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# Measuring What Matters in Sustainable Consumption: An Integrative Framework for the Selection of Relevant Behaviors

Abstract

In the face of existing obstacles in the interdisciplinary research on sustainable consumption behaviors, we argue for the need of an integrative framework from an interdisciplinary perspective. Such a framework is presented in form of a three-dimensional cube model of sustainable consumption behavior (SCB-cube) extended by a forth impact dimension. The model has two purposes for application: First, to systematize existing research on different behaviors on a common taxonomy and second, to facilitate the selection of relevant sustainable consumption behaviors in social sustainability research based on impact. We critically appraise existing intent- and impact-based research approaches on the four key dimensions of the SCB-cube focusing on the ecological *and* socio-economic impacts of consumption behaviors. Recommendations for the selection of relevant behaviors for empirical behavioral research are given, using the SCB-cube as a guiding heuristic. The main audiences for this model are social science researchers measuring sustainable consumer behaviors on the individual level.

Key words

sustainable consumption behavior, impact-based assessment, intent-based assessment, sustainability dimensions, consumption phases, consumption areas, key points of consumption

## Introduction: The Necessity and Difficulty of Measuring the Sustainability of Consumption Behavior

Research on sustainable development aims to improve our understanding of interactions between natural and social systems and to guide those interactions toward more sustainable trajectories (Kates et al., 2001). The advancement of solutions to grand challenges (ICSU and ISSC, 2010) thus requires contributions from and intensified collaboration between natural and social sciences perspectives (Bettencourt and Kaur, 2011; Schoolman *et al.*, 2012; Lam *et al.*, 2014). A key driver of current unsustainable development is individual consumption behavior and as such, a focal topic of research in natural and social sciences alike (Rockström *et al.*, 2009b; Thøgersen, 2014). Consequently, the question how

sustainable consumption behavior can be promoted features prominently on the agenda of policy-makers and researchers alike (Soron, 2010; Ceglia *et al.*, 2015; United Nations, 2015). What is needed are insights into *both,* how (un)sustainable consumption behaviors impact natural and social systems *and* how these behaviors could steered into a more sustainable direction. A crucial tool for the success of this enterprise are adequate methods to assess the sustainability of consumption behaviors. In our view of the field, the development of such methods is hindered by two obstacles: (1) the lack of consensus on which consumption behaviors are to be considered sustainable and (2) the lack of a shared reference framework to integrate existing fragmented research on different consumption behaviors.

The first obstacle relates to differences in conceptualizing the object of evaluation. So far, two major approaches mark the field. On one hand, *impact-oriented* approaches judge the sustainability of consumption behaviors by assessing the factual impact on the ecological or social surrounding caused by these behaviors. These approaches may consider different impact categories, ranging from single ecological or social criteria to the more integrative consideration of different sustainability dimensions. On the other hand *intent-oriented* approaches focus on the intentions underpinning a certain consumption behavior. Whether a particular consumption behavior is considered sustainable in this case is defined by a pro-ecological or pro-social intention underlying it, and not by the factual impacts it causes (see Fischer et al., 2012, for the distinction between intent- and impact-oriented assessments). This implies the threat of poor external validity, as intended and actual impact can differ considerably (Gatersleben *et al.*, 2002; Csutora, 2012). Much of the work of social science researchers is aimed at advancing our understanding of how individuals can be motivated to intentionally avoid unsustainable impacts through their consumption behaviors and belongs to intent-based approaches.

To advance sustainable consumption in our societies, obviously both approaches are needed. Ideally, *intent- focused* social scientists should help unveil the factors influencing those consumption behaviors with particularly high sustainability impacts, informed by *impact-focused* sustainability researchers. This necessity for a change of focus on high impact behaviors in the social sciences has been acknowledged by various authors in the field (Steg and Vlek, 2009; Gatersleben, 2013) and is advanced further in this paper.

The second obstacle refers to the situation that there is abundant body of empirical studies on sustainable consumption that concentrate on single behaviors (e.g. purchase of fair trade coffee or paper recycling). These studies often provide valuable insights for the

specific issues they address. However, with regard to the overall field of sustainable consumption research, they leave a rather fragmented picture of evidence that is hard to commensurate for other researchers and remains inconclusive for policy-makers seeking to promote behavioral change (Heiskanen *et al.*, 2014). In order to overcome the fragmentation of sustainable consumption research in loosely connected (sub-)disciplinary research strands, Di Giulio *et al.* (2014) stress the need to elaborate coherent reference frameworks that allow researchers from different fields to locate their approaches and relate their findings.

This paper addresses these two major obstacles and seeks to contribute to an interdisciplinary consolidation of research on sustainable consumption behaviors. Our main research aims for this article are to

1. present an overarching model to systematize individual sustainable consumption behaviors based on four dimensions (Section 2);
2. critically analyze existing assessment/measurement approaches according to these four dimensions (Section 3);
3. illustrate how such a model can be used to select target behaviors in empirical research on sustainable consumption (Section 4).

We conclude with considerations on the potential of the model to foster an interdisciplinary sustainable consumption research comprising different research topics (Section 5).

## The SCB-Cube Model for the Adequate Measurement of Sustainable Consumption Behavior

An often deplored impediment for researchers in the field of sustainable consumption is the lack of consensus on a definition of the very term itself (Jackson, 2007; Mont and Plepys, 2008). The prominent, so-called Oslo definition (Norwegian Ministry of Environment, 1994) is not a scientific definition, but stems from the political sphere and has received severe criticism in the academic field. Since then, several attempts have been made to propose more consolidated definitions. Our understanding of what sustainable consumption behaviors are is based on recent and comprehensive definitions applying the classic concept of sustainable development (World Commission on Environment and Development, 1987) to the field of consumption (Fischer *et al.*, 2012; Schrader *et al.*, 2013). It is informed by the common features in these definitions, namely the focus on consumption behavior as an act of satisfying needs (e.g. for food, shelter) that is not

confined to market-based purchasing of goods and a qualifying reference scale that requires those consumption behaviors to ensure that other human beings today or in the future have the same possibilities. Thus, we refer to sustainable consumption behavior as *individual acts of satisfying needs in different areas of life by acquiring, using and disposing goods and services that do not compromise the ecological and socio-economic conditions of all people (currently living or in the future) to satisfy their own needs*.

Despite the controversy surrounding the concept of sustainable consumption when it comes to the details of implications, our understanding reflects key elements that can be considered as widely consensual between different definitional approaches. Three dimensions span the universe of potential behaviors that fall under this ample definition:

1. *Sustainability dimension*: Sustainability comprises a socio-economic dimension as well as an ecological one.
2. *Consumption phases*: Consumption comprises different phases, not only the acquisition of goods (and services), but also their use and disposal.
3. *Consumption areas*: People have needs in different areas of life such as food, housing, mobility, clothing etc.

For the empirical issue of a meaningful measurement of sustainable consumption behaviors we see a forth, cross sectional dimension of utmost importance:

4. *Impact:* Behavioral measurement scales have to concentrate on the ecologically and socially most impactful behaviors in order to capture the essence of sustainable consumption.

Each of the four dimensions is represented by a theoretical stance and an according research strand, which are outlined in the following.

**First Dimension of the SCB-Cube: The Sustainability Dimension**

Traditionally, approaches drawing on the Brundtland definition (World Commission on Environment and Development, 1987) have conceptualized sustainable development as an integrative perspective compassing an ecological, an economic and a social dimension. The precise relation of these three spheres however is contested and has been illustrated in pillar, triple bottom line or nested models (Farley and Smith, 2013). More recently, Leach *et al.* (2013) have popularized the metaphor of a “sustainability doughnut”, i.e. sustainable development as a safe and just operating space for humanity that is constituted by outer planetary boundaries (ecological conditions) and inner social foundations (socio-economic

conditions). Sustainable development within this corridor model[1] does not exceed the limitations of the ecological Earth system while safeguarding minimum standards of human development including accordant social and economic conditions. Taking the corridor model as a basis, the sustainability of individual consumption behaviors can be defined in an impact-oriented perspective by their effects on outer ecological and inner socio-economic conditions. For each of the two dimensions, a number of approaches suggest different, highly debated criteria against which to measure effects of consumption behaviors.

Example criteria for the assessment of ecological conditions are multidimensional approaches as *planetary boundaries* (Rockström *et al.*, 2009a; Steffen *et al.*, 2015) or on a more concrete level *ecological* (Wackernagel and Rees, 1996), *carbon* (West *et al.*, 2015) or *integrated footprints* (Galli *et al.*, 2012) using different indicators such as GHG emissions or land use. Approaches on how to assess the state of socio-economic conditions might be even more varied than for the ecological conditions (Murphy, 2012). Some examples for broad approaches are: the *capability approach* (Comim *et al.*, 2007) or *matrices of objective or fundamental human needs* (Cruz *et al.*, 2009) that serve as the basis to derive concrete *indicators* as e.g. *safety, food security and household goods* (living standards) or *jobs and income* (livelihood) for mid-level criteria (Cole *et al.*, 2014). Following Holden *et al.* (2016) we see a hierarchy of increasing concreteness between sustainability dimension, approaches, criteria, indicators and single behavior items. The relationship between these concepts is highlighted in Table 1.

| Sustainability Dimension | *Ecologic* | | *Socio-Economic* | |
|---|---|---|---|---|
| Theoretical Approach | Planetary Boundaries | Ecological Footprint | Capability Approach | Fundamental human needs |
| Criteria | Climate change | Land use | Poverty | Livelihood |
| Indicator | $CO_2$ | $km^2$ of arable land | Income | Income |
| Behavioral Item | I buy imported fruits from overseas. | I buy organically grown food. | I buy fair trade food products. | I buy fair trade food products. |

***Table 1**: Relationship between sustainability dimension and behavioral item with examples for each level*

[1] The corridor model by Leach et al. (2013) refers to a *collective* corridor of sustainable development, and thus is distinct from the corridor model by Di Giulio and Fuchs (2014) who apply the same idea of a minimum and a maximum level to *individual* consumption to be sustainable. Both models coincide that the sustainability of a consumption behavior ultimately has to be measured against an absolute benchmark (e.g. as an overall GHG emission budget to reach the global warming below 1.5°).

While ecological and socio-economic thresholds metaphorically reflect two distinct flanks of a corridor for a safe and just development, it is vital to consider them as interrelated conditions that allow human beings to thrive. It is due to this interrelatedness that consumption acts could potentially affect both of these conditions and cannot be adequately assessed by considering only their isolated impact on one of these conditions.

**Second Dimension of the SCB-Cube: The Consumption Phase**

For the second dimension of our cube model, we lean on the general consumption model dominant in consumer behavior research. Here consumption is seen as a phenomenon that comprises different phases and does not exhaust itself in mere purchases of products or services. Commonly, three main phases of consumption are distinguished (e.g. Engel *et al.*, 1990; MacInnis and Folkes, 2010):

a) *Acquisition*: Commonly through purchase, but also possible through swapping, sharing, renting etc.
b) *Usage:* The use, demonstration or wasting of a product (actual consumption)
c) *Disposal:* Through removal, bartering, giving away, selling, etc.

The importance of all three phases for the assessment of the sustainability of consumption acts has been stressed in various definitions of sustainable consumption (Schrader et al, 2013; Fischer et al., 2012) and is also recognized here. We subsume all impacts due to the (co-) production of goods and services (e.g. pesticide use in agriculture) within the acquisition phase (e.g. purchase of organically grown foods), as goods and services that are acquired and accessed have been produced at some stage upstream (whether by oneself or others). Current consumption phenomena that blur the lines between phases, as e.g. collaborative consumption practices (Botsman and Rogers, 2011) are allocated to the most obvious phase (e.g. lending a tool as the elongation of usage).

For an example from the area of food this would mean that an adequate assessment of sustainable behavior would have to comprise the acquisition (purchase of organic vs. conventional produce, acts of growing food), the usage (how these foods are stored and cooked) and also the disposal of food (whether they are eaten completely or disposed of, in a compost or a regular trash bin, etc.).

**Third Dimension of the SCB-Cube: The Areas of Consumption**

Human needs have to be fulfilled in different areas of life. The aggregation of single consumption behaviors into *areas of consumption* based on the needs that are being

fulfilled, has been introduced by the Wuppertal Institut (1996). This was sought to reduce the complexity of sustainability issues and simplify the identification of relevant spheres of action and has been done by different authors ever since, albeit under different names: *consumption areas* (EEA, 2013), *consumption domains* ((Tukker *et al.*, 2010), *consumption categories* (Ivanova *et al.*, 2015) or *consumption fields* (Liu *et al.*, 2015). Three consumption areas are concordantly identified as ecologically most relevant in terms of greenhouse gases, acidification emissions, tropospheric ozone and resource / material requirements, namely: *food, housing* (including water and energy consumption), and *mobility* (Lorek and Spangenberg, 2001; Ivanova *et al.*, 2015; Steen-Olsen and Hertwich, 2015, EEA, 2013). *Clothing* is an ecologically less relevant consumption area, but nevertheless socio-economically relevant, as its consumption has great impact on e.g. the living conditions of workers involved in the production process (Overeem, 2009; Federal Ministry for Economic Cooperation and Development, 2014). Figure 1 illustrates these four consumption areas as examples for the ecologically and/or socio-economically most relevant ones. The dots ("…") represent further consumption areas that have been omitted due to their lesser impact, as e.g. the more immaterial consumption areas *education* or *health care*.

**Fourth Dimension *Within* the SCB-Cube: The Impact of Chosen Behaviors**

As will be outlined below (Section 3.1), impact based approaches have determined the multifold ecological consequences of concrete behaviors since the 1960s. Various approaches have ever since tried to break down these results to a meaningful everyday overview of most relevant household actions in as e.g. the "short list" in terms of energy savings or $CO_2$ emission reductions respectively (Gardner and Stern, 2008; Dietz *et al.*, 2009). Bilharz *et al.* (2008) introduced the denomination "peanuts" for low impact and "big points"/"key points" for especially high impact behaviors based on life cycle assessments. A more comprehensive approach that allows the parallel consideration of various aspects is the so-called "hotspot-analysis" that also includes recommendation on following actions (UNEP/SETAC Life Cycle Initiative, 2014). The prioritization of high impact behaviors is not only important for consumers, who need to allocate limited resources of attention and motivation to relevant behaviors, but also for sustainability researchers and policy makers, trying to find effective ways to alter consumption behaviors that make a real difference.

### Synthesis: The SCB-Cube

The first three dimensions (sustainability dimension, consumption phase and consumption area) make up a cube model of sustainable consumption behaviors that comprises 3 x 5 x 2 voxels (see Fig. 1).

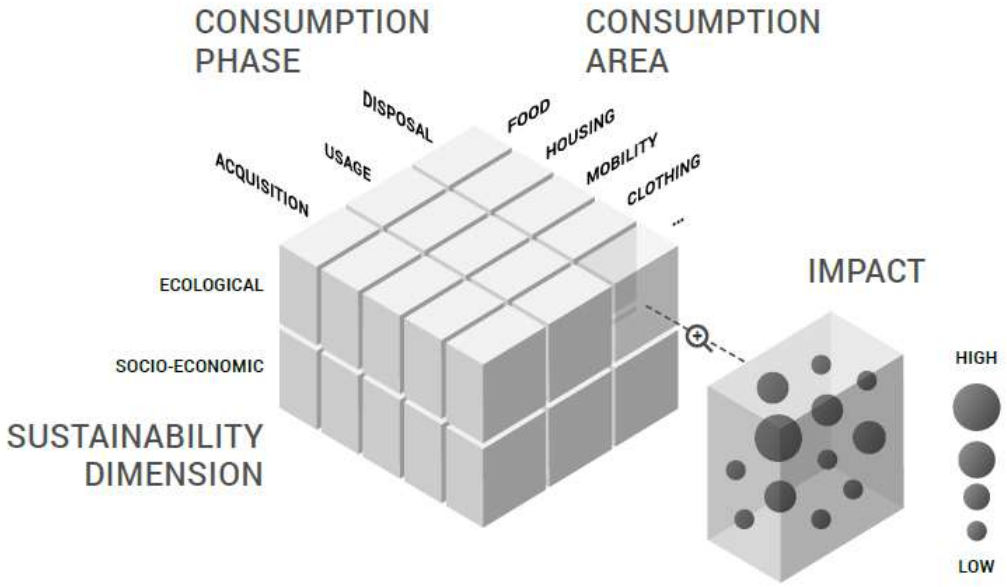


***Figure 1**: The cube model of sustainable consumption behavior (SCB-cube)*

For an adequate measurement of sustainable consumption behaviors it is crucial to concentrate on the most relevant ones for each voxel. For an illustration take the ecologic – usage – housing voxel: the temperature setting of a heating system would constitute an ecological "big point" whereas the switching off of one LED light when leaving a room can be considered a "peanut" in terms of energy savings. A big point for the socio-economic-acquisition-clothing voxel could be the purchase of a garment produced under fair working conditions, whereas using one drop-off box system for used clothes vs. another might be considered as a peanut.

### First Application of the SCB-Cube: Analysis of Existing Measurement Approaches

Against the background of our model, we will analyze existing approaches on the measurement of sustainable consumption behavior. As a show case for the systematizing function of our model we evaluate three prominent examples from three different approaches and appraise them critically based on the four key dimensions (for the overall results see Table 2). This systematic stock taking allows to expose over- and under-

researched areas in sustainable consumption behavior. Shortcomings of all approaches and a procedure for deriving a valid scale avoiding such shortcomings are outlined in the sections below. The examples were chosen on the basis of citation frequency or comprehensiveness of approach.

**Impact-Oriented Sustainability Assessments**

Ever since the beginning of the conceptual debate about sustainable development, the question had been raised how the impact of human activities can be measured and monitored. A starting ground was the research field of environmental impact assessment that had emerged in the 1960s/70s, strongly informed by the environmental sciences and industrial ecology (Pope *et al.*, 2004). A prominent early example from this field is the pressure-state-response framework (Rapport and Friend, 1979). It suggests to focus analyses on how human activities cause pressure on the state of the environment and how society responds to these observed changes (Singh *et al.*, 2012). Consumption behaviors feature prominently in product-related assessment approaches that are primarily concerned with material and energy flows related to the production of goods and services (Ness *et al.*, 2007). A methodology that is strongly advocated for in the policy discourse on sustainable consumption and production is life cycle assessment (LCA) or life cycle *impact* assessment (LC*I*A) (Hertwich *et al.*, 1997; Hertwich, 2005; Tukker and Jansen, 2006; Finnveden *et al.*, 2009). Today, environmental impact assessment is a diversified field of research that has confronted the challenge of sustainable development with more comprehensive sustainability assessment approaches (Pope *et al.*, 2004).

With regards to different *sustainability dimensions*, impact assessment approaches have a strong tradition in the ecological realm. Even though more recently some attempts have been made to complement environmental life cycle assessment with social life cycle assessment methodologies (S-LCAs) (Jørgensen *et al.*, 2008), the approach is characterized by a strong environmental focus and a lack of integration of social and economic aspects and their potential trade-offs (Ness *et al.*, 2007; Morrison-Saunders and Pope, 2013). Concerning the *areas of consumption*, impact assessment approaches are available for a number of different areas such as food (Heller *et al.*, 2013) or textile consumption (Muthu, 2015). Regarding *consumption phases*, impact assessment approaches are traditionally strong in the pre-consumption (i.e. production) phase, with their focus on products and the background in industrial ecology. Another phase prominently addressed is post-consumption behavior, such as recycling. Di Polizzi Sorrentino *et al.* (2016) have recently called for a stronger integration of (social) behavioral sciences to include the use-phase of

products in impact assessment methodologies more prominently and identify leverage points for behavioral change. As the denomination of assessment approaches shows, all of them are concerned with the evaluation of real world *impacts*, social or ecological.

While most approaches from the field of impact assessment focus on analyzing the impacts of sectors or products, some methodological approaches like the ecological footprint (Wackernagel and Rees, 1996) to aggregate different consumption behaviors into a per-capita based measurement. With this perspective on individual consumption behavior they have popularized easy accessible online footprint calculators that are used in education for sustainable development (for better or for worse, see Franz and Papyrakis, 2011). Table 2 presents examples for each of the assessment strategies LCA, S-LCA and the ecological footprint questionnaire (Dholakia and Wackernagel, 1999) with regards to our dimensions.

**Intent-Oriented Sustainability Assessments**

Prominent examples for intent-oriented measurement of sustainable consumption behavior stem from the social and behavioural sciences. We will outline exemplary approaches from environmental psychology and consumer behavior.

*Environmental Psychology*

One field with a growing interest in sustainable behaviors is environmental psychology. The research is focused on pro- environmental behaviors (PEB) defined as behaviors "that consciously seek to minimize the negative impact of one´s action on the natural and built world" (Kollmuss and Agyeman, 2002: p. 240) or behaviors that people engage in for the subjective reason to conserve the environment (Kaiser and Wilson, 2004). Thus, sustainable behavior in many psychological measurement scales follows a clear *intention-based* concept. The focus of environmental psychology studies is the investigation of potential motivational *and* impeding factors of sustainable consumption behavior and explaining the – sometimes complicated or indirect – relationships between different determinants of sustainable consumption behavior (e.g. Bamberg and Möser, 2007). If aimed at relevant behaviors, the discipline could potentially contribute to policy advice on effective measures to induce behavioral change as it is focused on explaining the determinants of behaviors.

With regards to the *sustainability dimension*, in psychology there still exists a strong focus on the environmental impact of behavior, as the denomination of the whole field reflects. Social and/or economic issues in consumer behaviors or their potential trade-offs are not in the research focus of studies in this field.

Considering the *scope of consumption*, most psychological studies concentrate on single, discrete behaviors as e.g. recycling (Corral-Verdugo, 1996; Berger, 1997; Schultz, 2002), electricity consumption (Abrahamse *et al.*, 2005; Steg, 2008) *or* water conservation (Corral-Verdugo *et al.*, 2006) without explicit reference to a specific consumption phase or area, often chosen depending on a specific research interest. Few researchers have conceptualized PEB as a more general conservation performance of people (Gatersleben *et al.*, 2002; Kaiser and Wilson, 2004) in all different consumption areas. One potential of this approach is the investigation of the coherence between different behavioral areas reflecting a wider "green lifestyle" (Kaiser and Wilson, 2004; Brown and Kasser, 2005).

Concerning the *impact* of chosen behaviors, criteria for selected behaviors are seldom given, and oftentimes items with low ecological relevance (switching out lights, recycling habits) are present next to high impact ones (insulating home, installing solar panels) in different scales (Kaiser and Wilson, 2004; Whitmarsh and O'Neill, 2010). An exception represents the work by Gatersleben *et al.* (2002) which explicitly aims at key points of direct energy consumption in households.

In summary, many environmental psychology studies are concerned with single or few behaviors eluding exclusively to the ecological dimension, with unclear selection criteria all over different consumption phases and areas. As three prominent examples for comprehensive measurement instruments in environmental psychology we present the scale for goal-based conservation behavior by Kaiser and Wilson (2004), the comprehensive ad-hoc scale to assess ecologically responsible behaviors used by Brown and Kasser (2005) and the measurement of environmentally significant behaviors by Gatersleben *et al.* (2002) in Table 2.

| *Authors* | *Name of the scale / method* | *Item n* | *1.Sustainability dimension* | *2. Consumption phase* | *3. Consumption area* | *4. Impact of chosen items* |
|---|---|---|---|---|---|---|
| *Impact based assessment instruments* | | | | | | |
| Various | Life cycle assessments | NA | Ecological | Mainly production and disposal phase, | All consumption areas | High |
| Various | Social Life Cycle assessments | NA | Social | Mainly production and disposal phase, | All consumption areas | High |
| Dholakia and Wackernagel (1999) | Ecological Footprint Questionnaire | 14 | Ecological | Acquisition and Usage phase | Food, Housing, Mobility | High, based on Ecological Footprint |
| *Intent based measurement instruments from environmental psychology* | | | | | | |
| Kasser and Brown (2005) | Ecologically responsible behaviour | 54 | Ecological | Acquisition and Disposal (+ Collaborative consumption) Usage: Frugality | Food, Housing (Energy and Water), Mobility | Not reported |
| Kaiser and Wilson (2004) | Goal-directed conservation behavior | 50 | Ecological | Acquisition and Disposal Usage (Mobility) | Housing (Energy), Mobility, (+ vicarious conservation behaviors) | Not reported |
| Gatersleben et al. (2003) | Environmentally significant consumer behavior | 20/ 5 | Ecological | Acquisition & Usage (Housing) Usage (Mobility) | Housing (Energy and Water) Mobility | High, based on Energy Consumption |
| *Intent based measurement instruments from consumer behavior research* | | | | | | |
| Balderjahn et al. (2013) | Consciousness for sustainable consumption | 19 | Ecological, Social and Economic | Acquisition (+ Collaborative Consumption) | Unspecified products | Not reported |
| Pepper et al. (2009) | Socially conscious and frugal consumer behaviours | 12 | Social and Ecological | Acquisition | Food, Clothing & unspecified products | Not reported |
| Gilg et al. (2005) | Green consumer behavior | 9 | Ecological | Acquisition | Food & unspecified products | Not reported |

***Table 2**: Analysis of exemplary assessment methods regarding the four key dimensions of the SCB-cube*

*Consumer Research*

A common denominator of the general multidisciplinary field of consumer research can be seen as the "core concern with acquisition, consumption, and disposal of marketplace entities by people in a consumer role" (MacInnis and Folkes, 2010: p. 910). The part of it focusing on *sustainable* consumption is an interdisciplinary field with a dynamic history (Liu *et al.*, 2017). As it "abounds in theories and methodological approaches that have been mostly developed and refined in neighboring fields and applied to the field of sustainable consumption" (Reisch and Thøgersen, 2015: p. 1) it is difficult to present a definition of sustainable consumption behaviors that would be universally accepted in the field. Works concerned with the assessment of sustainable consumer behaviors focus on e.g. "consciousness for sustainable consumption as an *intention* to consume in a way that enhances the environmental, social and economic aspects of quality of life" (Balderjahn *et al.*, 2013: p. 182) or on purchasing behaviors based on either pro-social or pro-environmental *intent* (Pepper *et al.*, 2009: p. 126). Thus, such measurement approaches qualify as intent-based approaches with all the implied downsides. Similar to the psychological approach, the consumer research perspective is characterized by its focus on individuals (here: In their role as consumers) and drivers that support or impede certain consumption behaviors. Newer approaches that highlight the role of consumer as citizens and their expression in civic action (Reisch, 2004), were not considered here, because these behaviors exert only indirect impact which is not possible to quantify.

In regards to the *sustainability dimension*, there are various measurement instruments that beside ecological or green consumption behaviors (Gilg et al. 2005, Tanner and Wölfing Kast 2003) also tackle socially responsible or ethical consumption behaviors that explicitly include socio-economic aspects as e.g. fair working conditions (Pepper *et al.*, 2009; Balderjahn *et al.*, 2013). Concerning the *phase of consumption*, empirical measurement scales mostly focus on decisions for certain products in the acquisition phase (Tanner and Wölfing Kast, 2003; Gilg *et al.*, 2005; Pepper *et al.*, 2009; Balderjahn *et al.*, 2013). Only one scale that we are aware of (Webb *et al.*, 2008) explicitly covers purchase and disposal behaviors, leaving the *usage* phase widely disregarded. Typical *consumption areas* covered are nutrition and household products, but oftentimes the targeted products of purchase decisions are not specified (e.g. "I buy a product if I believe that it is produced in an environmentally manner", Balderjahn *et al.*, 2013). Ecological or social *impact* information for investigated consumer choices is hardly given in these approaches or sometimes even impossible to quantify (for the non-specified product choices see above).

Typically for the intent-based approaches, the argumentation behind the selection of specific consumer behaviors is oftentimes not elaborated.

In general, the measurement scales used in consumer research mostly focus on the limited role of consumers as purchase decisions makers and come at the expense of a more integrated visions of consumers' potential impacts on sustainable development. In Table 2 we present three exemplary scales from consumer behavior research: The measurement scales for consciousness for sustainable consumption by Balderjahn *et al.* (2013), for green consumer behaviors by Gilg *et al.* (2005) and for socially conscious and frugal consumer behaviors by Pepper *et al.* (2009).

### Comparative Appraisal

To sum up, the different approaches to assess impact / measure sustainable consumer behavior focus on different behaviors, covering some, but never all aspects implied by our model of sustainable consumption behavior. For example, most tools do not explicitly consider the social-economic dimension, although in impact assessment this has been a recently added consideration. Concerning the consumption phase, there are also considerable differences between approaches, ranging from explicitly looking at purchase decisions in consumer research to unsystematically sampling behaviors from all areas of everyday life in environmental psychology. Food as one of the most impactful consumption area does not feature in all approaches, while housing or mobility choices are omitted by the consumer approaches cited here. With regards to the impact of investigated behaviors, the two intent-based approaches do not elaborate their selection criteria. Omissions of sustainability dimensions and consumption phases or areas are not reflected and thus seem accidentally rather than intended. For an overview of the foci of nine exemplary approaches (three for each field), see Table 2.

In the following section we outline how the model could be used to avoid some of the shortcomings observed in existing measurements.

## Second Application of the SCB-Cube: Guideline for Valid Scale Construction

The SCB-cube is intended as a guide for behavioral social scientists to select valid items for a behavioral scale to measure the sustainable consumption behavior of a person. We acknowledge that it might be impossible or– depending on research interests - undesirable to measure the whole cube. What we recommend instead, is the use of the SCB-cube as a multidimensional guideline for a reflected selection of behaviors and a possible systematization of existing research.

## Recommended Proceedings for Behavior Selection in Scale Construction

Parting form the cube´s dimensions we suggest subsequent steps for a more transparent selection of behaviors based on explicit considerations of sustainability criteria. In the following we outline some guiding questions for the selection process:

Step 1: Define the ***sustainability dimension(s)*** of interest.

- Do ***social-economic aspects*** as well as ***ecological aspects*** matter?
- Choose criteria for each dimension: against which impact criteria should behaviors be assessed (e.g. carbon footprint, fair prices/pay)

Step 2: Define the ***consumption area(s)*** of interest.

- What is the research focus? Which consumption area(s) are of specific interests? (e.g. food, housing, etc.)?
- Are some consumption areas excluded due to practical constraints (e.g. not applicable to the age group under investigation)?

Step 3: Define the ***consumption phase(s)*** of interest.

- Which consumption phases are most important for this area?
- Is there a sound reason to omit a specific phase (e.g. disposal of clothing because of low ecological impact)?

Step 4: Which are the consumption behaviors with the ***highest impact*** in the chosen dimension/area/phase?

Using these questions as a guideline will lead to a more systematic selection of behavioral items which will hopefully lead to more comparable behavioral studies in the future.

## Exemplary Implementation of a Behavior Scale Based on the SCB-Cube

This section will outline how the cube model was used to determine an appropriate selection of sustainable consumption behaviors in a research project on the effects of daily meditation practice on sustainable consumption behaviors. In this project we decided to include both the ecologic and the socio-economic sustainability dimension (Step 1), as the intervention was intended to raise awareness for both. Due to constraints placed by the research focus (sensitive for change over a period of the 8-week intervention period, relevant to different age groups), we concentrated on two of the consumption areas, namely *food* and *clothing* (Step 2). Here (see Table 3) we exemplarily present the SCB-cube scale for food, namely the first slice of the cube. Next, we decided to include all consumption phases (Step 3) as each involves relevant contributions to ecological and socio-economic impacts, resulting in a 2x3 Table. For step 4 we collected a pool of items on food related

habits and behaviors used in other scales (Brown and Kasser, 2005; Pepper *et al.*, 2009) and classified them according to the two dimensions of sustainability, namely the ecological and the socio-economic. Based on a review of the literature on ecological and socio-economic impacts of consumer behaviors and consultations with experts in the fields, more items were generated.

To single out the most relevant items with regard to *ecological impacts*, we focused on energy consumption, GHG emissions and/ or ecological footprint (10 items were selected, 4 for acquisition, 2 for usage and 4 for disposal). Eating meat [1] (for bracketed numbers please refer to Table 2) and dairy products [2] have been identified as most relevant behaviors (Horrigan *et al.*, 2002; Tukker and Jansen, 2006; Goldstein *et al.*, 2016). Also, the purchase of organic [3] and the avoidance of imported foods, transported over long distances [4] has been considered as a key leverage point for affluent societies to reduce the environmental impact of diets (Reisch *et al.*, 2013). In the consumption phase of storing and preparing food products, studies found that significant environmental impacts are related to cooking techniques like using pot lids [5] (Hager and Morawicki, 2013) and the avoidance of frozen ready-made meals [6] (Schmidt Rivera *et al.*, 2014). Finally, with regard to the disposal phase, the prevention of excessive [8] and one-way food packaging [10] as well as the prevention of food losses (e.g. through expiry [7] or tossing of left-overs [9]) have been identified as consumer behaviors of particular relevance for ecological impacts (Aarnio and Hämäläinen, 2008; Hall *et al.*, 2009; Parfitt *et al.*, 2010; Williams and Wikström, 2011; Beretta *et al.*, 2013; Goldstein *et al.*, 2016).

We proceeded likewise with behaviors that exert an impact on the *social-economic* dimension of sustainability. Here, we chose working conditions and fair prices, health issues and fair distribution. The underexposure of this sphere is reflected in the fact that we could only identify n = 6 undisputed items (3 acquisition, 2 usage, 1 disposal phase). The support of structures that favor fair working conditions and decent income for producers through fair trade [11] is among the most cited consumer behaviors in the acquisition phase (Le Mare, 2008; Arnould *et al.*, 2009); similarly, backing regional food provision systems or local alternative food networks [12] and growing food for self-supply [13] have been discussed as relevant consumer strategies to promote regional development, strengthen small-scale economies and achieve food security (Bekin and Seyfang, 2007; Franklin *et al.*, 2011; Kortright and Wakefield, 2011). In the usage phase the preparation of meals in the household [15] has been found to have positive effects on peoples' sense of self-reliance and independence, and to increase cohesion between household members

(Simmons and Chapman, 2012). Moreover, a healthy diet [14] is considered as a contribution to individual life-satisfaction and to reduced social costs (Macdiarmid *et al.*, 2012; Reynolds *et al.*, 2014). Finally, with regard to the disposal phase, the purchase of food products close to or beyond the minimum expiry date [16] can be also considered as a reasonable economic choice (as they are often discounted) and as a contribution to a changing practice in date labelling (Milne, 2012).

In total, we identified 16 items for both dimensions based on the evidence found (see Table 3). The items were assessed on a general 7-point Likert scale from 0= "never" to 6= "always" for items that concern non-daily activities like shopping. For daily activities targeting eating /cooking habits we adapted the scale option from 0= "never" to 6 = "daily" with the middle option reading 3= "once a week").

| Sustaina–bility dimension | Consumption phase | | |
|---|---|---|---|
| | *Acquisition* | *Usage* | *Disposal* |
| *Ecologi–cal dimension* | [1] I eat meat for the main meals.<br>[2] I eat dairy products.<br>[3] I buy certified organic food.<br>[4] I buy imported fruits from overseas (e.g. Mango) | [5] I cook in an energy saving way (with little water suitable lids, etc.)<br>[6] I buy frozen foods and meals. | [7] I dispose of food in the garbage.<br>[8] I refrain from foods with excessive packaging.<br>[9] I use left-overs for the next meal.<br>[10] I buy snacks and drinks in one-way packaging (e.g. take away, fast food) |
| *Socio-economic dimension* | [11] I buy fair trade food products.<br>[12] I buy regional food products.<br>[13] I produce/grow food myself. | [14] I eat healthily.<br>[15] I cook my own meals with fresh ingredients. | [16] I buy foods close to their expiration date. |

***Table 3**: Items of the $SCB_{NUTRITION}$-scale, based on the SCB-cube*

**Challenges and Chances**

Constructing the scale based on our cube model we encountered several limitations and challenges that are outlined in the following.

*Appropriate Scope / Cut-Off Criteria*

Obviously, to capture the full impact of food related behaviors of a person, a lot of information would have to be recorded, e.g. for the ecological impact the quantity of food eaten, the distance of food travelled, etc. also plays a role. The same holds true for the socio-economic dimension, with regards to health issues for example, the consumption of

unhealthy foods such as alcohol, fats or sweets, could be justified. For potential detrimental cultural effects of the popularization of ethnic foods, Quinoa from Bolivia (Romero and Shahriari, 2011) serves as an illustrative example. For an administrable and feasible questionnaire, the crucial question is to find a reasonable cut-off point between comprehensiveness and a manageable length.

*Weighing and Trade-Offs of Items*

Depending on which indicators are used, results of impact assessments can vary considerably in either sustainability dimension and one major challenge is weighing the relevance of different indicators for an overall balance (Bengtsson and Steen, 2000). This is especially aggravated when indicators are barely comparable (e.g. land use vs. $CO_2$ or health care vs. drinking water access) or are at odds with each other, as sometimes the case between socio-economic and ecological indicators (e.g. avoidance of imported fruits for ecological reasons vs. strengthening of local farm industry in tropical countries). Hence, for any specific example, potential opposing consequences need to be measured against each other with care, and in the end remain a normative decision.

*Data Availability and Contingency*

While significant progress has been made in the assessment of impacts, sustainable consumption scholars looking for reliable evidence on different impacts of consumer goods are still facing a stock of research that has been described as heterogeneous, ambiguous and inconsistent (Duchin, 2005). One reason for this situation is that different LCA tools have different scopes and are based on different parameters, which why is they produce different results for the same product. Especially S-LCAs are impeded by less reliable data sources in many world regions where the fulfillment of socio economic minimum standards is particularly threatened (United Nations, 2007).

*Uniqueness and Co-Benefits of Behaviors*

Some items are difficult to assign to one specific cell. One ambiguity exists regarding the sustainability spheres: Many behaviors benefit environmental and socio-economic issues alike. E.g. buying local produce from organic farmers is good for the planet (short transport distance) but also supports local business structures. With regards to the consumption phase, some behaviors also defy an unequivocal classification as e.g. buying frozen food; here the acquisition of a product implies a certain usage behavior (freezing) and thus could be classified as either. The sometimes ambiguous assignment of items to cells does not forfeit the construct validity of the scale in our view. More important than a clear cut assignment of an item to one specific cell, is the consideration of *all* cells that were

intended conceptually. To the contrary, that some behaviors co-benefit different aspects is regarded a welcome instance of an inner-sustainability double dividend.

## General Conclusions

In this article we presented a comprehensive model of sustainable consumption behavior that serves two purposes: Firstly, it allows to relate research results to one another and enables conclusions on a meta-level. Secondly, it can serve as a guideline to include impact information into the social science approaches on sustainable consumption.

Regarding the systematizing purpose of the cube model, we analyzed current measurement practice of sustainable consumption behaviors in different disciplines and pointed out existing blind spots. On this meta-level, the model could also be used to guide research on spill-over effects from one sustainable behavior to another (e.g. Thøgersen and Crompton, 2009; Truelove *et al.*, 2014). It could serve as an orientation frame to systemize existing research as to from which consumption area, sustainability dimension or impact-category to another spill-over has taken place. The same is true for behavioral rebound effects, where technological efficiency gains are consumed by intensified consumption behaviors (Santarius *et al.*, 2016). Here the cube model could also orient rebound research to summarize which areas of sustainable consumption are specifically relevant for the rebound phenomenon or potentially overplayed (Gillingham *et al.*, 2013).

With respect to the scale construction purpose, the lack of transparency and documented argumentation for the selection of behaviors in social science studies was singled out as a major obstacle hindering comparability and thus the advancement of the interdisciplinary research field. Most investigations on sustainable consumer behavior to date do not comply with this minimum standard of explicitly laying open the selection criteria for investigated behavior(s). As a second application purpose, the cube model can help to spell out such explicit criteria and advance scale construction in the measurement of sustainable consumption behaviors.

In summary, our cube model of sustainable consumption behavior is situated right at the nexus of impact-related information from the natural sciences and individual behaviors from the social sciences at a per-capita level. With its systematizing function it is intended to make interdisciplinary research on sustainable consumption behavior more comparable and enable meta-level conclusions that are useful for researchers and policy makers alike. The case of sustainable consumption is a good example that it is both necessary and

possible for social and natural science approaches to complement and advance each other to generate scientific impetus for sustainable development.

## References

Aarnio T, Hämäläinen A. 2008. Challenges in packaging waste management in the fast food industry. *Resources, Conservation and Recycling* **52**(4): 612–621.

Abrahamse W, Steg L, Vlek C, Rothengatter T. 2005. A review of intervention studies aimed at household energy conservation. *Journal of Environmental Psychology* **25**(3): 273–291. DOI: 10.1016/j.jenvp.2005.08.002.

Arnould EJ, Plastina A, Ball D. 2009. Does Fair Trade Deliver on Its Core Value Proposition? Effects on Income, Educational Attainment, and Health in Three Countries. *Journal of Public Policy & Marketing* **28**(2): 186–201.

Balderjahn I, Buerke A, Kirchgeorg M, Peyer M, Seegebarth B, Wiedmann K. 2013. Consciousness for sustainable consumption: Scale development and new insights in the economic dimension of consumers' sustainability. *AMS Review* **3**(4): 181–192. DOI: 10.1007/s13162-013-0057-6.

Bamberg S, Möser G. 2007. Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour. *Journal of Environmental Psychology* **27**(1): 14–25. DOI: 10.1016/j.jenvp.2006.12.002.

Bekin C, Seyfang G. 2007. Growing sustainable consumption communities: The case of local organic food networks. *International Journal of Sociology and Social Policy* **27**(3/4): 120–134.

Bengtsson M, Steen B. 2000. Weighting in LCA – approaches and applications. *Environmental Progress* **19**(2): 101–109. DOI: 10.1002/ep.670190208.

Beretta C, Stoessel F, Baier U, Hellweg S. 2013. Quantifying food losses and the potential for reduction in Switzerland. *Waste management* **33**(3): 764–773.

Berger I. 1997. The demographics of recycling and the structure of environmental behavior. *Environment and Behavior* **29**(4): 515–531.

Bettencourt LMA, Kaur J. 2011. Evolution and structure of sustainability science. *Proceedings of the National Academy of Sciences* **108**(49): 19540–19545. DOI: 10.1073/pnas.1102712108.

Bilharz M, Lorek S, Schmitt K. 2008. Key points of sustainable consumption: Focusing sustainability communication on aspects which matter AND appeal. In *Sustainable Consumption and Production: 2nd Conference of the Sustainable Consumption Research Exchange (SCORE!) Network*. Refereed Sessions I-II, SCORE!-Network: Brussels; 287–307.

Botsman R, Rogers R. 2011. *What's mine is yours: How collaborative consumption is changing the way we live,* Rev. and updated ed. Collins: London.

Brown KW, Kasser T. 2005. Are Psychological and Ecological Well-being Compatible? The Role of Values, Mindfulness, and Lifestyle. *Social Indicators Research* **74**(2): 349–368. DOI: 10.1007/s11205-004-8207-8.

Ceglia D, de Oliveira Lima, Sérgio Henrique, Leocádio ÁL. 2015. An Alternative Theoretical Discussion on Cross-Cultural Sustainable Consumption. *Sustainable Development* **23**(6): 414–424. DOI: 10.1002/sd.1600.

Cole MJ, Bailey RM, New MG. 2014. Tracking sustainable development with a national barometer for South Africa using a downscaled "safe and just space" framework. *Proceedings of the National Academy of Sciences* **111**(42): E4399-E4408. DOI: 10.1073/pnas.1400985111.

Comim F, Tsutsumi R, Varea A. 2007. Choosing sustainable consumption: a capability perspective on indicators. *Journal of International Development* **19**(4): 493–509.

Corral-Verdugo V. 1996. A Structural Model of Reuse and Recycling in Mexico. *Environment and Behavior* **28**(5): 665–696. DOI: 10.1177/001391659602800505.

Corral-Verdugo V, Fraijo-Sing B, Pinheiro JQ. 2006. Sustainable Behavior and Time Perspective: Present, Past, and Future Orientations and Their Relationship with Water Conservation

Behavior. *Revista Interamericana de Psicología/Interamerican Journal of Psychology*(40): 139–147.

Cruz I, Stahel A, Max-Neef M. 2009. Towards a systemic development approach: Building on the Human-Scale Development paradigm. *Ecological Economics* **68**(7): 2021–2030.

Csutora M. 2012. One More Awareness Gap? The Behaviour–Impact Gap Problem. *Journal of Consumer Policy* **35**(1): 145–163. DOI: 10.1007/s10603-012-9187-8.

Dholakia R, Wackernagel M. 1999. *The Ecological Footprint Questionnaire*. Redefining Progress: San Francisco.

Di Giulio A, Fischer D, Schäfer M, Blättel-Mink B. 2014. Conceptualizing sustainable consumption: toward an integrative framework. *Sustainability: Science, Practice, & Policy* **10**(1): 45–61.

Di Giulio A, Fuchs D. 2014. Sustainable Consumption Corridors: Concept, Objections, and Responses. *GAIA - Ecological Perspectives for Science and Society* **23**(3): 184–192. DOI: 10.14512/gaia.23.S1.6.

Di Polizzi Sorrentino E, Woelbert E, Sala S. 2016. Consumers and their behavior: State of the art in behavioral science supporting use phase modeling in LCA and ecodesign. *The International Journal of Life Cycle Assessment* **21**(2): 237–251.

Dietz T, Gardner GT, Gilligan J, Stern PC, Vandenbergh MP. 2009. Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions. *Proceedings of the National Academy of Sciences of the United States of America* **106**(44): 18452–18456. DOI: 10.1073/pnas.0908738106.

Duchin F. 2005. Sustainable consumption of food – A framework for analyzing scenarios about changes in diets. *Journal of Industrial Ecology* **9**(1-2): 99–114.

EEA. 2013. *Environmental pressures from European consumption and production. A study in integrated environmental and economic analysis.* Technical report No 2/2013: Copenhaguen.

Engel JF, Blackwell RD, Miniard PW. 1990. *Consumer behavior,* 6. ed. Dryden Press: Chicago.

Farley HM, Smith ZA. 2013. *Sustainability: If it's everything, is it nothing?* Routledge: New York.

Federal Ministry for Economic Cooperation and Development. 2014. *The partnership for sustainable textiles: Report*.

Finnveden G, Hauschild MZ, Ekvall T, Guinée J, Heijungs R, Hellweg S, Koehler A, Pennington D, Suh S. 2009. Recent developments in Life Cycle Assessment. *Journal of Environmental Management* **91**(1): 1–21.

Fischer D, Michelsen G, Blättel-Mink B, Di Giulio A. 2012. Sustainable consumption: how to evaluate sustainability in consumption acts. In *The nature of sustainable consumption and how to achieve it: Results from the focal topic "from knowledge to action - new paths towards sustainable consumption"*, Defila R, Di Giulio A, Kaufmann-Hayoz R (eds). Oekom: München; 67–80.

Franklin A, Newton J, McEntee JC. 2011. Moving beyond the alternative: sustainable communities, rural resilience and the mainstreaming of local food. *Local Environment* **16**(8): 771–788.

Franz J, Papyrakis E. 2011. Online calculators of ecological footprint: Do they promote or dissuade sustainable behaviour? *Sustainable Development* **19**(6): 391–401. DOI: 10.1002/sd.446.

Galli A, Wiedmann T, Ercin E, Knoblauch D, Ewing B, Giljum S. 2012. Integrating Ecological, Carbon and Water footprint into a “Footprint Family” of indicators: Definition and role in tracking human pressure on the planet. *Ecological Indicators* **16**: 100–112.

Gardner GT, Stern PC. 2008. The Short List: The Most Effective Actions U.S. Households Can Take to Curb Climate Change. *Environment: Science and Policy for Sustainable Development* **50**(5): 12–25. DOI: 10.3200/ENVT.50.5.12-25.

Gatersleben B. 2013. Measuring environmental behavior. In *Environmental psychology: An introduction*. 1. publ, Linda Steg (ed.). BPS Blackwell: Chichester [u.a.]; 131–140.

Gatersleben B, Steg L, Vlek C. 2002. Measurement and determinants of environmentally significant consumer behavior. *Environment and Behavior* **34**: 353–362. DOI: 10.1177/0013916502034003004.

Gilg A, Barr S, Ford N. 2005. Green consumption or sustainable lifestyles?: Identifying the sustainable consumer. *Futures* **37**(6): 481–504. DOI: 10.1016/j.futures.2004.10.016.

Gillingham K, Kotchen MJ, Rapson DS, Wagner G. 2013. Energy policy: The rebound effect is overplayed. *Nature* **493**(7433): 475–476. DOI: 10.1038/493475a.

Goldstein B, Birkved M, Fernández J, Hauschild M. 2016. Surveying the Environmental Footprint of Urban Food Consumption. *Journal of Industrial Ecology*: 1–15.

Hager TJ, Morawicki R. 2013. Energy consumption during cooking in the residential sector of developed nations: A review. *Food Policy* **40**: 54–63.

Hall KD, Guo J, Dore M, Chow CC. 2009. The progressive increase of food waste in America and its environmental impact. *PloS one* **4**(11): e7940. DOI: 10.1371/journal.pone.0007940.

Heiskanen E, Mont O, Power K. 2014. A Map Is Not a Territory—Making Research More Helpful for Sustainable Consumption Policy. *Journal of Consumer Policy* **37**(1): 27–44.

Heller MC, Keoleian GA, Willett WC. 2013. Toward a life cycle-based, diet-level framework for food environmental impact and nutritional quality assessment: a critical review. *Environmental Science & Technology* **47**(22): 12632–12647. DOI: 10.1021/es4025113.

Hertwich EG. 2005. Life cycle approaches to sustainable consumption: A critical review. *Environmental Science & Technology* **39**(13): 4673–4684.

Hertwich EG, Pease WS, Koshland CP. 1997. Evaluating the environmental impact of products and production processes: A comparison of six methods. *Science of The Total Environment* **196**(1): 13–29.

Holden E, Linnerud K, Banister D. 2016. The Imperatives of Sustainable Development. *Sustainable Development.* DOI: 10.1002/sd.1647.

Horrigan L, Lawrence RS, Walker P. 2002. How Sustainable Agriculture Can Address the Environmental and Human Health Harms of Industrial Agriculture. *Environmental Health Perspectives* **110**(5): 445–456.

ICSU, ISSC. 2010. *Earth System Science for Global Sustainability: The Grand Challenges*. International Council for Science: Paris.

Ivanova D, Stadler K, Steen-Olsen K, Wood R, Vita G, Tukker A, Hertwich EG. 2015. Environmental Impact Assessment of Household Consumption. *Journal of Industrial Ecology*: 526–536.

Jackson T. 2007. Sustainable Consumption. In *Handbook of Sustainable Development*, Atkinson G, Dietz, S., Neumeyer, E. (eds). Elgar: Cheltenham, UK; 254–268.

Jørgensen A, Le Bocq A, Nazarkina L, Hauschild M. 2008. Methodologies for social life cycle assessment. *The International Journal of Life Cycle Assessment* **13**(2): 96–103. DOI: 10.1065/lca2007.11.367.

Kaiser FG, Wilson M. 2004. Goal-directed conservation behavior: the specific composition of a general performance. *Personality and Individual Differences* **36**(7): 1531–1544. DOI: 10.1016/j.paid.2003.06.003.

Kates RW, Clark WC, Corell R, Hall JM, Jaeger CC, Lowe I, McCarthy JJ, Schellnhuber HJ, Bolin B, Dickson NM, Faucheux S, Gallopin GC, Grubler A, Huntley B, Jager J, Jodha NS, Kasperson RE, Mabogunje A, Matson P, Mooney H. 2001. Sustainability Science. *Science* **292**(5517): 641–642.

Kollmuss A, Agyeman J. 2002. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research* **8**(3): 239–260. DOI: 10.1080/13504620220145401.

Kortright R, Wakefield S. 2011. Edible backyards: A qualitative study of household food growing and its contributions to food security. *Agriculture and Human Values* **28**(1): 39–53.

Lam JCK, Walker RM, Hills P. 2014. Interdisciplinarity in Sustainability Studies: A Review. *Sustainable Development* **22**(3): 158–176. DOI: 10.1002/sd.533.

Le Mare A. 2008. The Impact of Fair Trade on Social and Economic Development: A Review of the Literature. *Geography Compass* **2**(6): 1922–1942.

Leach MA, Raworth K, Rockström J. 2013. Between social and planetary boundaries: Navigating pathways in the safe and just space for humanity. In *World Social Science Report 2013: Changing Global Environments*, International Social Science Council (ISSC), United Nations Educational, Scientific and Cultural Organization (UNESCO) (eds). OECD Publishing and UNESCO Publishing: Paris; 84–89.

Liu W, Oosterveer P, Spaargaren G. 2015. Promoting sustainable consumption in China: A conceptual framework and research review. *Journal of Cleaner Production* **134**(Part A): 13–21.

Liu Y, Qu Y, Lei Z, Jia H. 2017. Understanding the Evolution of Sustainable Consumption Research. *Sustainable Development.* DOI: 10.1002/sd.1671.

Lorek S, Spangenberg JH. 2001. Indicators for environmentally sustainable household consumption. *International Journal of Sustainable Development* **4**(1): 101–120.

Macdiarmid JI, Kyle J, Horgan GW, Loe J, Fyfe C, Johnstone A, McNeill G. 2012. Sustainable diets for the future: Can we contribute to reducing greenhouse gas emissions by eating a healthy diet? *The American journal of clinical nutrition* **96**(3): 632–639.

MacInnis DJ, Folkes VS. 2010. The Disciplinary Status of Consumer Behavior: A Sociology of Science Perspective on Key Controversies. *Journal of Consumer Research* **36**(6): 899–914.

Milne R. 2012. Arbiters of waste: Date labels, the consumer and knowing good, safe food. *The Sociological Review* **60**: 84–101.

Mont O, Plepys A. 2008. Sustainable consumption progress: Should we be proud or alarmed? *Journal of Cleaner Production* **16**(4): 531–537. DOI: 10.1016/j.jclepro.2007.01.009.

Morrison-Saunders A, Pope J. 2013. Conceptualising and managing trade-offs in sustainability assessment. *Environmental Impact Assessment Review* **38**: 54–63. DOI: 10.1016/j.eiar.2012.06.003.

Murphy K. 2012. The Social Pillar of Sustainable Development: A Literature Review and Framework for Policy Analysis. *Sustainability: Science, Practice, & Policy* **8**(1): 15–29.

Muthu SS. 2015. *Handbook of Life Cycle Assessment (LCA) of textiles and clothing*. The Textile Institute; WP Woodhead Publishing; Elsevier: Amsterdam.

Ness B, Urbel-Piirsalu E, Anderberg S, Olsson L. 2007. Categorising tools for sustainability assessment. *Ecological Economics* **60**(3): 498–508.

Norwegian Ministry of Environment. 1994. *The Srioa Moria Symposium on Sustainable Production and Consumption*: Oslo.

Overeem P. 2009. *Reset: Corporate social responsibility in the global electronics supply chain*. https://www.somo.nl/reset/ [12 July 2016].

Parfitt J, Barthel M, Macnaughton S. 2010. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* **365**(1554): 3065–3081. DOI: 10.1098/rstb.2010.0126.

Pepper M, Jackson T, Uzzell D. 2009. An examination of the values that motivate socially conscious and frugal consumer behaviours. *International Journal of Consumer Studies* **33**(2): 126–136. DOI: 10.1111/j.1470-6431.2009.00753.x.

Pope J, Annandale D, Morrison-Saunders A. 2004. Conceptualising sustainability assessment. *Environmental Impact Assessment Review* **24**(6): 595–616.

Rapport D, Friend A. 1979. *Towards a comprehensive framework for environmental statistics: a stress-response approach*. Ministry of Supply and Services Canada: Ottawa.

Reisch LA. 2004. Principles and Visions of a New Consumer Policy: Discussion Paper by the Scientific Advisory Board for Consumer, Food, and Nutrition Policies to the German Federal Ministry of Consumer Protection, Food, and Agriculture. *Journal of Consumer Policy* **27**(1): 1–42.

Reisch LA, Eberle U, Lorek S. 2013. Sustainable Food Consumption: An Overview of Contemporary Issues and Policies. *Sustainability: Science, Practice, & Policy* **9**(2): 7–25.

Reisch LA, Thøgersen J (eds). 2015. *Handbook of research on sustainable consumption*. Edward Elgar Publishing: Cheltenham, UK.

Reynolds CJ, Buckley JD, Weinstein P, Boland J. 2014. Are the dietary guidelines for meat, fat, fruit and vegetable consumption appropriate for environmental sustainability? A review of the literature. *Nutrients* **6**(6): 2251–2265. DOI: 10.3390/nu6062251.

Rockström J, Steffen W, Noone K, Persson Å, Chapin FS, Lambin EF, Lenton TM, Scheffer M, Folke C, Schellnhuber HJ, Nykvist B, Wit CA de, Hughes T, van der Leeuw S, Rodhe H, Sörlin S, Snyder PK, Costanza R, Svedin U, Falkenmark M, Karlberg L, Corell RW, Fabry VJ, Hansen J, Walker B, Liverman D, Richardson K, Crutzen P, Foley JA. 2009a. A safe operating space for humanity. *Nature* **461**(7263): 472–475.

Rockström J, Steffen W, Noone K, Persson Å, Chapin FS, III, Lambin E, Lenton TM, Scheffer M, Folke C, Schellnhuber HJ, Nykvist B, Wit CA de, Hughes T, van der Leeuw S, Rodhe H, Sörlin S, Snyder PK, Costanza R, Svedin U, Falkenmark M, Karlberg L, Corell RW, Fabry VJ, Hansen J, Walker B, Liverman D, Richardson K, Crutzen P, Foley J. 2009b. Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society* **14**(2): 32. DOI: 10.5751/ES-03180-140232.

Romero S, Shahriari S. 2011. Quinoa's Global Success Creates Quandary at Home. *New York Times.* 19 March 2011.

Santarius T, Walnum HJ, Aall C (eds). 2016. *Rethinking Climate and Energy Policies: New Perspectives on the Rebound Phenomenon*. Springer International Publishing: Cham, s.l.

Schmidt Rivera XC, Espinoza Orias N, Azapagic A. 2014. Life cycle environmental impacts of convenience food: Comparison of ready and home-made meals. *Journal of Cleaner Production* **73**: 294–309. DOI: 10.1016/j.jclepro.2014.01.008.

Schoolman ED, Guest JS, Bush KF, Bell AR. 2012. How interdisciplinary is sustainability research? Analyzing the structure of an emerging scientific field. *Sustainability Science* **7**(1): 67–80. DOI: 10.1007/s11625-011-0139-z.

Schrader U, Liedtke C, Lamla J, Arens-Azevedo U, Hagen K, Jaquemoth M, Kenning P, Schmidt-Kessel M, Strünck C. 2013. *Verbraucherpolitik für nachhaltigen Konsum – Verbraucherpolitische Perspektiven für eine nachhaltige Transformation von Wirtschaft und Gesellschaft: Stellungnahme des wissenschaftlichen Beirats Verbraucher- und Ernährungspolitik beim BMELV*. German Federal Ministry for Food, Agriculture and Consumer Protection: Berlin.

Schultz W. 2002. Knowledge, Information and Household Recycling: Examining the Knowledge-Deficit Model of Behavior Change. In *New tools for environmental protection: Education, information, and voluntary measures*, Dietz T, Stern PC (eds). National Academy Press: Washington, DC; 67–82.

Simmons D, Chapman GE. 2012. The significance of home cooking within families. *British Food Journal* **114**(8): 1184–1195. DOI: 10.1108/00070701211252110.

Singh RK, Murty HR, Gupta SK, Dikshit AK. 2012. An overview of sustainability assessment methodologies. *Ecological Indicators* **15**(1): 281–299. DOI: 10.1016/j.ecolind.2011.01.007.

Soron D. 2010. Sustainability, self-identity and the sociology of consumption. *Sustainable Development* **18**(3): 172–181. DOI: 10.1002/sd.457.

Steen-Olsen K, Hertwich EG. 2015. Life cycle assessment as a means to identify the most effective action for sustainable consumption. In *Handbook of research on sustainable consumption*, Reisch LA, Thøgersen J (eds). Edward Elgar Publishing: Cheltenham, UK; 131–144.

Steffen W, Richardson K, Rockström J, Cornell SE, Fetzer I, Bennett EM, Biggs R, Carpenter SR, Vries W de, Wit CA de, Folke C, Gerten D, Heinke J, Mace GM, Persson LM, Ramanathan V, Reyers B, Sörlin S. 2015. Sustainability. Planetary boundaries: guiding human development on a changing planet. *Science* **347**(6223). DOI: 10.1126/science.1259855.

Steg L. 2008. Promoting household energy conservation. *Energy Policy* **36**(12): 4449–4453. DOI: 10.1016/j.enpol.2008.09.027.

Steg L, Vlek C. 2009. Encouraging pro-environmental behaviour: An integrative review and research agenda. *Journal of Environmental Psychology* **29**(3): 309–317. DOI: 10.1016/j.jenvp.2008.10.004.

Tanner C, Wölfing Kast S. 2003. Promoting sustainable consumption: Determinants of green purchases by Swiss consumers. *Psychology & Marketing* **20**(10): 883–902. DOI: 10.1002/mar.10101.

Thøgersen J. 2014. Unsustainable Consumption. *European Psychologist* **19**(2): 84–95. DOI: 10.1027/1016-9040/a000176.

Thøgersen J, Crompton T. 2009. Simple and Painless?: The Limitations of Spillover in Environmental Campaigning. *Journal of Consumer Policy* **32**(2): 141–163. DOI: 10.1007/s10603-009-9101-1.

Truelove HB, Carrico AR, Weber EU, Raimi KT, Vandenbergh MP. 2014. Positive and negative spillover of pro-environmental behavior: An integrative review and theoretical framework. *Global Environmental Change* **29**: 127–138. DOI: 10.1016/j.gloenvcha.2014.09.004.

Tukker A, Cohen MJ, Hubacek K, Mont O. 2010. The Impacts of Household Consumption and Options for Change. *Journal of Industrial Ecology* **14**(1): 13–30. DOI: 10.1111/j.1530-9290.2009.00208.x.

Tukker A, Jansen B. 2006. Environmental Impacts of Products: A Detailed Review of Studies. *Journal of Industrial Ecology* **10**(3): 159–182. DOI: 10.1162/jiec.2006.10.3.159.

UNEP/SETAC Life Cycle Initiative. 2014. *Hotspots Analysis: mapping of existing methodologies, tools and guidance and initial recommendations for the development of global guidance*.

United Nations. 2007. *Indicators of sustainable development: Guidelines and methodologies,* 3rd ed. United Nations: New York.

United Nations. 2015. Transforming our world: the 2030 Agenda for Sustainable Development: Resolution (A/70/L.1). United Nations: New York.

Wackernagel M, Rees WE. 1996. *Our ecological footprint: Reducing human impact on the earth*. New Society Publ.: Gabriola Island, BC.

Webb DJ, Mohr LA, Harris KE. 2008. A re-examination of socially responsible consumption and its measurement. *Journal of Business Research* **61**(2): 91–98. DOI: 10.1016/j.jbusres.2007.05.007.

West SE, Owen A, Axelsson K, West CD. 2015. Evaluating the Use of a Carbon Footprint Calculator: Communicating Impacts of Consumption at Household Level and Exploring Mitigation Options. *Journal of Industrial Ecology*: 396–409.

Whitmarsh L, O'Neill S. 2010. Green identity, green living?: The role of pro-environmental self-identity in determining consistency across diverse pro-environmental behaviours. *Journal of Environmental Psychology* **30**(3): 305–314. DOI: 10.1016/j.jenvp.2010.01.003.

Williams H, Wikström F. 2011. Environmental impact of packaging and food losses in a life cycle perspective: A comparative analysis of five food items. *Journal of Cleaner Production* **19**(1): 43–48. DOI: 10.1016/j.jclepro.2010.08.008.

World Commission on Environment and Development. 1987. *Our common future*. Oxford University Press: New York.

Wuppertal Institut. 1996. *Zukunftsfähiges Deutschland.: Ein Beitrag zu einer global nachhaltigen Entwicklung*. Birkhäuser: Basel.