPS concept' (Material Input Per Unit of Service), was considered as a complementary indicator. Thus, a combination allows an approximate assessment of the overall environmental

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