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Assessing Indicators and Limits for a Sustainable Everyday Nutrition

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ABSTRACT

Human nutrition is responsible for about 30% of the global natural resource use. In order to decrease resource use to a level in line with planetary boundaries, a resource use reduction in the nutrition sector by a factor 2 is suggested. A large untapped potential to increase resource efficiency and improve consumers' health status is assumed, but valid indicators and general guidelines to assess these impacts and limits can barely be found. Therefore we will have a try to define sustainable limits towards the individuals' daily diet and therefore stimulate current available scientific debate.

Within the paper an examination of existing indicators and assessment methods is carried out. We set the focus on health indicators, such as energy intake, and environmental indicators, such as the carbon or material footprint. The paper aims to provide first, an assessment of core indicators to explore the sustainability impact of foodstuff, and second, a deeper understanding and a discussion of sustainable limits for those dimensions of food and nutrition. Therefore we will discuss several ecological and health indicators which may be suitable to assess the sustainabilty impact and indicate differences or similarities. As a result it becomes obvious that several ecological indicators "point in the same direction" and therefore a discussion about the variability and the variety of these indicators has to be faced in the future. Further the definition of sustainable levels per indicator is an essential aspect to get an idea about the needed barriers for a sustainable nutrition, by now first steps had been made, but no binding guidelines are available yet. Therefore the paper suggests a few indications to set up sustainable levels for health and environmental indicators, based on the idea to reduce the resource use level up to 30-50% in 2030.

Keywords*: food, nutritional footprint, footprints, resource-efficiency, resource conservation, natural resource use, sustainability indicators, sustainable levels*

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1 Introduction

By actively considering sustainability principles and proposing sustainable meals, the food and nutrition sector has the potential to realize the concept of "sustainable development" in the consumers' everyday life (Leitzmann 2014). To achieve sustainability goals, it is necessary to take into account the highly diverse actors in the production and consumption of food. Besides technical improvements and a reduction of food losses in the food chain, diet shifts offer practicable opportunities to reduce environmental impacts in the agri-food sector. Within this paper we analyse environmental and health core indicators and the "sustainable levels" required – within both indicator sets[1]. Therefore we will give a brief introduction into the debate about sustainable nutrition (section 2) and present the methodological background (section 3). The next section (section 4) will point out the current results divided into two sections: core indicators and their relation to each other (section 4.1) and the definition of sustainable levels (section 4.2). The discussion (section 5) will reflect the ideas shortly. The paper is led by following research questions:

- *Which indicators could be defined as core indicators to assess impacts and improve the sustainability of foodstuffs and diets?*
- *Which sustainable levels in the field of nutrition are currently available and discussed and which target areas are suggested?*
- *How should "sustainable levels" for a more sustainable nutrition be designed?*

2 Background

The concept of a healthy and environmentally sustainable diet is not new. However, it has gained increasing concern, due to e.g. future scenarios about global food security and climate change which point out a renewed interest in this topic (Macdiarmid 2013). More and more studies suggest diets which contain a lower content of animal-origin foods and a higher content of plant-based foods. This could both prevent chronic diseases and reduce mortality as well as decrease environmental impacts (Tukker et al. 2011, Masset et al. 2014). Thus, more healthy dietary patterns and recommendations, such as the pattern of a Mediterranean (Dernini & Berry 2015) or the recommendations of the Nordic diet (Mithril et al. 2012), seem to produce smaller environmental impacts than the common less healthy eating patterns. Macdiarmid et al. (2012) show that diets meeting dietary requirements for health also may have a lower environmental impact. Thus, it cannot be assumed that a healthy diet will always have a small environmental impact, especially due to the fact that general data is still missing. With different combinations of food products it is possible to consume a diet that meets dietary requirements for health, but has a high environmental impact (Vieux et al. 2013). By now, studies suggest that e.g. the sustainability of food production depends on the extent to which production impacts the environmental needs of a region or from how dietary eating patterns are indicated[2]. Against this background it is important to understand the correlation of food production and consumption and what constitutes a sustainable diet and how supply chains and production methods do have an effect. Unfortunately recent studies often draw system boundaries narrowly (Tom et al. 2015) and try to illustrate the status quo of diets and consumption patterns with regard to environmental impact, but do not report or suggest any sustainable levels or limits for nutrition. When nutrition is regarded under the consideration of health and environmental consequences, it is usually not pointed out where the corridor of a sustainable diet ends or where an unsustainable diet begins. This rating is only done for the health dimensions according to general recommendations made by FAO, WHO or national institutions such as DGE (German Association for Nutrition).

[1] By now, we exclude social and economical indicators to reduce the complexity of the topic.
[2] Several studies use several measuring units (kilocalories or GHGE) and thus create results, which are by now not comparable and which do not reflect the complexity of nutrition as a whole.

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So far, recommendations are missing on the ecological side and there are no highly professionalized binding guidelines. Furthermore, indicators to improve those environmental rating processes have not been adopted yet and concepts lack of a definition of ecological targets or what is called "sustainable levels" in Lukas et al. (2015). Therefore this paper will try to give an overview onto core health and environmental indicators, which may be useful for science and business.

3 Methods

3.1 Selection of indicators

The idea to select valid and meaningful indicators for the health and environmental was set in 2013 by Rohn et al. Afterwards a comprehensive desk research was conducted and a variety of economic, social, environmental and health indicators as well as relevant (multi-dimensional) concepts have been analysed. To get a satisfying number of relevant concepts and indicators, an expert workshop was hosted in July 2015 to further evaluate the desk research. Within this paper, we will present the findings considering the health recommendations made in several studies, e.g. Macdiarmid et al. 2012, Lukas et al. 2015, Scheiper 2015.

Regarding ecological indicators, some of these can easily be assessed using life cycle assessment (LCA) software like Umberto, GaBi or openLCA in connection with LCA databases like Ecoinvent or GaBi-Databases, as the most widely used indicators and many processes are implemented. However some input based indicators like the resource use respectively the material footprint have not been implemented up to now, so that an adaption of the database is needed for the calculation, as can be seen in Wiesen et al. (2014) and Saurat and Ritthoff (2013).

3.2 Estimation of sustainable levels

After the selection of indicators we focussed on the assessment of sustainable levels for a distinct group of indicators. This was made on the basis of several existing proposals for resource consumption. The estimation of sustainable levels for different indicators is based on the idea that in most industrialized countries the Total Material Consumption (TMC) is exceeding environmental limits (Bringezu 2009). Lettenmeier et al. (2013) state, that with a change in our individual lifestyles a sustainable level of natural resource use by households is achievable. Since most of production and consumption activities of an economy can be attributed to private households (Lettenmeier et al. 2014) a reduction of resource use on the household level seems to be a good starting point for the establishment of sustainable levels.

For most fields of consumption (e.g. housing, mobility, leisure activities) the system of household consumption per person per year offers a suitable analytical framework. In the field of nutrition, however, is seems reasonable to further break down the sustainable levels to single meals or per person per day/week in order to ensure the applicability and the comprehensibility of the method. For instance, when comparing the sustainability of diets, information is usually provided per 100g. Most foods, however, are not consumed in 100g quantities. Besides, low-calorie food such as salad or vegetables is usually consumed in a larger quantity than high-calorie food such as meat. Therefore, some studies suggest using other reference units for the comparison of health and environmental impacts of food (such as 1000 kcal). To avoid this problem, we use a "meal portion" as a reference. This reference unit is per lunch meal about 600g per Person.

4 Current Results

In the following section we present core indicators that serve to assess the environmental and health impacts of nutrition. Within the research process, we first identified indicators that are relevant within the current

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scientific debate. To ensure the applicability of the method and avoid unnecessary costs and efforts, it seemed particularly important to select indicators that do not “point in the same direction” but provide different information. For this purpose, we subsequently compared the selected indicators and the implications they led to in order to identify a practicable and informative set of indicators.

4.1 Selection of core health indicators

According to the long research history of nutrition science various indicators can be used to describe the health characteristics of nutrition. To select the most suitable ones, the following selection criteria were important: relevance (within the scientific discussion), measurability and practicability (e.g. for catering companies) and comprehensibility (for consumers). After an extensive screening phase (described in Lukas et al. 2014) we propose different sets of indicators, which seem to be useful for science and business. Generally, the assessed health indicators can be divided into two groups: Where some indicators assess the influence of individual nutrients (e.g. ‘salt content’ or ‘sugar content’), others regard the different food groups and often combine multiple indicators into one (e.g. ‘proportion of fruits and vegetables’).

One of the most important and common indicators is the indicator ‘energy intake’ (measured in kilocalories or kilojoule). It is often used within studies, as a factor to display eating patterns and for a several distinction of food products, especially in reviews regardings obesity and adipositas to display the overall ‘energy content’ (Hill et al. 2012, Lukas et al. 2015). Daily calorie requirements depend on individual factors such as activity level, sex, age and body mass index. Hence, it is another possibility to look at the ‘energy density’ of a meal and calculate the amount of energy (kcal or kJ) per weight unit (g) (Scheiper 2015)[3]. Within this concern, convenience food, fast food or sweets for example, often have a high density of energy since they contain a high amount of sugar and/or fat. By contrast, natural products usually have a low energy density, but contain a lot of nutrients and fibres. The indicator ‘energy density’ therefore indirectly includes other indicators such as, ‘sugar content’, ‘fat content’ or ‘fibre content’.

Another relevant indicator regards the amount and the quality of fatty acids. Lukas et al. (2015) considered the indicator ‘saturated fat’ as particularly important. A high intake of saturated fatty acids is responsible for a high cholesterol level, which can increase the risk of cardiovascular diseases (Mozaffarian et al. 2010; Skeaff and Miller 2009). Moreover, also the amount of total fat and trans fatty acids in a meal can be connected to nutrition related diseases, obesity and adiposities. Scheiper (2015) therefore suggested to examine the total fat content and to include the ‘amount of total fat’, ‘polyunsaturated fatty acids’ and ‘trans fatty acid’ as additional indicators.

Since the intake level of salt and sugar in industrialized countries is significantly higher than national and international agencies recommend (WHO 2014), the indicators ‘sugar content’ and ‘salt content’ are also important. The content of ‘dietary fibre’ is another important indicator because fibre-rich food usually has a high food volume without containing a lot of kilocalories. Fibres also decrease the risk for colon cancer, high blood pressure and coronary heart diseases, increase satiety and improve digestion (Leitzmann et al. 2009).

Other relevant individual indicators that evaluate the health impact of food are the indicators ‘vitamins’, ‘secondary plant substances’ and ‘minerals’. In practice, however, the calculation of these indicators can be difficult. To still include as much relevant individual indicators as possible without increasing the complexity for consumers, a near choice would be to use aggregated indicators that combine multiple indicators. The indicator ‘amount of fruits and vegetables’, for example, offers the possibility to cover a wide range of health

[3] Nevertheless we have to face within this debate that in the western and countries the energy intake is constantly rising within the last 30 years. Also the insufficient supply with food and the consequential malnutrition is still one of the most important problems, the debate of a sustainability impact of nutrition has to be sure. We resume the appropriate amount of energy intake is still one of the most important influential factor to take into account.

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characteristics. For one thing, the consumption of fruits and vegetables decreases the risk for diseases such as colon cancer, high blood pressure or coronary heart diseases. At the same time, the indicator ‘amount of fruits and vegetables’ directly and indirectly gives information about individual indicators such as ‘vitamins’, ‘minerals’, ‘secondary plant substances’, ‘fibre content’ or ‘energy content’ (Scheiper 2015).

In conclusion, it seems reasonable to combine the use of individual and aggregated indicators. Even though aggregated indicators might involve some effort and costs for catering companies, they usually cover a very wide range of information without increasing the complexity for consumers. Against this background, the most suitable health indicators seem to be the ‘energy content’ or ’energy density’, the ‘salt content’, the ‘fibre content’, the ‘fat quality’ (e.g. the amount of ‘saturated fat’) and the ‘amount of fruits and vegetables’.

Table 1 gives an example of meals and several core health indicators. The display of all core indicators shows how they are correlated and linked to each other. Within the debate about the amount of core indicators, the question is raised, how many indicators are needed in total. Coming from a scientific view, it may be the most useful to calculate a broad set of indicators, to illustrate the most comprehensive perspective, but coming from a business perspective, a minimum of indicators is applicable and useful. Therefore a collection of indicators, which point into the same direction seems useful.

Table 1: Health data of different lunch menus (own estimation, based on Souci/Fachmann/Kraut 2008)

	Portion weight (g)	Energy intake (kcal)	Salt content (g)	Saturated fat (g)	Fibre content (g)	Amount of fruits and vegetables (g)
Veggie-Lasagne	570	502	3.0	7.1	8.6	340
Beef roll	590	697	2.4	6.8	5.9	130
Salad with chicken	570	494	1.6	4.6	6.7	180
Fish menu	570	510	2.6	14.7	5.8	130
German stew	570	280	2.1	2.6	8.5	220
Spaghetti bolognese	560	881	3.6	9.4	8.4	130
Vegetarian asian wok	560	640	2.2	3.5	15.8	330
Sweet meal (milk rice)	560	532	0.3	2.4	6.2	150

The examples given in Table 1 illustrate different lunch menus (Vegetable lasagne plus a small salad; Beef roll with potatoes and red cabbage; Large salad with turkey and baguette; Breaded sea fish filet with remoulade, potatoes and broccoli; German stew with vegetables and meat; Spaghetti Bolognese plus a small salad; Brokkoli-Tofu-Wok with rice; Milk rice with apple sauce). The examples point out relations between the indicators. The indicator ‘energy intake’, for example, is related with any of the other indicators directly, indirectly it is related to the fat content. The two indicators (‘salt content’ and ‘saturated fat’) – which state a negative impact on health – show several relations in comparison to “positive” indicators such as ‘fibre content’ or ‘amount of fruits and vegetables’. Furthermore the two positive/negative indicators do not regularly “point into the same direction”: The menu with the highest content of salt and saturated fat (Menu 6) still has a high amount of dietary fibres despite having a rather low proportion of fruits and vegetables. Overall, the chosen indicators do not seem to overlap, but to provide different information.

4.2 Selection of core ecological indicators

Studies assessing diets regularly use the indicator of greenhouse gas emissions (GHG) to illustrate the level of impact on the environment. However, we would like to compare a few ecological indicators to include different aspects of environmental pressure (e.g. climate change, resource use, land use) and furthermore assess the suitability of input based indicators.

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The indicators biotic and abiotic material input regard the resource use according to the MIPS concept (Material Input per Service Unit, Liedtke et al. 2014), and are thus input-based indicators. The abiotic input considers all mineral resources, including economically used resources as well as unused extraction like overburden from mining processes, whereas the biotic input sums up all biomass from cultivated as well as uncultivated areas that is taken from the ecosystem (Schmidt-Bleek 1998). These two indicators can be called the material footprint when added up (Lukas et al. 2015).

Furthermore the carbon footprint as an output based indicator, which is widely used and regards the greenhouse gas emissions (according to IPCC 2007) was regarded.

Water withdrawal as used here is calculated according to MIPS concept but excludes rainwater and all water used to drive turbines (also see Wiesen et al. 2014). It includes all water withdrawal including fresh, ground water and salt water taken from the environment for the use in the supply chain of a product and is given in kg or t of water.

Land occupation takes into account the land occupied during one year and land transformation takes into account the area of land transformed from one use to another. Water use and land use indicators also are input based indicators.

The ecological footprint as an aggregated indicator is also regarded more closely. It measures the biologically productive land and water needed as land occupation over time, by taking into account direct land occupation, indirect land occupation related to nuclear energy and CO_2 emissions (Huijbregts et al. 2006).

Regarding the ecological impact of food three aspects are mainly named in discussions as having a positive effect on the environment compared to conventional production: organic production, regional production and seasonal production. So one of the main questions considering the choice of a good indicator on the ecological level is if these aspects also show an impact on the results of the indicators and if so, do the different indicators show similar results when considering organic, regional and seasonal production. To assess and compare the indicators and their suitability to display differences in the supply chain, the production of potatoes was calculated as an example using available processes in the Ecoinvent database. Other products, e.g. other kind of vegetables or fruits or animal-based products such as chicken meat, show nearly similar results, this example was chosen as a comparison of organic as well as conventional production and the impact of storage can be made and thus can illustrate the differences well.

As can be seen the values for organic and conventional, regional, fresh or stored potatoes vary for most indicators (see table 2).

The biotic input, land occupation, land transformation and ecological footprint however show a relevant difference only for organic and conventional production. Transport almost has a small impact, despite the products are transported by plane. The same assumption is made for the storage as long there are no very long lasting energy intensive cooling processes involved . These three indicators show similar results and mainly indicate agricultural land use and production, for this reason also displaying a lower value for conventional than for organic production.

Water withdrawal is also mainly connected to agriculture, thus showing a high variation between conventional and organic produced potatoes (with a high impact for conventional production) but only low impacts for storage and transportation. However, the lack of specific data for potato production in Israel and Spain means that the total influence of different production regions cannot even be displayed here. For instance in Israel and Spain there might be a higher need for water in production but also a higher yield because of warm growing temperatures.

The abiotic input and the carbon footprint show in comparison to the other screened indicators the most deviating results, also displaying that transport and storage have an influence on the environment. However,

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the difference for organic and conventional production is rather low in the results of the carbon footprint compared to the other indicators.

Two aggregated indicators - the material footprint and the ecological footprint - were assessed. The ecological footprint aggregates three indicators - greenhouse gas emissions, land occupation and nuclear - into one, making it a hard to grasp indicator. Furthermore because of the high impact of land occupation the overall ecological footprint is lower for conventional than for organic production, showing very different results compared to the carbon footprint and the abiotic material input. The material footprint as overall material input is easier to grasp and by combining the abiotic and biotic input the disadvantage of organic production – a higher biotic input – is also taken into account.

To conclude, some indicators point into the same direction (e.g. biotic input, land use, land occupation) and assessing all of them does not necessarily lead to a further gain in information. Also the input based indicator abiotic material input and the emission based calculation of the carbon footprint both show a high diversity for the given example, so that it can be said that both approaches lead to valid and differentiated results both taking into account the different aspects of production in the supply chain. Aggregated indicators like the ecological footprint are often harder to understand and can thus lead to less transparent results. Due to this the most suitable and transparent indicators seem to be the material footprint split in abiotic and biotic material input, the carbon footprint and as further indicators water use and one land use indicator could be used (see also: Tukker et al. 2015), which are both very important to map agricultural processes.

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Table 2: Ecological indicators for potato production: influence of organic, regional and seasonal production (own illustration, based on ECOINVENT data 3.3)

	Material Footprint			**Carbon footprint in kg**	**Water withdrawal in kg**	**Land occupation in m^2/a**	**Land transfor-mation in m^2/a**	**Ecological footprint**			
Values per kg potatoes	**abiotic input in kg**	**biotic input in kg**	**Material footprint in kg**					**CO_2 - total, converted into m^2a**	**land occu-pation - total in m^2a**	**nuclear - total in m^2a**	**Eco-logical footprint TOTAL in m^2a**
Potato, organic*, regional (Germany), fresh	0.30	1.16	1.46	0.14	0.71	0.56	2.02	0.17	1.21	0.04	1.41
Potato, organic*, regional (Germany), stored	0.40	1.17	1.57	0.15	5.25	0.56	2.02	0.19	1.22	0.09	1.50
Potato, conventional**, regional (Germany), fresh	0.62	1.10	1.72	0.17	233.84	0.28	0.59	0.30	0.61	0.07	0.98
Potato, organic*, transported by boat (Israel), fresh	0.64	1.16	1.80	0.22	1.38	0.56	2.02	0.37	1.22	0.05	1.64
Potato, conventional**, regional (Germany), stored	0.72	1.10	1.82	0.18	238.39	0.28	0.59	0.33	0.61	0.12	1.06
Potato, conventional**, transported by boat (Israel), fresh	0.95	1.10	2.05	0.25	234.51	0.28	0.59	0.51	0.61	0.08	1.20
Potato, organic*, transported by truck (Spain), fresh	1.73	1.17	2.89	0.39	2.76	0.56	2.02	0.81	1.22	0.08	2.11
Potato, conventional**, transported by truck (Spain), fresh	2.04	1.10	3.14	0.43	235.89	0.28	0.59	0.94	0.62	0.11	1.67

*: the calculation of organic production is based on data for Switzerland; **: the calculation of conventional production is based on data for the USA

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4.2 Design of sustainable levels for nutrition

After the selection of core indicators, which illustrate the health and environmental impacts of nutrition and meals, the second important step to illustrate the concept of sustainable nutrition is the qualitative and quantitative definition of sustainable levels for a environmental-friendly diet.[4]

As nutrition is an essential need and the input cannot be ever reduced, setting sustainable levels is especially important for this field of activity. However, depending e.g. on gender, size and age as well as physical activities of individuals different nutritional inputs are necessary, which should also be accounted for. To be practically applicable the levels for nutrition should be set in a way that it is possible for a person to reach them while covering the energy intake he or she requires. It should be possible to personally monitor them on a daily basis, i. e. they should be broken down to values per week, day or meal. Seeing the health dimension, for nearly every kind of the indicator, general recommendation are made by several international and national authorities (such as FAO, WHO, DGE) exist per person, meal, day, or week. For the environmental dimension no guiding or universally accepted principles for the environmental indicators exist, e.g. such as now for a binding global climate goal (Paris Agreement – UN 2015).

The debate on the scientific level was stimulated during the last few years. Lettenmeier et al. (2014) had established target corridors for several fields of action such as nutrition, housing, leisure or mobility only for the material footprint (see also for more general target levels: Bringezu 2015). They give recommendations of a sustainable material footprint of 8 t per person and year for Finnish households reducing today's footprint by 80 %. The recent resource consumption rate for nutrition is 16 kg/d/cap, what means recently 16 kg of resources are consumed per day and person. They furthermore tried to define sustainable footprints for several fields of action evaluating that a sustainable material footprint for nutrition would be 3 t per person and year, which is a reduction by 49 % of the current state. Further Stricks et al. (2015) propose that "a per-capita target based on the absolute target of 45 billion tonnes TMC would lead to a maximum of 5 tonnes per-capita of material use with a world population of nine billion people in 2050" (Stricks et al. 2015:7). Therefrom they formulate a more ambitious global level to reach a sustainable global resource use, than Lettenmeier et al. 2014 with 8 tonnes per person or Schmidt Bleek's (2009) suggestion of a global per capita threshold value of 6 tons of raw materials. Nevertheless, Lettenmeier et al. (2014) try to break down the general suggestions towards daily field of activity, whereas the other scientific statements remain on a more general level. The different quantitative suggestions reflect the currently ongoing research und scientific debate. It shows that until now there is no common agreement on an overall exact figure for resource use, even all studies shows that there is an tremendous decrease in resource use needed.

Within the paper here, the challenge is addressed to break down scientific knowledge with regard to a definition of sustainable levels in the context of daily nutrition which indicate generally understandable recommendations, such as it is done by the international and national health institutions regarding energy intake or the intake of vitamins, minerals or fibres. For this reason Rohn et al. (2013) and Lukas et al. (2015)

[4] As mentioned in the beginning, the debate about resource use and sustainable consumption lacks guiding recommendations for sustainable limits of resource use, especially on the private, daily consumption level. Seeing the sustainability debate over the last 30-40 years, a lot was done regarding the analysis and evaluation of the status quo and scenario building. However, the discussion about target corridors and sustainable limits was not considered sufficiently. Coming from the idea to set up sustainability recommendations and levels, e.g. Schmidt-Bleek (1993, 2004) and Weterings & Opschoor (1993), also Opschoor (1995), mentioned the definition of the needed environmental utilization space and the MIPS concept (Liedtke et al. 2014). Those concepts tried to design a first corridor to define a sufficient resource use in general. By now new global environmental boundaries are proposed by Steffen et al. (2015)

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tried to define first steps towards sustainable levels per meal, using the current resource use[5] and a future scenario which includes a reduction of 20-75% per person in the field of nutrition.[6] Within that discussion, the same core indicators (as here) where used to illustrate a broad set of indicators. Within that discussion the point which was missing, was an overall definition of sustainable levels and the evaluation of the indicators (done within this paper in section 3 and by Scheiper 2015). Thus, we now would like to define a first version of a qualitative definition of sustainable levels:

*A **sustainable level per environmental indicator** tries to set up a quantitative corridor for usage limits towards daily private consumption, which stays within the planetary boundaries based on current knowledge within a longterm vision until 2050.*
*A **sustainable level per health indicator** tries to set up a quantitative corridor for a healthy private nutrition, which stays within the (inter)national recommendations based on current knowlegde.*

Further, to quantify these qualitative descriptions, the authors used data available for each environmental and health indicator and tried to extrapolated recent consumption values within the amount of 3 tonnes resource use per person in a year proposed by Lettenmeier et al. 2014 for a sustainable nutrition and set up a level and target corridor per day and meal.[7]

Difficulties in defining the sustainable level arise because in literature there exists limited data[8] on how to determine the sustainable level, further challenge arise in the measurement of an indicator, setting a sustainable level. Because of this, some indicators have to be estimated based on literature review.
The table 3 illustrates the current proposals of a moderate sustainable level, based on Lukas et al. (2015) and a more strict sustainable level (based on updates made by Scheiper (2015) and inspired by Stricks et al. (2015).

Table 3: Indicators and Sustainable Levels (selection, own illustration)[9]

Dimension	**Indicator**	**Definition of a moderate Sustainable Level** (Target area: reduction of 20%)	**Unit**	**Ref**
Environment	Carbon Footprint	800 (- 640)	g $CO_{2\ eq}$ / meal	1,7
Environment	Material Footprint	2670 (- 2136)	g / meal	2,7
Environment	Water Withdrawel	640 (- 600)	l / meal	7
Environment	Land Use	1,25 (- 1)	m^2 /meal	7
Health	Energy intake	670 (- 600)	kcal / meal	6
Health	Salt intake	< 2	g / meal	1,4
Health	Fibre content	8 (- 9)	g / meal	1,4
Health	Fat content/	< 6,7 (max. fat content of a meal: 24 g)	g / meal	

[5] Within that debate assessment methods stated by Meier et al. (2014) or Müller (2015) which validate meals and foodstuff with respect to sustainability issues extrapolate national sustainability goals for a target allocation. Unfortunately, this point of view does cover a national, but not a global perspective for a sustainable nutrition.
[6] For instance, a vegan diets' Material Footprint can be assumed by 6 kg/day, while the Material Footprint for a day of a meat-based diet will hardly be below 15 kg/day. Considering this, a reduction factor 2-3 of present resource use, based on levels in Lettenmeier et al. (2014) is desirable.
[7] Regardless from uncertainties, such as food wastage, etc.
[8] Röckstrom et a. (2009); Lettenmeier et al. (2014); Bringezu (2015) and Steffen et al. (2015)
[9] Basis data, please see Appendix 1

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	saturated fatty acids			
Health	Proportion of fruits and vegetables	> 217	g / meal	6

1 = Lukas et al. (2015); 2 = Lukas et al. (2015) & Rohn et al. (2013) on the basis of Lettenmeier et al. (2014); 3 = DGE (2014); 4 = WHO-Guideline (2015); 5 = aid (2015); 6 = Scheiper (2015); 7= Stricks et al. (2015)

The table 3 gives an overview of selected core indicators and a current assessment of sustainable levels and their target areas. For instance, the sustainable level for the indicator Carbon Footprint proposed here, depicts that the whole supply chain of one meal should not emit more than 800 g CO_{2eq} (as assumed in Lukas et al. 2015). Inspired by latest data[10], we assume that the level should be extended by a kind of target area. Thus, the sustainable level for the Carbon Footprint per meal could vary from about 800g til 640g CO_2 eq per meal based on current results and assumptions. These target areas should illustrate that the sustainable levels should be regarded as a first estimation, but not as a binding, unflexible goal definition.

5 Discussion and Outlook

The paper sheds light on the debate about core indicators to assess the sustainability impacts of everyday nutrition, regarding the health and environmental perspective. Further the paper intends to stimulate the debate about definitions and limits of sustainable levels for nutrition, especially in a combination of the health and environment perspectives. We point out that several health indicators may in a relevant way contribute to the assessment of foodstuff without pointing in the same direction, thus a set of indicators in this field is useful to display. On the other hand, the paper shows that some environmental indicators may point into a similar direction (e.g. biotic input, land use, land occupation) so that a limited amount of environmental indicators may provide a sufficient gain in information. Moreover we draw a picture about the so-called sustainable levels, which shows necessity for further research concerning the general quantitative figures for each environmental indicator as well as the amount in the field of nutrition. Therefrom we argue for a constant rethinking of the sustainable levels, as proposed here with the help of moderate and more strict levels.

Generally a shifting from current consumption patterns to a more sustainable (plant-based and saisonal/regional adapted) eating pattern is needed in western and emerging countries. While our results are intended to stimulate the debate about a sustainable and healthy nutrition, we do draw attention to the need for cooperative efforts to discover and development sustainable levels for nutrition, and to including policymakers, health organisations and consumers to establish recommendations that meet health and environmental objectives.

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[10] Based on updates for health data made by Scheiper (2015) and inspired by the current argumentation stated by Stricks et al. (2015) who suggest a reduction up to 20-40% for the environmental dimension

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Appendix 1

Table A1: Environmental indicators - status quo and targets for a sustainable diet in the future (modified from Lukas et al. 2015)

Topic	Indicator	Referecne year	Recommendation/ Impact		Reference
Carbon Footprint					
Sustainable diet target	Carbon footprint	2050	Reduction of 70%		Macdiarmid et al. 2011
Sustainable diet target	Carbon footprint	2012	Reduction of 36% GHGEs		Macdiarmid et al. 2012
Material Footprint					
			Value kg/(cap*a)	**Value kg/(cap*d)**	
Present Finnish diet	Material Footprint	2005	5900	16.2	Lähteenoja, et al., 2007
Resource cap target	Material Footprint	2050	3000	8.2	Lettenmeier et al. 2014
Land use					
			Value		
Global agricultural land use global	Land use	2030	4,18 billion ha (25 % less meat consumption and less food waste)		Wirsenius et al., 2010
Land use and food consumption	Land use	2012	Minus of 25-3% (5-10m^2/cap/d)(2900 m^2 per capita and year in Germany. The global target is 2000 m^2 per capita and year.)		Noleppa, 2012; von Witzke, et al., 2011
Global overall land use	Land use	-	Minus of 25-30% (from 20 m^2/cap/d)		Rockström et al., 2009
Global cropland	Cropland	2030	0,2 m^2/cap/d	5,5 m^2/cap/a	UNEP, 2014
Water consumption					
			Value /(cap*a)		
Water footprint in developed countries	Water use	2030	Reduction by 25 %		UNEP, 2014
Water footprint sustainable scenario	Water footprint	2050	-2 % compared to 2000		Ercin & Hoekstra, 2014
Water footprint – current status quo	Water footprint	1996-2005	1385 m^3 // 92 % related to agricultural products		Mekonnen & Hoekstra, 2011

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