Healthy, environmentally friendly and socially responsible – how an online tool helps to cook more sustainably

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Health as an incentive for resource-efficient nutrition

Environment and health – these two global fields of action can and must be tackled together as a resource-efficient diet is often also a healthier one [1–4]. In particular, meat-reduced diets [5], such as the „Nordic Diet" [6] or the "Mediterranean Diet" [7], have comparatively low environmental impacts. Compared to a regular mixed diet, a plant-based one has an ecological reduction potential of approximately 20–30% [8–9, supplemented by own calculations]. Some indicators even show a significantly higher reduction (e.g. land use up to 40% [10], NH_3 emissions up to 89% [11]). The less animal protein is consumed, the higher the savings potential. However, plant-based food that contributes to a constitutional healthy diet, such as some vegetables or nuts [12], some fruits as well as fish and seafood [13], can also have a high environmental impact. Practitioners in the out-of-home consumption sector cannot be left alone with this specific assessment. Accounting procedures as well as suitable tools are needed to help identify and compare resource-intensive food and meals and to present alternatives in a transparent manner. Supported by the fact that 43% of Germans regularly eat out of the home [14], the application of such methods in the out-of-home catering sector offers great multiplication effects. Out-of-home con-

Abstract

Every diet has an impact on an individual's health status, the environment as well as on social aspects. In particular, ecological and social concerns are usually only vaguely assessed in the daily routines of out-of-home catering and a systematic sustainability assessment of meals is usually not carried out. Since May 2018, the menu calculator presented in this paper has been supporting stakeholders in various catering establishments with their sustainability assessment. The tool was developed within the NAHGAST project[1] (→ www.nahgast.de) in cooperation with five practice partners and tested and validated by a total of 120 recipes. This article provides an overview of selected recipes' sustainability assessments (meals with fish and meat as well as vegetarian and vegan meals) and highlights the effects on the ecological, health and social dimensions.

Keywords: sustainable nutrition, nutritional footprint, health, environment, out-of-home catering

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[1] The research project NAHGAST – Development, Testing and Dissemination of concepts for sustainable production and consumption in out-of-home catering – had the goal to initiate, support and disseminate transformation processes for sustainable management in out-of-home catering. Over a period of three years (03/2015–02/2018), practical concepts, tools and methods were developed to make out-of-home catering more sustainable but also to make sustainable offers more attractive for consumers. The project was implemented in cooperation with five practice partners.

Dimension	Ecology	Social concerns	Health	Economy[a]
Indicator	• material Footprint (< 2,670 g/< 4,000 g/ > 4,000 g) • carbon Footprint (< 800 g/< 1,200 g/ > 1,200 g) • water requirement (< 640 L/< 975 L/> 975 L) • land requirement (< 1.25 m²/< 1.875 m²/ > 1.875 m²)	• share of fairly traded food (> 90%/> 85%/< 85%) • share of animal welfare-friendly products (> 60%/> 55%/< 55%)	• energy content (< 670 kcal/< 830 kcal/ > 830 kcal) • fat content (< 24 g/< 30 g/> 30 g) • carbohydrate content (< 90 g/< 95 g/> 95 g) • thereof sugar (< 17 g/ < 19 g/> 19 g) • dietary fibre content (< 8 g/> 6 g/< 6 g) • salt content (< 2 g/< 3.3 g/> 3.3 g)	• popularity (no quantified target value) • degree of cost recovery (no quantified target value)

Tab. 1: **Indicators and target values of the calculator** (Basis: [8])
The assessment of the final results is classified as follows: recommendable/less recommendable/not recommendable.
[a] The dimension "economy" was not calculated in the online tool and was therefore not considered in detail in the further course of this paper. This was mainly due to data availability. It was assumed that in the catering facilities examined, both cost recovery as well as a certain popularity of the menus can be assumed.

sumption becomes an important point of reference as the decision what to have for lunch is primarily determined by the available time and monetary budget, although respondents also mention other motives for the selection of food [15–18]. The commonly named Food Environment [19], i.e. the supply in the immediate vicinity, is decisive.

If stakeholders are increasingly helped to expand the range of out-of-home menus to include resource-efficient, tasty and well-placed meals, then guests will make corresponding choices as well [20, 21]. Furthermore, it can be assumed that the large quantities and efficient preparation methods used in out-of-home catering may result in lower additional costs per meal than in private households [22, 23]. Against this background the following **research questions** (Q1 and Q2) arose for the project:

Q1: How can recipes be evaluated regarding their health, ecological, economic and social effects?
Q2: Can a sustainability assessment be controlled in the daily routines of out-of-home catering via an online-tool?

Methods[2]

Sustainability assessment of food

Today, a number of scientifically based methods help to assess out-of-home meals with regard to various sustainability aspects [2430]. The methods mainly refer to health as well as ecological criteria. They were partly tailored to internal company structures and are therefore not accessible to all stakeholders within the out-of-home catering sector. In addition, they are usually subject to a fee. In order to create an evaluation method that is as low-threshold as possible and that empowers out-of-home catering stakeholders to implement sustainability assessment themselves, the free menu-calculator based on the Nutritional Footprint [8] was developed in the test phase of the NAHGAST project. The indicators used for this purpose were evaluated in a stakeholder process according to their scientific relevance, their practical applicability (also in terms of data availability) and their communicability [24]. After this selection process, a sustainability target value (sustainable level) was defined for each indicator, partly based on concrete scientific recommendations, partly by deriving target values – especially for the ecological indicators. ◆ Table 1 summarises all target values for a luncheon.

The German Nutrition Society (DGE) has set target values for the health sector, for example the energy content of a luncheon [31]. In the ecological area, however, target values only exist at a higher level, such as the targeted total material consumption (expressed in material footprint) per capita and year of a maximum of eight tonnes [9] or 2 to 3 tonnes in the nutritional field of action. Maximum and minimum values per meal were defined for each indicator, e.g. by calculating the maximum resource consumption per year proportionally down to a maximum value per day and then per luncheon. This results in a maximum material consumption of 4,000 g. Thus, if a meal has a value of more than 4,000 g, it must be classified as unsustainable. If the meal achieves a value of less than 2,670 g it meets the sustainability target and is declared recommendable. For the social dimension, the

[2] The following data are not presented in this paper for reasons of space. The underlying recipes and meal assessments can be requested from the authors.

solution to map social implication via widely used labels or certifications (e.g. the Fair Trade Label)[3] was found in close cooperation with the five practice partners[4] from different sectors (school and hospital catering, event and university catering). The different evaluations are numerically coded, which makes it possible to set the indicators or the dimensions off against each other. At indicator level, the evaluation is carried out on a three-stage scale: recommendable = 3, limited recommendable = 2, not recommendable = 1. At dimensional level, a more differentiated assessment is carried out on a six-stage scale. In order to convert the values between one and three resulting from the indicators into an evaluation of the dimensions between one and six, the arithmetic mean of the indicators ($\overline{x}_{Ind}$) of a dimension (x_{Dim}) is first calculated. The arithmetic mean is then transformed up to the six-stage scale (by the term ($\overline{x}_{Ind}$–1)×1,5). In total this results in the following calculation:

$$x_{Dim} = \overline{x}_{Ind} + (\overline{x}_{Ind} - 1) \times 1{,}5 \quad [5]$$

Formula 1: **Conversion of the indicators to a six-stage scale**

The overall evaluation of a meal – which the menu calculator does not currently indicate – is calculated from the arithmetic mean of the individual indicators. As a result, each indicator is equally weighted:

$$\text{Menu-Pro}_{\text{Total}} = \frac{I_{Ecol1} + \ldots + I_{Ecoln} + I_{S1} + I_{S2} + I_{G1} + \ldots + I_{Gn} + I_{Ecol1} + \ldots + I_{Ecol}}{n_{Ecol} + n_S + n_H + n_{Ecol}}$$

Formula 2: **Total result of a menu in the menu calculator**

Creating sustainable recipes – Everyday food assessment

The discourse with stakeholders from the out-of-home catering sector showed that a comprehensive sustainability assessment in everyday kitchen routines is not possible without supporting tools. Thus, at the end of the NAHGAST project the initiative was launched to transfer the methodology presented above into a publicly accessible online tool. This tool should also enable untrained persons to conduct a sustainability assessment. In the context of this development, recipes from the partner organizations were used as a basis for the first test phase. In order to cover as wide a range as possible at this point, six different recipe classes, which are offered in each of the partner organisations, were selected for the lunch menus: dishes with potato fritters, poultry dishes (e.g. chicken fricassee), fish dishes, bratwurst dishes, soup dishes (e.g. stew), vegetarian escalopes. A total of 29 recipes of the five NAHGAST practice partners were evaluated with the menu calculator and compared with each other. The food categories were chosen in such a way that they largely reflect the recipes assessed manually in the project (n = 120). The use of conventional products was assumed for all recipes, which corresponds to the project experience. The selected recipes were assessed with the menu calculator (→ www.nahgast.de/rechner).

Results

Sustainability assessment of selected menus in the out-of-home- catering sector

A comparison of the six recipe categories reveals interesting differences. In the ecological evaluation, the soup dishes (6), vegetarian escalopes (5), dishes with potato fritters (5), fish dishes (5) and bratwurst dishes (5) calculated here all score as "recommendable". The poultry dishes achieve a medium rating (4). A look at indicator level shows that the high proportion of animal protein in the poultry recipes implies high results for the material footprint and CO_{2e} footprint. It is interesting that the poultry dishes evaluated in this example perform worse regarding the environmental dimension than the menus with pork or beef, although poultry meat is generally considered to be more resource efficient. The reason for this lies in the recipe design. The poultry recipes used contained on average a high proportion of poultry meat ($\overline{x}$=118,4 g, $\overline{x}$=132 g), while the other meat-containing recipes contained a lower proportion of pork or beef per portion ($\overline{x}$=93 g,$\overline{x}$=100 g). At this point it becomes clear that it is often not only important which animal product is used, but also its quantitative proportion in the recipe. With regards to the health dimension, soup dishes receive the best average rating (6). All other recipe categories are located in the middle range (4). In the social dimension, the soup dishes receive a medium rating on average (3), all other recipe categories perform poorly (vegetarian escalopes 2, rest 1). The assessed

[3] This solution is to be critically reflected upon and possibly revised in the course of the work in the current NAHGAST II project.

[4] As shown in the follow-up project NAHGAST II, the findings from the NAHGAST project can be classified as comprehensive and versatile. Many organizations can work with it. Through a further feedback process with stakeholders (from similar and other areas of the out-of-home catering sector), further weak points can be identified, e.g. the missing login area or the portion size which cannot be adapted at present.

[5] Exemplary calculation: If all indicators were given a rating of 3, i.e. "recommendable", the dimension would consequently also have to be rated "recommendable", i.e. a 6. This is possible – even for numerical values that are less easy to transform (e.g. 2.5 – with the help of formula (1).

[6] All calculations and evaluations of the menu calculator refer to the individual meal. The offer as a whole is not considered, accordingly there is no evaluation of the range of drinks or food on offer as a whole.

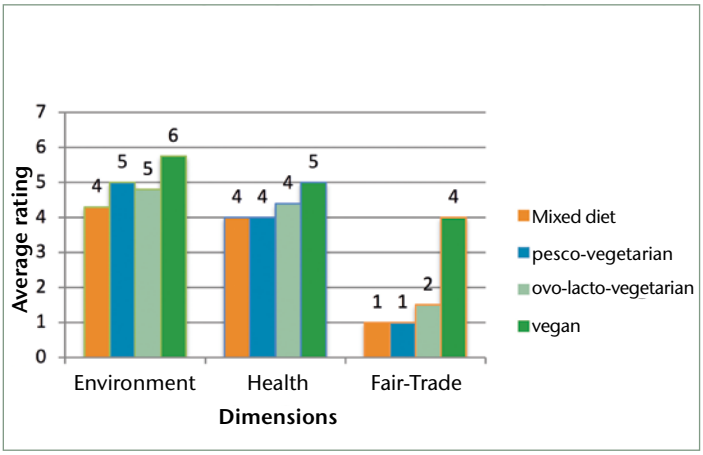

Fig. 1: **Average rating of the dimensions according to diet**

recipes are examples given for different offer categories: Mixed diet: dishes with meat (n=10), pesco-vegetarian: dishes with fish (n=5), ovo-lacto-vegetarian: vegetarian dishes (n=10) and vegan: vegan dishes (n=4). ◆ Figure 1 illustrates the different average ratings given to meals within these categories after entering the data into the online menu calculator. Each block of grouped columns represents one dimension – environment, health, or social concerns. Within the individual blocks, each column represents one of the four offer categories[7].

The diagram illustrates that vegan recipes perform best in all three dimensions, mostly followed by vegetarian recipes. Only in the environmental dimension fish dishes receive a better rating than vegetarian dishes. Overall, it becomes clear that the less animal products a meal contains, the better is the average rating calculated by the menu calculator for all three dimensions. Consideration of the indicators shows what is decisive for this: The indicators water, land use, carbohydrates, sugar (3 each) as well as fair trade (1) are on average the same for all four examined menu categories. The results are somewhat more mixed for the indicators material (1-3), greenhouse gas emissions (2-3), dietary fibres (2-3), fat (1-2) and salt (1-2). Here, vegan[8] or vegetarian meals tend to get better results.

Using the menu calculator

According to the test users' feedback, the handling of the calculator is very intuitive and plausible. Users must first name the meal and indicate the number of portions to which the information will later refer (e.g. Spaghetti Bolognese, one portion). Afterwards the menu's components can be specified (e.g. spaghetti and Bolognese sauce). For these, users select the ingredients from the drop-down menu and specify the quantity and the method of preparation, such as preparation in a combi-steamer[9]. In addition, the ingredients' country of origin can be indicated, how and how long they have been stored and which energy source is used for cooking. For selected ingredients it can furthermore be added if they have been organically grown or fairly traded. The selection of ingredients is limited to a database that currently contains around 300 common ingredients (as of July 2019)[10], these being fruit, vegetables, animal products such as meat, eggs and dairy products, cereals, vegetable oils and fats, nuts, spices, convenience products and others, such as vegetable broth. After entering the recipe, the menu calculator displays a sustainability assessment as shown in ◆ figure 2: As shown in ◆ figure 2, the dimensions environment, health, fair for human and animal as well as the corresponding indicators (influencing factors in the calculator) are represented with the help of a coloured scale. These influencing factors can be unfolded, which is illustrated in ◆ figure 2 as an example for the environmental dimension. In order to make the influencing factors more comprehensible for users, the material footprint is referred to as material input and the carbon footprint as greenhouse gas emissions. The calculator evaluates the influencing factors in three colour-coded levels: red = not recommendable, yellow = limited recommendable, green = recommendable. Currently, each indicator is treated and communicated equally at this point. For the revision of a less recommendable recipe, the tool provides general tips that can be called up by clicking on the information

	Material	GHG	Fibres	Fat	Salt	Animal husbandry
Mixed diet	1	2	2	2	2	1
pesco-vegetarian	2	2	2	1	1	1
ovo-lacto-vegetarian	2	3	2	2	2	1
vegan	3	3	3	2	2	3

Tab. 2: **Assessment of selected indicators according to different offer categories**
GHG = greenhouse gas emissions

[7] The example given here is intended to provide an overall overview of the types of food offered in community catering. At this point it is not possible to draw any further conclusions about the diet of individual guests.

[8] Vegan recipes receive a positive evaluation in the calculator regarding the indicator animal husbandry as no animal products are contained and therefore no animal products can be used that do not originate from welfare-oriented animal husbandry.

[9] Up to now it is only possible to select one preparation method type for each recipe component and one common preparation method for all components together.

[10] As part of the follow-up project of NAHGAST: Sustainability in out-of-home catering, the ingredient base is being expanded.

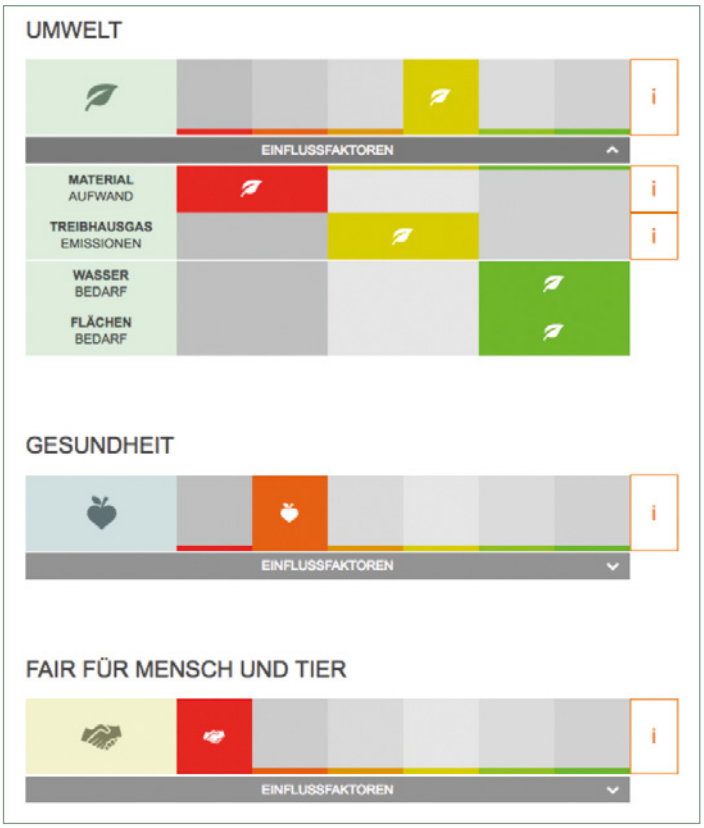

Fig. 2: **Sustainability assessment of a meal with the menu calculator developed in the NAHGAST project**
Umwelt – environment; Einflussfaktoren – determinants; Materialaufwand – material input; Treibhausgasemissionen – greenhouse gas emissions; Wasserbedarf – water use; Flächenbedarf – land use; Gesundheit – health; Fair für Mensch und Tier – fair for human and animal

button. Depending on how the menu is rated, these tips may, for example, recommend reducing the proportion of animal products, cooking with green electricity, or using less salt. In the future, even more detailed advice on the specific optimization of meals is planned at this point, as is a prioritization of action steps to reduce material consumption or greenhouse gas emissions.
The menu calculator has been online since May 2018. Since then, a total of 856 menus have been created up to and including January 2019. These contained 878 different components and used almost the entire range of ingredients (278). Most of the entered recipes are mixed diet dishes (413), however 235 vegetarian and 208 vegan dishes were evaluated as well. 133 recipes were optimised, i.e. adjusted and recalculated based on the sustainability tips. The menu calculator is currently being revised in the follow-up project NAHGAST II. More than 20 partner companies are testing the functionality and a further revision of the calculator profile is planned for the beginning of 2020.

Discussion

The paper on hand provides an interim status after 18 months of virtual sustainability assessment by the menu calculator. Irrespective of all limitations, the tool with the underlying database provides a practical sustainability assessment of meals and points out alternative offers. Especially the methodology of measuring sustainability effects at recipe level should continuously be entitled an innovative approach. Breaking down complex sustainability targets to the reference units that are common in daily routines is a step that still needs to be implemented in many other fields of action in order to further promote sustainable development.
The results show that the absolute reduction of meat/meat products as well as milk/dairy products provides results that are considered recommendable. Compared to meat-based dishes, vegan meals score better, especially with regard to the indicator of material consumption but also in terms of greenhouse gases and dietary fibre. Overall, the recipes of the NAHGAST practice partners used here as examples require an adjustment in the salt content and in the content of saturated fatty acids.
Against the background of the research results, there is still a need for improvement in terms of indicators and methodology. The menu calculator provides results from which options for action can be derived. However, the following limitations apply: Most of the data used for the calculation are based on simplified assumptions, such as for transport, storage, refrigeration, packaging, and processing, which is partly due to data availability[11]. A further challenge is to keep sustainability target values up to date, some of which are constantly changing[12]. The aim is to expand the data set with regard to the ingredients, their cultivation methods and the production process. The focus is on vegetarian and vegan as well as on fairly traded and organic ingredients, so that more alternative products can be selected. The data sets are to be expanded realistically, types of preparation are to be supplemented and differentiations regarding the used temperatures are to be permitted. Medium-term, the Sustainable Level, i.e. the sustainability target values, are to be revised. For example, the target value for the proportion of dietary fibre is to be raised slightly in the future in order to support the German

[11] This fact applies to all tools that are not adapted in-house e.g. tailored to the value chains and processes of the company.
[12] In order to reach goals of sustainability, such as climate goals until 2050, the indicators need to be continuously downgraded.

Nutrition Society's (DGE) recommendation of 30 g dietary fibre intake per day even more.

This aspect requires a critical look at the choice of indicators in order to assess the health performance of a meal. It is not possible to make a comprehensive statement about the health quality of the food based on the indicators, as the quality of carbohydrates, fat, and protein as well as the supply of micronutrients are not taken into account. Nevertheless, there are rough indications that can already help stakeholders in many decision-making situations. Up to now the economic dimension cannot be sufficiently assessed as the economic aspects are meal- and company-specific data which could not be estimated in the project. Many of the participating companies did not want to publish their internal information at this point. This is to be counteracted in future by a login area where users can enter this information themselves in accordance with data protection regulation. The login area should also allow to save created and assessed recipes. In the long term, a link-up with the merchandise management systems of the addressed out-of-home consumption establishments is aimed at. Furthermore, it should be possible to switch more flexibly between the different types of preparation and to address the individual preparation steps within a recipe in a better way.

An important need for action has become apparent in the evaluation of the social dimension. Currently, the allocation of the assessment here results from the indicators "Share of fairly traded food" and "Share of animal welfare-friendly products". Recipes without animal products receive a positive assessment in terms of animal welfare as they cannot contain ingredients that do not originate from species-appropriate animal husbandry. This results in vegan recipes always receiving at least a medium rating regarding the social dimension. This does not reflect reality and must be represented by additional indicators in the future.

Furthermore, the representation of the social dimension by means of two indicators is, of course, inadequate in many places. In order to address them in more detail in the future it would be conceivable, for example, to save the information on the country of origin with a numerical value and to calculate a social impact which is independent of a certificate. Nevertheless, it should not be underestimated that the calculation steps and information queried in the calculator are not too complex in order to keep the tool as practical as possible.

In addition, the comparability of the evaluation results on the basis of selected recipes should in the future be compared with other available tools such as susDish or the MNI[13].

The potential for further development of the tool is great but already today the menu calculator offers a scientifically based and yet simple and practical possibility to assess meals free of charge and ingredient accurate, taking into account ecological, social as well as health related aspects.

[13] For this purpose, a scientific exchange with the institutions that have developed the instrument is sought.

Conflict of Interest
The authors declare no conflict of interest.

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