Special Issue
Sustainable Food Consumption: Current Trends, Policy Approaches, and Future Scenarios

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Sustainable food consumption: when evidence-based policy making meets policy-minded research—Introduction to the special issue

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Unsustainability of Current Global Food Consumption

Food is a major issue in the politics of sustainable consumption and production (SCP) because of its impact on the environment, the economy, social cohesion, and individual and public health.¹ Some of the most serious environmental problems high on policy agendas worldwide are related to food production and consumption, including climate change, water pollution and scarcity, soil degradation, eutrophication of water bodies, and loss of habitats and biodiversity.² Population growth and rising economic prosperity are expected to increase demand for energy, food, and water, whereas in many parts of the world they are already forced to compete for inadequate resources. Growing requirements around the so-called energy-food-water nexus might thus compromise the sustainable use of natural resources and could lead to social and geopolitical tensions.

We are witnessing today the disturbing situation of about 800 million people worldwide suffering hunger and underconsumption of food and lacking access to clean drinking water. At the same time, more than a billion people are overweight and 300 to 500 million of them obese, with the trend increasing in most regions. Consequently, due primarily to shifts in diet toward more sugar, animal protein, and trans fats, diet- and lifestyle-related health problems, such as cardiovascular diseases and diabetes, are hitting young age groups and significantly increasing health costs. Given demographic changes and the growing global population, these problems will likely worsen in the near future.

Sustainable Food Consumption as a Policy Area

Policy action for sustainable food consumption is driven primarily by growing scientific understanding of the above-mentioned dilemmas. Over the last twenty years, an increasing number of policies, programs, and initiatives by international organizations and governments at all levels (including a number at the regional and local/community level) have been implemented. Yet it is somehow surprising that, while the sustainability impacts of the food sector are widely accepted, efforts to design and implement integrated sustainable food production and consumption policies have been largely absent. This lack of attention to more systemic issues may be one reason why food consumption patterns show barely any shift toward sustainability.

Another reason for the reluctance of policy makers to take more decisive action to facilitate sustainable food consumption might be the fuzzy and ill-defined nature of the challenge. To start, there is no commonly agreed upon definition of sustainable food consumption. The UK Sustainable Development Commission (2009) has to date proposed the most encompassing formulation:

[S]ustainable food and drink is safe, healthy, and nutritious for consumers in shops, restaurants, schools, hospitals, and so forth; can meet the needs of the less well off worldwide; provides a viable livelihood for farmers, processors, and retailers, whose employees enjoy a safe and hygienic working environment whether nationally or abroad; respects biophysical and environmental limits in its production and processing while re-

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¹ Food is one of the three consumption areas, together with housing and mobility, recognized as having the most significant social and environmental impacts (see, e.g., Foster et al. 2006; Tukker et al. 2009; EEA, 2012).
² For example, food consumption and production is responsible for about one fifth of greenhouse-gas emissions, as well as the bulk of water use worldwide.
producing energy consumption and improving the wider environment; respects the highest standards of animal health and welfare compatible with the production of affordable food for all societal sectors; and supports rural economies and the diversity of rural culture, in particular by emphasizing local products that keep food miles to a minimum.

This ambitious and cross-cutting framework requires intensive policy integration and cooperation. In a number of European Union (EU) member countries, this agenda has not yet become fully institutionalized and thus the initiatives carried out by governments tend to be ad hoc instead of systematic or “structural,” as well as fragmented across various ministries (primarily ministries of the environment, food and agriculture, land use, consumer protection and public health, and regional or social affairs) and tied to various other policy frames (such as health policy) rather than explicitly to an integrated sustainable food-consumption strategy.

Although numerous policy instruments have been trialed (often without an integrative approach), their common feature is a specific orientation toward the consumer. This approach can be considered a relatively new form of governing that entails active self-governing by responsible citizen-consumers and is supported by specific kinds of scientific and statistical knowledge. Asking individuals to “work on themselves and their conduct and transform themselves with the help of experts, training and services” (Dean, 2007) means that, for ethical purposes, the “subject of the state” is being transformed into a “responsible subject.”

A recent sectoral analysis of policy tools for sustainable food consumption (BIO Intelligence Service, 2012) shows that most available interventions are behavioral and informational. They aim for changes in awareness and attitudes of consumers through provision of information (e.g., product labeling, information campaigns tailored to specific audiences, nutrition and obesity education, “food literacy”), in household competences and skills (e.g., food competence and home economics training programs), or in behavior by making “right” choices easier (choice editing) and by shaping identities and lifestyles (e.g., toward regional identities and lifestyles of health and sustainability—LOHAS). Researchers emphasize that in terms of the latter, sustainable food styles must fit into people’s everyday lifestyles (i.e., must be “feasible,” available, affordable, and accessible) and should allow for sociocultural diversity (Eberle et al. 2006). Other categories of policy instruments can be considered at a more conceptual or experimental stage, such as market intervention through public procurement of sustainable food, other market-based instruments (elimination of harmful subsidies, organic production subsidies, and differentiated consumption taxes based on product environmental performance), as well as regulatory (“command and control”) instruments (e.g., bans on unhealthy food, prohibitions on quantity-based marketing strategies).3 Policy makers also seek synergies with instruments that are aimed at producers and caterers such as certification, standardization, and inspection schemes associated with product labeling, various voluntary and self-commitment instruments, and cooperation and networking with food-system actors. At the same time, practices of monitoring and data collection (gathering of consumption statistics, measurement of environmental impacts of various foods, establishment of databases or statistical indicators) are carried out to reach a common understanding of issues, to enable construction of the link between consumers and global environmental and social problems, and to enable design of the mentioned policy interventions.

Science-Policy Gap in Sustainable Consumption and the CORPUS Project

The complexities related to the contemporary system of food production and consumption are immensely challenging for sustainability policy making. One response to this situation has been the emergence of “evidence-based policy making” that aims to improve quality and impact through more effective use of scientific expertise. Accurate knowledge about system dynamics, strategic levers, and unintentional consequences is needed to design and implement effective policies. Indeed, we contend that increasing scientific evidence and political consensus are proving to be important drivers for the institutionalization of sustainable food consumption as a policy area. However, evidence-based policy making is not easy to put into practice. A particular problem with respect to food seems to be conflicting knowledge claims. In fact, some observers contend that conflicts among food experts have been described as “endemic” (Smith & Phillips, 2000; cf. Levidow et al. 2005). Furthermore, numerous structural factors hinder successful knowledge translation between science and policy (e.g., Choi et al. 2005; EC, 2008; Ward et al. 2009a; 2009b).

3 Command and control instruments typically serve to respond to acute threats to life and health of citizens such as food safety in relation to genetically modified organisms (GMOs), the mad-cow scare, or dioxin and E. coli poisonings, but have also recently been considered for food groups where the threats to life and health are long term and related to lifestyles.
While policy makers need to seek solutions to particular issues (solutions that fit into problem-centered “policy narratives”), researchers strive for scientific excellence in ways that are not necessarily measured by real-world impact. As a consequence, policy makers are required to engage with a range of stakeholders, while researchers can often confine themselves to interaction with their scientific peers. Moreover, policy makers face rapidly evolving challenges that often require prompt responses. Researchers, by contrast, are usually not exposed to decision-making processes and operate in an environment that does not require results with an immediate impact on society or policy making. Finally, policy makers use scientific evidence to inform their decision making, either ex ante, in defining policy, or ex post, in evaluating policy choices. This information must be accessible and presented so that it can contribute to practical solutions to problems. To meet this requirement, researchers need to translate their findings into formats and formulations that are useful to policy makers.

Against the background of these practical barriers to evidence-based policy making, the EU-funded CORPUS project developed a knowledge-brokerage system designed to improve the science-policy interface in SCP. Addressing three priority areas of consumption—food, mobility, and housing—the system comprised online and offline elements supporting knowledge exchange and built up practice communities comprising both policy makers and researchers. The backbone of the project was an Internet-based platform that, after three years of operation, serves as a repository of almost 600 knowledge items (e.g., scientific publications, policy documents, event reports) and encompasses approximately 900 registered users from science, policy, and civil society. In addition, we convened nine so-called “Policy Meets Research” workshops that employed a broad range of activating moderation techniques—from poster walks to participatory scenario building—and thus provided space for intense dialogue and cross-community networking. The CORPUS approach brought to fruition the notions of a knowledge-system framework and a transactional framework that have been conceptually developed in the academic literature on knowledge brokerage (e.g., Oldham & McLean, 1997; Pregernig, 2004).

The CORPUS experience revealed that policy makers find research on sustainable consumption to be too wide-ranging and complex to process, and they call for “better” (i.e., more usable) rather than more knowledge. More effective processing and presentation of existing evidence thus seems to be crucial, as is the provision of guidance in numerous opportunities for research partnerships. Furthermore, scientific knowledge is only one among the various types of knowledge policy makers ask for—they also find knowledge about good policy practice very useful. Transnational dialogue within and across the science and policy communities helps research findings and policy experience travel widely and is therefore another important ingredient to evidence-based policy making for sustainable consumption. The articles presented here contribute to this dialogue.

**Articles in this Issue**

This special issue comprises articles that focus on different aspects of (un)sustainable food consumption and production as outlined above. In an introductory article, Lucia Reisch, Ulrike Eberle, & Sylvia Lorek present an extensive literature review and describe the major issues in the current system of food production and consumption. Suggesting the need for an integrative approach, they lay out the interlinkages among the ecological, social, ethical, health-related, and economic dimensions. For each impact domain, they provide an overview of the main policy and research issues, key theoretical approaches, major empirical studies, and available data, as well as the main challenges on both the production and the consumption side. Reisch and her colleagues also identify priority areas and corresponding policy options for SCP strategies for the food sector and conclude with recommendations for the diverse actors in the system.

Over the past few decades, meat consumption—a “hot spot” of both environmentally harmful consumption practices and public health—has grown markedly. In “Does Global Meat Consumption Follow an Environmental Kuznets Curve?” Jennifer Rivers Cole & Suzanne McCoskey assemble data on meat consumption, per capita income, and other socioeconomic variables for 150 countries to test the hypothesis that per capita meat consumption follows a Kuznets-style inverted U-curve. This proposition contends that as per capita income increases in a country, consumers at first purchase more meat but ultimately modify their eating practices. The results signal that although there is evidence of a Kuznets relationship in the data, the income level that needs to be reached for meat consumption to taper off is sufficiently high that most countries will not begin to see a decline in the foreseeable future. For a cross-section of high-income countries, Rivers Cole & McCoskey demonstrate that a reversal in meat consumption does not occur until per capita income reaches US$49,848. In the full-panel data sample, combining high- and low-income countries, they find an inflection point

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4 See http://wwwscp-knowledge.eu.
for meat consumption at US$36,375, still quite high for any prospective reduction in impact. The authors conclude that effectively decelerating the global demand for meat may require aggressive and potentially controversial policy interventions.

Policy interest in the meat consumption “hot spot” has also led to a call for more reliable and coherent meat-consumption data to be able to build a more scientifically reliable foundation for national sustainability strategies and dietary recommendations. Elinor Hallström & Pål Börjesson take up this challenge and assess the consistency and trustworthiness of current meat-consumption statistics. They describe how these statistics are produced and discuss their strengths and limitations. The article in particular identifies several uncertainties and discrepancies in available meat statistics and explores some of the ramifications of this variation. The authors outline how meat-consumption data are assembled and presented at the national (Swedish), regional (Eurostat), and international (FAOSTAT) levels and highlight how inconsistencies can create complications when data are used to formulate environmental and health policy. Among the many challenges are inclusion or exclusion of bone weight, food losses and waste, weight losses during cooking, and nonmeat ingredients in mixed-meat products and prepared meals. The article illustrates that familiarity with procedures used to collect and assemble the data is essential for correct understanding, interpretation, and use of meat-consumption statistics for policy making. The authors conclude with recommendations for improving the design, presentation, and use of these data.

Food consumption is influenced by a variety of sociodemographic features and values, attitudes, and lifestyles, and has both environmental and health consequences. Zsófia Vetőné Mózner & Mária Csutora discuss the novel idea of designing “lifestyle-specific food policies based on nutritional requirements and ecological footprints.” This study is innovative because it incorporates two often distinct discourses: environmental sustainability and health impacts of food intake. The authors make clear that the constitution of a healthy diet may be in tension with requirements for reducing ecological footprints, and combining these two aspects and advancing meaningful recommendations about diets is a major challenge. The authors highlight differences in the ecological footprint necessary to meet physiological requirements and actual food consumption by activity level for different social groups. The study is empirically based on a combination of healthy diet requirements formulated by the World Health Organization (WHO) and a representative survey of 1,013 Hungarian adults, using a bottom-up approach for calculating carbon and ecological footprints. As expected, students and women with babies have greater-than-average food-related ecological footprints due to their higher nutritional needs. At the same time, the eating practices of the elderly give rise to lower footprints. While such detailed empirical analyses are quite time- and cost-intensive—and hence beyond the usual scope of policy making—they promise to be useful in developing targeted environmental and health policies.

As mentioned above, the ever-increasing consumption of meat is one of the biggest sustainability challenges in the food domain, not least because research suggests that individual habits and social norms shape meat consumption in ways that are more extensive than other food categories. Nevertheless, Hans Dagevos & Jantine Voordouw find on the basis of two successive representative surveys that the meat-consumption patterns of Dutch consumers have become considerably more flexible in recent years. They develop a nuanced typology that goes beyond the conventional distinction between “meat-eaters” and “meat-avoiders” and identify a substantial and growing number of “meat-reducers” that eschew meat on a daily basis. In the Netherlands, the share of so-called “flexitarians” rose from 69.5% in 2009 to 77.1% in 2011. Based on these empirical insights, and the observation that policy makers are reluctant to endorse strong interventions to reduce meat consumption, the authors outline an incremental approach to policy making. It starts with encouraging greater self-commitment on the part of politicians through interventions by nongovernmental organizations (NGOs), and moves on to call for development of more sustainable systems of food provisioning that involve both consumers and innovative businesses.

In “How Big is Your Foodprint?” Corné van Dooren & Tine Bosschaert describe development of an ecological “foodprint” tool that promises to quickly scan the environmental impact of one’s food consumption and can be used to raise public awareness of a healthy and sustainable diet. The tool provides custom-made and practical advice for consumers to reduce their foodprint (the ecological footprint of food consumption). The tool demonstrates to consumers that the most critical contribution to their foodprint is associated with animal-protein sources (dairy, meat, and fish), and nonlocal and out-of-season products, drinks, food waste, and packaging represent the next most critical contributions. The article also describes the strategy, design, and results of a social media campaign that resulted in 90,000 consumers using the foodprint tool during its first four months. The authors conclude that this tool promises to be an effective and efficient instrument for raising awareness about overconsumption and setting an example—if not establishing a social
norm—for what sustainable and healthy food consumption can be.

To explore possible trajectories and future impacts of food consumption and to reduce uncertainty during policy-design processes aimed at shaping these trajectories, scenario analysis has become a useful method. Anna Kirveennummi, Johanna Mäkelä, & Riikka Saarimaa suggest that scenarios are instructive as context orientation and for an approximation of desirable futures. They describe a three-year participatory exercise for formulating scenarios of prospective food practices in Finland in 2030. The aim of the initiative was “not to predict but to analyze the intertwining relationships between the many trends and aspects of food consumption.” The result of the process was four scenarios—cornucopian, ecological, food scarcity, and technology-driven—which the authors discuss together with crucial questions for current policy practice that emerge out of the scenarios. They identify a “joint area,” a space where current action can acknowledge and deal with the sustainability challenges of all four scenarios simultaneously. Nevertheless, reaching consensus becomes a particular obstacle of this “joint area,” in which interests, values, and knowledge of all kinds of stakeholders meet.

The question of how to steer the contemporary system of food production and consumption in a more sustainable direction also marks the starting point for the article by Ullrich Lorenz & Sylvia Veenhoff. They argue that strategic foresight is an appropriate tool to provide guidance for policy makers who face a complex and dynamic system and a variety of policy options. They report the findings of an extensive German scenario-building process that searched for sustainable solutions to food consumption and production in different future contexts. An exploratory scenario technique (“scenario management”) was employed to investigate how the external environment for food consumption might develop in the future (“context scenario”) and what solutions for more sustainable food are at hand (“strategic food scenarios”). In a final evaluation stage, the strategic food scenarios were reviewed against the context scenarios to assess their feasibility under different future conditions. The participatory scenario-building process, which comprised a series of workshops involving different stakeholders, revealed that a solution such as “think globally, act locally” works in both a neoliberal growth scenario and an economic recession scenario. Their approach sketches a framework that successfully integrates policy instruments with environmental, economic, and social contexts.

The final article in this special issue, by Michal Sedlacko, Umberto Pisano, Gerald Berger, & Katrin Lepuschitz, reflects on the CORPUS project and the science-policy interface it created. It documents the development of a joint-research agenda involving researchers and policy makers and analyzes the factors that increased engagement between the two communities. The authors suggest that fit between the organizational contexts of the participants and the process for developing a research agenda is critical for influencing future cooperation and use of the research-agenda document. They characterize organizational contexts through variables such as regularity and character of policy maker-researcher exchange, and develop a typology of bureaucratic, managerial, and communicative “praxis/discourse formations of knowledge.” Comparing the agenda development with these contexts, they formulate a comprehensive analysis that helps to explain the somewhat limited impact of the research agenda one year after its development. These factors include the multinational and research-driven nature of the process, limited time for interaction, and absence of links to particular national policy issues and processes.

This special issue reflects some of the most pressing themes and challenges of policy-relevant research on sustainable food consumption. Meat consumption remains a dominant theme. There are also important questions about how research and policy making can be better aligned in terms of topical focus as well as timing, and how in particular research can help policy makers cope with uncertainty and provide sound statistical data. We hope that this special issue—and the discussion that it generates—will contribute to further research and useful policy initiatives.

References


Contemporary food production and consumption cannot be regarded as sustainable and raises problems with its wide scope involving diverse actors. Moreover, in the face of demographic change and a growing global population, sustainability problems arising from food systems will likely become more serious in the future. For example, agricultural production must deal with the impacts of climate change, increasingly challenging land-use conflicts, and rising health and social costs on both individual and societal levels. The unsustainability of current arrangements arises from the industrialization and globalization of agriculture and food processing, the shift of consumption patterns toward more dietary animal protein, the emergence of modern food styles that entail heavily processed products, the growing gap on a global scale between rich and poor, and the paradoxical lack of food security amid an abundance of food. These factors are attributable to national and international policies and regulations, as well as to prevalent business practices and, in particular, consumers’ values and habits. The most effective ways for affluent societies to reduce the environmental impact of their diets are to reduce consumption of meat and dairy products (especially beef), to favor organic fruits and vegetables, and to avoid goods that have been transported by air on both individual and institutional levels (e.g., public procurement, public catering). In examining the unsustainability of the current food system this article reviews the pertinent literature to derive a working definition of sustainable food consumption, outlines the major issues and impacts of current food-consumption practices, and discusses various policy interventions, including information-based instruments, market-based initiatives, direct regulations, and “nudges.” It concludes with a call for integrative, cross-sectoral, and population-wide policies that address the full range of drivers of unsustainable food production and consumption.

KEYWORDS: food selection, food processing, food consumption, environmental impact, public policy, public health

Sustainable Food Consumption: Where Do We Stand Today?

Food consumption is a major issue in the politics of sustainable consumption and production (SCP) because of its impact on the environment, individual and public health, social cohesion, and the economy. Several key concerns currently high on policy agendas worldwide clearly illustrate how far-reaching the problem is:

- Serious environmental problems related to food production and consumption include climate change, water pollution, water scarcity, soil degradation, eutrophication of water bodies, and loss of habitats and biodiversity. Food consumption is associated with the bulk of global water use and is responsible for the generation of approximately one-fifth of greenhouse-gas emissions (GHGs).
- Population growth and rising economic prosperity are expected to increase demand for energy, food, and water—the so-called energy-food-water nexus (Bazilian et al. 2011)—which will compromise the sustainable use of natural resources and could exacerbate social and geopolitical tensions.
- Approximately 800 million people globally suffer from hunger and underconsumption of food, and a lack of access to safe and sufficient drinking water remains a pressing issue (Coff et al. 2008; Millstone & Lang, 2008). At the same time, 1 to 1.5 billion people are overweight and 300 to 500 million of them obese, an increasing tendency in most regions due primarily to dietary shifts toward more sugar, animal protein, and trans fats.
- Diet- and lifestyle-related health problems such as cardiovascular diseases and diabetes are appearing in young age groups (CEC, 2007), significantly increasing health costs (BCO, 2007), while social cohesion is increasingly in danger because health is so closely related to socioeconomic status.
Given demographic changes and the growing global population, these problems are only expected to worsen in the future. Yet, although the relevance of the food dimension for sustainability policies is now widely accepted, efforts are largely lacking toward an integrated policy of sustainable development that covers all actors in the food sector (Reisch, 2006). Except for the challenges of food security and agricultural production, political action plans and programs barely touch upon interdependencies along the food chain and the complexities of modern global food systems. This lack of attention to more systemic issues—and hence the lack of political will for changes—may be one reason why food-consumption patterns show barely any shift toward sustainability.

At the same time, despite considerable progress in the development of sustainability targets and indicators worldwide, there is as yet no commonly agreed upon definition of sustainable food consumption. Perhaps the most encompassing attempt is that introduced by the UK Sustainable Development Commission (2005: 2009), defining “sustainable food and drink” as that which is safe, healthy, and nutritious for consumers in shops, restaurants, schools, hospitals, and so forth; can meet the needs of the less well off at a global scale; provides a viable livelihood for farmers, processors, and retailers whose employees enjoy a safe and hygienic working environment; respects biophysical and environmental limits in its production and processing while reducing energy consumption and improving the wider environment; respects the highest standards of animal health and welfare compatible with the production of affordable food for all sectors of society; and supports rural economies and the diversity of rural culture, in particular by emphasizing local products that minimize food miles. Other researchers have also pointed out that sustainable food styles must fit into people’s everyday lifestyles (i.e., must be “feasible,” available, affordable, and accessible) and should allow for sociocultural diversity (Eberle et al. 2006). Policies for sustainable food consumption, therefore, should learn from and build on evidence from effective consumer policies (Reisch, 2004).

The breadth of this approach clearly illustrates the scope of the issues to be analyzed by researchers, discussed by societal stakeholders, and finally dealt with by policy makers. This article takes a step toward such an analysis by drawing on an extensive literature review to outline the major issues in the current system of food production and consumption and by discussing their impact on sustainable development. Specifically, using an integrative approach to sustainable food consumption and following the definitions provided above, the first part of this article lays out the ecological, social, ethical, health-related, and economic impacts—as well as their interlinkages. For each impact dimension, we provide an overview of the main policy and research issues, key theoretical approaches, major empirical studies, and key available data. To encompass all driving forces and barriers, the study examines the main challenges on both the production and consumption sides.

The second part of the article identifies priority areas and corresponding policy options for SCP strategies for the food sector and concludes with recommendations for the diverse actors in the overall system. The primary aim is to set the stage for the other contributions comprising this special issue that dig deeper into the respective issues. We thus undertake more an exercise in scoping and “sounding” than an attempt to fully cover, analyze, and reflect on the field’s many dimensions. Moreover, although the discussion aims to reflect global trends related to sustainable food, the main geographical focus of both the empirical data and the policies presented is the European Union (EU).

### The Food System: The Interlinkages Between Production and Consumption

#### Major Impacts and Trends on the Production Side

Contemporary food production is becoming ever more globalized and industrialized, and products are subject to increasing standardization. Seasonal varieties are now available nearly all year round and available food products come from all over the world (Oosterveer & Sonnenfeld, 2012). In industrialized countries, agriculture in particular is being intensified and yields per hectare have been steadily climbing over the last several decades. This growing productivity is a consequence not only of rationalization and specialization but also of improvements in plant breeding with and without the use of genetically modified (GM) seeds. Such developments, although expected to continue, also come with untoward side-effects that include further concentration of agricultural industries and decrease in the number (and

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1. This article builds on three discussion papers prepared for the “Policy Meets Research” workshops on sustainable food consumption within the CORPUS consortium (see http://www.scp-knowledge.eu) held at the Lebensministerium in Vienna in 2010/11. Also drafted for these workshops and available on the CORPUS website are the so-called “knowledge units,” highly condensed policy briefs offering succinct overviews on such topics as a definition of “sustainable food consumption,” “hot spots” of sustainable food consumption, sustainable food systems, food waste, food and GHG emissions, and obesity as sustainable consumption issues.

2. Unless otherwise noted, “European Union” and “EU” refers to the group of EU-27 member states.
growth in the average size) of small farms (the so-called “farm crisis”).

Instead of purveying their output in local markets, farmers today are more likely to sell to large, complex supply chains of which they are normally only a tiny part. As a result, only one fourth of the retail food price goes to the farmers, compared to approximately 50% a half century ago (Tischner & Kjaernes, 2007). The loss of the local market to an industrial food system also means increasing “food miles,” the transport distances between farmers, industry, and consumers and this trend carries both cultural and environmental costs (Blay-Palmer, 2008).

Within the EU, food and drink is the second largest industry, employing some 4.8 million people in more than 310,000 companies and achieving a 2011 manufacturing turnover of €917 billion (US$1.2 trillion). The food industry, however, is highly fragmented. Despite the small number of large global players selling a huge variety of products worldwide, 99% of all companies are SMEs. In fact, available data indicate that, in terms of overall numbers, the European food industry is dominated by enterprises employing fewer than twenty employees and these entities account for 86% of the industry (EC, 2011).

By contrast, food retailing is characterized by high levels of concentration with fewer and larger retail chains sharing the market and competing primarily on the basis of price. Accordingly, the food sector has witnessed the rise of giant corporations that control significant proportions of retail sales, as well as the emergence of internationally operated retail groups. The size of these retailers ranks them among the largest companies in their home countries (e.g., the UK’s Tesco, Germany’s Metro Group, the United States’ Wal Mart). In their role as “supply-chain bottlenecks,” these large retail chains and supermarkets wield enormous market power over both agricultural producers and processors (Oosterveer & Sonnenfeld, 2012). Currently, however, in both American and European food markets, a notable process of bifurcation is taking place between more healthful varieties at relatively more expensive price points and products geared for so-called “value” consumers (often processed foods with high fat and sugar content). Growth rates are higher at both the upper and lower ends of the market, which is prompting a discernible pattern of migration away from midmarket retailing (Oosterveer & Sonnenfeld, 2012).

In 2010, the size of the market for organic food in Europe was €19.6 billion (US$26.5 billion), with the largest single country being Germany, which had a turnover of €6 billion [US$8.1 billion], followed by France (€3.4 billion [US$4.6 billion]) and the UK (€2 billion [US$2.7 billion]) (Willer & Kilcher, 2012). For European consumers, the most important reason for buying organic food is the belief that it is healthier (Willer & Kilcher, 2012) and there is apparently little difference among European countries in motivation for organic food consumption (Thøgersen, 2009; 2010). It is likely, therefore, that the barriers to purchasing organic produce stem more from the structural characteristics of the living environment, that is, the access, availability, and affordability of the supply.

Regarding the different process qualities of food items, two more trends—overwhelmingly perceived as risks by European consumers—have emerged during the last decade. The first is the application of nanotechnologies, particularly nanoparticles, to a number of consumer products. As a result, food products, and especially food packaging, are expected to become a growing market that will be second only to cosmetics and textiles. The same holds true for so-called nano-enhanced dietary supplements. One especially popular category for such supplements is intended to help people lose weight and is already being sold globally, mainly via the Internet. Nevertheless, the potential contribution of nanotechnologies to sustainable food consumption—mainly less food waste from smart nano-enhanced packaging—is estimated to be rather low (Möller et al. 2009). Consumers in Europe express concern about the application of nanotechnologies in and around food items, primarily because of possible health risks (Reisch et al. 2011).

The second trend is the use of GM products in agriculture, a practice that has been growing steadily on a global basis in recent decades. The area around the world planted with GM crops increased from 1.7 million hectares (ha) in 1996 to 148 million ha in 2010, with an increasing proportion grown by developing countries. In 2010, there were 29 so-called “biotechnology countries” comprising 19 developing countries and ten industrial countries, with 17 of the 29 growing crops on 50,000 ha or more (James, 2010). This development contravenes the expressed desires of the majority of consumers, at least within EU member states, who do not approve of GM products (Gaskell et al. 2010). In Europe, unlike the United States, Canada, or South America, public fear over safety has been widely voiced and has effectively halted the commercial production of GM crops.

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4 “Small and medium-sized enterprises” (SMEs) are defined by EU law (EU recommendation 2003/361) primarily in terms of number of employees (< 250) and either annual turnover (< €50 million [US$67.5 million]) or balance sheet total (< €43 million [US$58 million]).
(Millstone & Lang, 2008). The development of these products has also generated global debate, centered particularly on the risk of releasing modified genetic material into the environment, the environmental impacts of the growing use of pesticides, the control of technology by monopolistic multinational companies, and consumer fears of the unknown risks of eating GM products (Pechan & de Vries, 2005; Oosterveer & Sonnenfeld, 2012).

Nevertheless, in general, the EU allows modified seeds and leaves member countries to establish their own procedures for separating traditional and modified crops, and a small but growing number of European countries, including Spain, Portugal, and Germany, allow a few GM varieties. Nevertheless, except for Denmark, the Netherlands, and the Czech Republic, all EU member states have installed “GMO [genetically modified organism]-free zones” (Consmüller et al. 2012), and in the EU the labeling of GM food is mandatory for all products made from or containing GMOs, as well as all GM additives and GM flavorings. Foodstuffs produced from animals fed with GM fodder, however, do not fall under this legislation. Hence, Germany and Austria have introduced “free from GMO” labels that are applicable to foodstuffs to which neither GM additives nor GM feed have been introduced.

**Major Impacts and Trends on the Consumption Side**

In industrialized countries, the range of available food products is extensive and, because most are affordable all year round, the notion of seasonality has lost its meaning. In addition to an abundant choice of healthy fruits and vegetables all year, consumers in most EU countries benefit from the comparatively low prices and high convenience that have accompanied changes in food production and globalization. The downside of this process, however, is that consumers have become increasingly estranged from the production of their food and, despite the recent recurrence of regional food and new trends like slow food and organic produce, consumer knowledge of seasonality and regional supply has withered (e.g., Tischner & Kjaernes, 2007; Blay-Palmer, 2008).

On an individual level, food habits and preferences are shaped by cultural traditions, norms, fashion, and physiological needs, as well as by personal food experience and exposure to the consumption context (i.e., foodstuff availability and accessibility). Such preferences and tastes, together with finances, time, and other constraints (e.g., work patterns, household decision making) influence food consumption. Price, in particular, is a major decision criterion, but food preferences also differ significantly by household characteristics such as age, income, education, family type, and labor-force status. Food styles and demand additionally vary greatly among EU member states and this diversity has prompted researchers to cluster consumers into groups representing different “nutrition styles” or “food styles” so that they can be targeted by social marketing with “proper food” messages (Michaelis & Lorek, 2004; Friedl et al. 2007; Schultz & Stieß, 2008).

Despite individual, (sub)cultural, and national differences, it is still possible to identify some general food-consumption trends relevant to sustainable development and already evident in most EU countries (as well as in those nations that are part of the Organization for Economic Cooperation and Development). Probably the most important development in terms of impact on climate and health (Shindell et al. 2012) is the increase in meat consumption (especially pork and poultry) and fresh dairy products that has taken place over the last few decades (EEA, 2005; OECD & FAO, 2011). Also on an upswing is demand for highly processed meals (fast and convenience food) (RTS Resource Ltd., 2006), a trend attributable to the fact that time spent on food purchasing and cooking, as well as on eating, has decreased significantly over the past few years (Hamermesh, 2007). Socially, home meals and their preparation are losing their significance as loci for communication and structuring of everyday lives, while convenience products, fast food, and restaurant meals are gaining in importance. Out-of-home consumption now accounts for a significant and growing proportion of European food intake. For example, 35% of the Belgian population consumes over 25% of its daily energy intake outside the home (Vandevijvere et al. 2009), and 27% of participants in a representative Spanish study reported eating out at least twice a week (Bes-Rastrollo et al. 2010). Such varying food habits (e.g., home-made versus ready-to-eat or school-provided lunches) have a clear impact on both climate and eutrophication (Saarinen et al. 2012).

At the same time, food consumption is increasingly furnished with symbolic meaning and hedonic experiences, and “social food” has become ever more significant in combatting the perils of an individualized society. Today, food marketing promises solutions not only to indulgence and prestige problems, but also to health and fitness concerns (Schröder, 2003). Indeed, with respect to both convenience food and food services, high-quality and health-oriented products and organic foodstuffs have become increasingly important (Tempelman, 2004). As a result, although the market share of organically grown and fairly traded food products remains small in absolute terms, both categories have grown steadily, and even...
remained quite stable during the financial crisis (Willer & Kilcher, 2012). Well-being and healthy lifestyles have even become a social and economic megatrend. Nevertheless, overweight conditions and obesity are spreading worldwide, and the rate of obese adults has more than doubled over the past twenty years in most EU countries (OECD, 2010b), a trend that is hardly surprising given that the food supply in the EU-15 countries is a third more than is required for a healthy diet. In many industrialized countries, this food wealth, combined with increasingly sedentary lifestyles and modern diets, is leading to rising obesity, particularly among children and teenagers, but also among lower socioeconomic groups with low access to fruits and vegetables (WHO, 2005).

Concerning food-market transparency, the complexity of food choice has increased and the more options and novelties the more troublesome the information search and the more complex decisions are for consumers. Although information brokers—from independent testing institutes to commercial food magazines to food activists and Web 2.0 slow food communities—may work to reduce complexity for a few people, many consumers report being overwhelmed and would rather adhere to their habitual choices (Mick et al. 2004). In fact, the success of food retailers such as Trader Joe’s, which offers a very narrow food assortment, results from the attractive mix of little choice (and hence, low search costs) and the high quality of the organic products that they sell at relatively low prices—something that full-line super- and hypermarkets cannot match. The growing consumer uncertainty in the food sector has been fueled by a decade of food scares, combined with differing expert evaluations of risk, contradictory and short-lived nutrition information in the media, pronounced variety of available food products, and globalization and distancing of food production (Bergmann, 2002). Hence, the multitude of coexisting food labels, rather than helping consumers navigate, has led to consumer confusion and information overload that prevents quick retrieval of relevant information. As a result, (re)building consumer trust in the food information provided by both the state and the market is a key challenge (Kjærnes et al. 2007).

Finally, one-third of food globally is wasted (Gustavsson et al. 2011), particularly during the retail process and by consumers. For instance, according to one recent study, British households discard 33% of the food that they buy, 61% of which could have been eaten if it had been better managed (Ventour, 2008). Likewise, in Germany, 61% of food waste originates from households, two-thirds of which could have been avoided or partly avoided (Kranert et al. 2012). The reasons for such wastage range from poor menu planning and a general lack of food competence (i.e., knowledge of food freshness and storability) to huge package sizes enabled by large home-storage capacities and the attractiveness of quantity discounts at points of purchase.

Unsustainability of the Current Food System: Dimensions and Factors

Given escalating rates of obesity and diet-related diseases, excessive food miles, food scares and food insecurity, the spread of fast food culture, and increasing food waste—all of which have consequences for global climate change—the western food system is clearly unsustainable (SDC, 2009). To achieve sustainable food consumption, the problems of both over- and under-consumption must be confronted, together with food-safety issues in affluent societies and food-security issues in poorer regions. This section therefore briefly reviews the environmental, health-related, ethical, and economic aspects of food consumption and the key challenges that constitute contemporary public debate.

Environmental Aspects

Food consumption is one of the private consumption areas that has the largest impact on the environment; among the EU-25 countries approximately one-third of households’ total environmental impact—including energy use, land use, water and soil pollution, and GHG emissions—is related to food and drink consumption (EEA, 2005). The overall impact and private household space for maneuvering, however, also depend on the decisions of other actors in the production chain, whose roles and responsibilities—particularly regarding environmental “hot spots”—are highlighted below.

Agriculture

The main environmental effects from food arise in the primary production stage. Agriculture is a major source of such impacts through land usage and soil degradation, water consumption, eutrophication and water pollution, monocultures that cause biodiversity loss, and introduction of hazardous chemicals through synthetic pesticides and mineral fertilizers. In

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5 The EU-15 encompasses Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom.

6 The EU-25 includes Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.
terms of energy use, agricultural production is responsible for about 30% of the food sector’s total energy demands (Owen et al. 2007), 40% of which result from the production of chemical fertilizers and synthetic pesticides (Heller & Keoleian, 2003). Another more indirect cause is the production of cattle fodder (Tempelman, 2004), which in terms of primary production accounts for nearly half of the GHG emissions from food consumption (Tukker et al. 2006). Simultaneously, climate change is dramatically affecting agriculture and will do so increasingly (Schaffnit-Chatterjee, 2009). Yet research on the environmental impacts of organic production (e.g., FAO, 2003; Shepherd et al. 2003) shows that, depending on the products involved, organic farms use 50 to 70% less energy (direct and indirect) per unit of production than conventional farms, mainly as a result of different fertilizer use. Organic production also has clear benefits for biodiversity on agricultural land, although lower yields may mean that a larger land area is required than under conventional production methods. In milk production, however, the advantages are less clear, primarily because of the higher output of conventional dairy farming and the higher GHG emissions from grass-fed cattle. Nevertheless, animal treatment is typically better on organic farms, and cows are less likely to be lame or stressed or to carry disease (Owen et al. 2007).

Industry

Because the food industry encompasses all stages of the value chain beyond the farm gate and before food purchase and consumption, it includes manufacturers, wholesalers, retailers, and food-service providers. The activities of this industry can degrade the environment in numerous ways, including through the generation of air emissions from grinding grain, bulk-product transfers, and silo vents; the contamination of land from accidental oil spills and past site use; the creation of noise pollution from food-manufacturing equipment, grinding machinery, and packaging lines; the (over)use of resources such as water, energy, and food-packaging materials; the disposal of out-of-date products, peelings, animal byproducts, food packaging, food-manufacturing equipment, and effluent-plant sludge; and the discharge of water from effluent plants, accidental spills, and cooling towers.1 Within the UK, for instance, the food industry accounts for 14% of the energy consumption by all businesses, seven million tons of carbon emissions per year, about 10% of all industrial use of the public water supply, approximately 10% of the industrial and commercial waste stream, and 25% of all heavy goods vehicle kilometers (DEFRA, 2008).

Consumers

The environmental impacts of food consumption in households, restaurants, schools, and other institutionalized settings result mostly from the handling and preparation of food, that is, storage (primarily freezing), cooking, and dishwashing. The choice of diet and food types, however, is also relevant in that, for example, (red) meat and dairy products cause by far the highest GHG emissions. In fact, within the EU-25, meat and meat products contribute to between 9 and 14% of total releases, with the second most relevant food products being milk, cheese, and all types of dairy products (Tukker et al. 2006). Cereals, fruits, and vegetables, in contrast, contribute comparatively low levels of GHG emissions (Dabbert et al. 2004; Carlsson-Kanyama & Gonzalez, 2009). In terms of storage, cooking, and dishwashing, the environmental impacts depend in particular on the energy efficiency of the relevant household appliances (Quack & Rüdenauer, 2007). Another factor that affects the environment, one too easily neglected by consumers, is the means chosen for the “last mile of transport” (Reinhardt et al. 2009). That is, the tendency to travel by car to out-of-town supermarkets for food purchases counteracts consumers’ own interest in environmentally sound grocery shopping, a typical “tragedy of the commons” situation where individual and social interests stand in contradiction. Finally, at the very end of the food chain, the main issue, as previously discussed, is waste and discarding of food.

Environmental “Hot Spots”

Although the food-related factors affecting the environment are manifold, if policies and corporate strategies are to effectively and efficiently make a difference, they must necessarily concentrate on “hot spots.” The academic literature generally agrees upon a number of these primary environmental impact categories related to food consumption and production, including GHG emissions, water consumption and pollution, eutrophication, land use and soil degradation, and biodiversity loss.

One of today’s main environmental challenges is to contain climate change to a maximum of a 2°C global average (IPCC, 2007). The primary contributor to such global warming is GHG emissions, caused in particular by the use of synthetic pesticides and mineral fertilizers, livestock farming (especially methane and nitrous-oxide emissions), transportation, food packaging and processing, and cooling and cooking. In fact, 45% of all nutrition-related GHG emissions derive from food production (agriculture,
processing, and transportation), while the remaining 55% are generated by storage, food preparation and consumption, and to a minor extent by the transportation of food purchases. Eating out also contributes substantially to GHG emissions (Eberle et al. 2006). The seriousness of this issue is clearly demonstrated by calculations for Germany that food accounts for about 16% of GHG emissions, the same share as mobility (Eberle et al. 2006), and by the fact that the UK’s food production and consumption is responsible for about 18% of its GHG emissions (BCO, 2008).

Agriculture also consumes most of the freshwater used in the world, accounting in some developing countries for up to 90% of usage. Changes in diet place even higher pressure on water resources (Schaffnit-Chatterjee, 2009). For example, one study by the World Wildlife Fund for Nature (2009) reveals that agriculture accounts for about three-quarters of German water consumption, about 40% consumed in Germany itself but about 60% “imported” through agricultural products from outside the country. Overall, the study estimates per capita water consumption of nearly 4,000 liters per day just for food, which includes the so-called “virtual water” consumed during agricultural or manufacturing production. At the same time, agriculture is one of the main polluters of water bodies, due mainly to the appropriation of nitrates from the soil and the use of pesticides. In fact, experts expect not only a further increase in chemical trates from the soil and the use of pesticides. In fact, experts expect not only a further increase in chemical applications but also increasing absolute contamination stemming from their long persistence in both soil and water (SRU, 2004). Most particularly, agriculture is one of the main sources of water eutrophication, primarily through the use of fertilizers and nitrous-oxide emissions from livestock breeding (SRU, 2002). Agriculture also demands land for crop cultivation and animal management, which requires especially high land usage, primarily for cattle-feed cultivation. This pattern of land-use activity is expected to multiply exponentially in coming decades to meet the growing demand for meat in developing countries (Tempelman, 2004). Even without such changing trends in diet, agricultural production will have to be increased in the future to feed a growing global population. For instance, the World Bank (2007) projects that cereal production will need to increase by 50% and meat production by 85% between 2000 and 2030. At the same time, however, experts estimate that since the 1950s, about 22% of all cropland, pasture, forest, and woodland worldwide has suffered soil degradation (Schaffnit-Chatterjee, 2009).

Finally, compared to other sources (e.g., households, industries, transport, energy), agriculture also has the highest negative impact on biodiversity, most especially due to biodiversity loss from the use of agrochemicals associated with intensive farming. In some places, the replacement of local varieties of domestic plants with high-yield or exotic alternatives has also broken down important gene pools (Schaffnit-Chatterjee, 2009). Yet, biological diversity is critical for food security and this awareness has prompted the Food and Agriculture Organization of the United Nations (2010) to actively promote the conservation and sustainable use of biodiversity. In meeting this goal, organic agriculture has a substantially lower environmental impact than conventional agriculture (Foster et al. 2006).

**Health Aspects**

**Over and Under Nutrition, Health, and Well-Being**

Under-nutrition and malnutrition exist to a considerable degree in both industrialized countries and countries in transition. Even in Europe, about 5% of the overall population is at risk of malnutrition, and among vulnerable groups—the poor, the elderly, and the sick—this percentage is still higher. At the same time, people worldwide face an increase in such food-related health problems as cardiovascular disease, obesity, and diabetes because of rich foods, modern diets, sedentary lifestyles, and overeating. Key diet-related factors are the high intake of saturated fat, salt, and sugar and the low consumption of fruits and vegetables. It has been estimated that 70,000 premature deaths in the UK could be avoided each year if diets matched national nutritional guidelines (BCO, 2008). In fact, according to the British Cabinet Office (2007), food-related ill-health costs amount to £6 billion (US$9.3 billion) per year (or 9% of National Health System costs), and malnutrition, mainly in the elderly, costs public services £7.3 billion (US$11.3 billion) annually. The BCO (2007) also expects obesity, a risk factor for many serious health conditions, to continue increasing and further undermine health and well-being, health-service costs, state benefits, and the economy. Hence, stemming obesity, particularly in children, is a major challenge for sustainable development (WHO, 2008).

In the affluent world, excess weight gain currently ranks as the third greatest risk factor after smoking and high blood pressure for all premature deaths and disabilities (IASO, 2009). Among children especially, obesity levels have risen in the EU during the last three decades to about one-third of the

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8 Virtual water is the same as a product’s water footprint (Hoekstra et al. 2011). It includes all water used, contaminated, or evaporated during the production process—the so-called green, blue, and grey water (WWF, 2009; Hoekstra et al. 2011).
population (CEC, 2007). By 2050, half of the UK’s population is projected to be obese (DEFRA, 2008), leading to an increase in chronic conditions including cardiovascular disease, hypertension, type-2 diabetes, stroke, certain cancers, musculoskeletal disorders, and even a range of mental health conditions. Obesity is most prevalent in lower socioeconomic (SES) groups, and particularly in women, which reduces their access to economic and social life chances (DEFRA, 2008). Women in lower SES groups also seem more vulnerable than men because of different environmental pressures in an “obesogenic environment” (Robertson et al. 2007). These women are also more likely to give birth to either under- or overweight babies (both risk factors for later obesity), and are less likely to follow recommended breastfeeding and infant-feeding practices (also linked to obesity risk). Hence, added to the public health and social care costs are personal costs like the impact on well-being of morbidity, mortality, discrimination, and social exclusion (DEFRA, 2008; Reisch & Gwozdz, 2010). Nor are such problems confined to the developed world: with the global spread of western high-fat, high-sugar diets, obesity has also become a problem in less affluent countries. Admittedly, at present, adiposity and overweight status in these countries remain primarily problems of the upper classes with access to modern diets (Witkowski, 2007; IASO, 2009). However, as such diets become more available, the consumption habits of the middle classes will follow.

Despite these findings, as Cohen (2005) rightly notes, scholarship on sustainable consumption, like policy making, has only very recently taken up nutritional excess, a fact that he attributes to the divide between environmental and nutritional policy. In fact, Lang & Heasman (2004) suggest that the development of a more integrated view is being hampered by an on-going “food war” between three schools of thought: the long-dominant “productionist” paradigm of food and health politics, a “life-science integrated paradigm” (i.e., with life sciences having the lead as regards topics and priorities), and an “ecologically integrated paradigm” that also includes the costs for the ecological system.

Food Safety

Health risks also result from the presence of unwanted substances in food products, including pathogenic organisms, toxic substances (e.g., pesticides and heavy metals), and contaminants. In Europe, the most serious food-safety issue is food-borne illness from food poisoning and poor hygiene. Despite this concern (or perhaps because of it), more food allergies have been reported over recent years, and the number of people with food allergies is still increasing (DEFRA, 2008). Because food risks are socially channeled and mediated, however, there is often a wide gap between perceived health risks and objective risks (Blay-Palmer, 2008). For instance, German consumers primarily fear health risks from food additives even though, objectively construed, the risks from active hormonal substances are much higher. Moreover, although the health risks from the use of (broadband) antibiotics in livestock breeding play only an ancillary role in public awareness, they are generating an increasing number of resistances in pathogenic organisms, which in turn present serious risks for human health (Dettenkofer et al. 2004).

Ethical Aspects

At the heart of sustainable consumption lies the idea of ethically responsible food production and consumption. This concept encompasses multiple aspects, ranging from food and water security to fair trading conditions to species-appropriate livestock breeding. The main areas of ethical concern regarding food are as follows (Coff et al. 2008). First, the supply of food and access to clean drinking water available to human beings should be just and fair (food security). Second, food should not endanger the health of consumers because of pathogens or pollution (food safety). Third, ethical issues need to be addressed in relation to new developments in nutritional research and technology, particularly functional foods, nano-enhanced foods, and GM foods, as well as personalized nutrition. Fourth, observation of specific production practices in the food chain affecting animal welfare, the environment, and (un)fair working conditions has given rise to a demand for “ethical traceability” of key consumer concerns. These ethical considerations have very concrete consequences. For instance, meeting the needs of a growing global population and the increasing demand for meat in developing countries will require substantial growth in land usage at a time when most productive cereal areas in North America, India, and China will be approaching their biophysical limits (Tempelman, 2004).

One essential aspect of ethically responsible food consumption today is fair trade and working conditions. The European market for fairly traded products is growing, with bananas, coffee, orange juice, tea, and chocolate most often sold (FLO, 2006; 2010). All of these products have been marketed in several Western European countries since the 1980s and 1990s (Oosterveer & Sonnenfeld, 2012). At the same time, several non-European countries, including Australia, the United States, and Canada, have seen notable growth rates of these products, making fair trade a global phenomenon. As a result, market shares have been rising rapidly since the early 2000s,
with Switzerland and the UK having relatively high penetration but Japan demonstrating slow uptake to date. Overall, the growth of fair trade sales has been impressive, reaching well beyond €3 billion (US$3.9 billion) in 2009—and this is in spite of the 2008/09 economic crisis (Oosterveer & Sonnenfeld, 2012). Interestingly, fairness in trade is not only an issue for developing nations. In European countries, farmers are also demanding fair payment for their produce. For example, in Germany, some farmers, retailers, and dairies have become organized into a cooperative to offer “fair milk,” whereby the income of farmers is secured through long-term contracts based on prices slightly above the fluctuating market price.

Another important aspect of consumer awareness is animal welfare, especially in European countries such as the Netherlands, Germany, and the UK. This concern has given rise to the development of different formats for food labels specifically evaluating animal welfare in the production process (SAB, 2011). For example, the production of eggs by cage-free hens and the participation of retailers in the Global Animal Partnership animal-welfare certification program have been notably visible developments.

Also a subject of increasing debate in industry, civil society, and the political arena is the contribution of corporate social responsibility (CSR) regimes, including those within the food sector (Hartmann, 2011). One means of managing ethical workplace conditions throughout global supply chains is to follow international standards, such as Social Accountability Standard 8000 (SA 8000) or the International Standards Organization standard for CSR (ISO 26000). According to a survey of 300 executives from retail and consumer-goods companies in 48 countries, ethical sourcing will also figure prominently as a food (retail) sector issue in the future (CIES–The Food Business Forum, 2007).

Economic Aspects

The share of total European household expenditure on food has declined steadily with rising incomes, ranging between 10 and 35% of total household consumption outlays in 2005, with the smallest shares in the EU-15 member states and the larger shares in new member states (EEA, 2005). Compared to previous years, international food prices are likely to remain, at higher levels, primarily because of the escalated cost of inputs. In the EU overall, the price index for food rose by almost 20% between 2005 and 2012 (Eurostat, 2012). Rising food prices create serious difficulties for vulnerable, low-income households that spend a substantial proportion of their income on food (Michaelis & Lorek, 2004).

Food from organic production is also more expensive than its conventional equivalents, on average around 17% more costly in Germany (GfK, 2007), and although the price of seasonal vegetables can be comparable, meat and meat products, particularly, are more costly. These price differences—which result from lower yields, more expensive materials, and more labor-intensive production methods—are even more pronounced in other countries around the world, ranging from 10–50% depending on product, season, and retailer. In Europe, a few innovative retailers are actively working to reduce the price difference. For example, the Dutch chain Albert Heijn maintains a permanent 5–35% price reduction on a selection of 25 organic food products while Auchan in France has set a limit of 25% on its margins for fair trade products (UNEP, 2005). One of the leaders in the Danish market, Coop, decided as far back as 1993 to fully eliminate the sales-price difference between organic milk and conventional milk, thereby bringing about an early breakthrough of organic products in Denmark (Schmidt et al. 2009). The same chain in Sweden has a specific pricing policy on organic food: instead of the normal price percentage mark-up, the same amount is added for organic products as for the conventional alternative product. Likewise, Denmark’s SuperBrugsen regularly combines promotions of sustainable products with discounts, making it easier for customers to trial these options (Schmidt et al. 2009). SuperBrugsen and KIWI Denmark and Norway also have “organic weeks” or “organic months” in which all organic products are offered with a price reduction of the full value added tax (VAT), which amounts to 25%.

Policies for Sustainable Food Consumption

Overview

In terms of sustainability promotion, the food-policy domain is quite complex. In addition to the environmental, ethical, and economic aspects of food consumption that have regional, national, and global impacts, public health concerns are an integral factor. In general, policy makers trying to enhance food-system sustainability have three major types of instruments at their disposal: information-based, market-based, and regulatory (Lorek et al. 2008). Recently, however, this toolbox has been enlarged with “nudging” instruments, such as choice architecture, in which the person or organization “designing” the choice can harmonize the default outcome with the desired outcome (see Thaler & Sunstein, 2008; Sunstein & Reisch, 2013). Sometimes referred to as behaviorally informed social regulation (Sunstein,
In the food and health area, particularly, nudging consumers toward more sustainable or healthier choices—for example, by moving the soda machines to more distant, less visited parts of a school or locating the salad bar in the middle of the cafeteria where everybody passes by—has been quite successful (Just & Wansinck, 2009; Reisch & Gwozdz, 2013).

Ideally, the goal is to build a coherent policy framework for appropriate action and to incentivize, enable, and empower the actors along the food chain to engage in more sustainable production and consumption. Governments can also influence markets and mindsets by stimulating and supporting businesses in voluntary self-commitment. Finally, governments and public bodies are themselves powerful role models and market makers that, by choosing sustainable alternatives by default, can help to create critical demand (public procurement). All these efforts should be coherent with other relevant policy initiatives, such as agricultural and consumer policies (Reisch, 2013). To give an overview of current practices, the next section summarizes the main policy instruments used today in relation to sustainable food consumption.

**Policy Instruments: The Scope**

On the production side, the European agricultural sector is a highly regulated market in which the regulatory and market-based instruments already in place are targeted primarily at production. They are, therefore, not the major focus of this discussion. Nevertheless, certain of these instruments—for example, the financial support provided to organic producers via subsidies under the reformed Common Agricultural Policy (CAP)—probably create a stronger push for increased availability and affordability of organic products than many other instruments discussed in relation to sustainable food consumption.

On the demand side, national governments generally play a relatively weak role in managing the adverse effects of (over)consumption. The main driver to date behind regulatory command and control instruments in the field of food consumption and production is the need to respond to acute threats to the life and health of citizens. Only recently has governmental attention about food intake extended to everyday diet and health issues. Nevertheless, these concerns, although they are slowly resulting in political measures (especially as they relate to obesity and its health impacts), are designed mostly for information provision and rarely take the form of overt regulation. Rather, “command and control” is usually applied only in cases that can be left neither to voluntary agreements (VAs) nor to the market because of the high risks involved or because of time pressure and doubts about VA effectiveness. Thus, regulation concentrates on food-safety issues and aims to protect consumer health, lives (e.g., through hygiene standards), and economic interests (e.g., through competition regulation).

With regard to food-sector sustainability, governments and their administrations come into play mostly as organizers of (public) certification, standardization, and inspection, as evidenced by the state-run labeling of organic and regional foods in about half of EU countries (Organic Europe, 2011). Such labels constitute an important tool for raising consumer awareness about the health and environmental aspects of food and for facilitating informed decision making (Eberle et al. 2011). Nevertheless, in terms of changing buying decisions, the effectiveness of labeling is limited (Larceneux et al. 2012). The main impact seems to be on the supply side since such labels have proven valuable marketing tools in saturated markets.

Another relatively recent approach to promoting sustainable food consumption is self-regulation in the form of sustainable public food procurement (or guidelines for procurement and catering) in such public bodies as kindergartens and schools, staff cafeterias in the public sector, prisons, and hospitals (Wahlen et al. 2012). However, examples from various member states, especially the UK and Sweden, demonstrate that such self-regulation, even though it requires much time and effort, effectively improves food quality only when government closely monitors the initiatives (Dalmeny & Jackson, 2010). In fact, one recent report concluded unambiguously that “the only way to achieve a radical improvement in public sector food—for example in our schools, hospitals, and care homes—is for government to introduce a new law which sets high, and rising, standards for the food served” (Dalmeny & Jackson, 2010).

In contrast, market-based instruments targeting households and individuals seem far less prevalent than regulations in the food domain, despite being applied upstream in the food-supply chain (e.g., subsidies to organic farmers). However, several national governments recently launched initiatives to tax certain food types (e.g., junk food) or food components (e.g., certain fats in Denmark) (Nicholls et al. 2011). Nevertheless, the dominant policy instruments in the food domain are information-based and education-oriented tools that focus on raising awareness and are often accompanied by voluntary strategies encouraging self-commitment, cooperation, and networking. These interventions contradict social trends insofar as
increased out-of-home and ready-made food consumption, and the rise of other priorities in formal school curricula, tend to result in declining education in growing, processing, cooking, and storing food. In some places, however, efforts continue to develop “food literacy” among young consumers with regard to choosing and preparing healthy (e.g., more fruits and vegetables) and sustainable (e.g., organic, regional, fair trade) food. For instance, as one element of a national food strategy, France has recently started systematically training school children’s sensory and taste competences. Related initiatives include an explosion of interest in school-gardening initiatives and efforts to reform school-meal programs.

Achieving behavior change in favor of more sustainable food consumption, however, is a long-term goal that involves several stages and requires the constant efforts of all actors involved. Yet, barriers at the institutional, informational, infrastructural, and personal levels are pervasive. Nevertheless, with the recent rise of new, alternative agrofood networks, small farmers’ movements, and different forms of community-supported agriculture (CSA) (Oosterveer & Sonnenfeld, 2012), policy makers do have effective tools to ease the availability, affordability, and accessibility of sustainable food supply, helping to “make the sustainable choice the easy choice.”

Overall, agreeing on a positive definition of what constitutes sustainable food choices remains difficult, a challenge fuelled by inconclusiveness and sometimes even contradiction in the scientific evidence. Research and policy do seem to agree on the main drivers of nonsustainability in the current food domain. These include, first, the distance between food consumers and producers (in miles, as well as in minds). Second, is the significant loss of biomass between the field and the table (including the waste generated). Finally, the high consumption of animal products in the form of meat and dairy products is a priority. These three issues constitute the critical aspects of nonsustainability, which governments should address with some urgency.

**The Need for Coherent Policy Frameworks**

Despite growing attention to the food domain on the policy level, approaches that integrate the different sustainability issues into coherent policy frameworks or action plans—or, at least, into noncontradictory policy tools—are rare. The same is true for explicit strategies for sustainable consumption. Not only do nutrition and food policies, environmental policies, and health and social cohesion policies seldom link to one another, but explicit policies for sustainable consumption in general and for food consumption in particular are uncommon. Moreover, policy toolboxes tend to be designed one dimensionally for specific policy domains, and the policy tools adopted primarily target individual consumers. Hence, although it has become clear that systemic changes in the prevailing socio-technico-cultural-econo-political system are necessary for a move toward sustainable consumption, the role of societal innovations is often underestimated (Brown et al. 2012).

Most particularly, in the face of the dominant, highly concentrated, powerful retail industry that characterizes the European food domain, governments tend to restrict themselves to a marginal role and to noninvasive instruments, such as consumer information and education (Mont, 2008). They also seem reluctant to implement strict national food policies because of the risk that sustainability goals and policies might conflict with European law. For instance, the EU recently asked Sweden to withdraw its National Food Administration’s (NFA) proposed guidelines for climate-friendly food choices because they are in tension with European trade goals. Specifically, the EU Commission found that the recommendation to eat more locally produced food contravenes the EU’s principles for the free movement of goods.11

Governments also lack vision of the possible forms that sustainable food systems might take. An understanding of the difference between sustainable food and sustainable diet seems a crucial starting point. For instance, an individual can consume very healthy, sustainably produced food but still eat too much or too little of it. Alternatively, food could come from sustainable farming but still be highly processed and overly packaged. Hence, a priority for governmental activities is to develop integrative, cross-sectoral, population-wide food policies on such issues as agriculture and food supply, availability and access to food, physical activity, welfare and social benefits, fiscal policies, animal welfare, and information and social marketing (Robertson et al. 2007). On a global scale, such an integrative paradigm would be even more important. Yet, if the differences between Europe and the United States in how to approach sustainable development are indicative...

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10 For instance, recent research has suggested that organic meat production may give rise to higher GHG emissions than conventional meat production (Kool et al. 2009), while the German Öko-Institut has claimed that apples grown in Germany may have a higher carbon footprint than apples imported from New Zealand (Grießhammer & Hochfeld, 2009).

A review of current European sustainable development strategies (SDS) and action plans highlights the following major goals for sustainable food consumption (in order of priority): improving health and lowering obesity levels, increasing organic food consumption and production, decreasing GHG emissions, and reducing food waste. These goals have been the focus of several major reports in recent years (e.g., EC–SCAR, 2011; UK Parliament, 2012) and serve as the starting point for both our analysis of policy instruments and the search for synergies and coherence. Because SDSs are a result of social debate in the various countries, their explicit goals reflect mainstream thinking about the areas in which policy instruments are appropriate and necessary. At the same time, however, they neglect other relevant aspects of food and drink sustainability, including the social and socioeconomic dimensions on both global and local levels. As already pointed out, the UK’s Sustainable Development Commission (2005) has emphasized the need to move beyond reflections on “safe, healthy and nutritious food” to include consideration of “the needs of the less well off”; that is, policy must take into account decent economic, living, and working conditions for those along the food-production chain, including respect for animals and support for rural economies and cultural aspects.

Two other issues prominent in recent academic discussion have not yet received sufficient attention from policy makers: a nation’s self-sufficiency in terms of food supply and the uneven impacts of food production on soil. These rather complex issues are made all the more challenging by World Trade Organization (WTO) rules and EU policies promoting intercountry trade. Nevertheless, they need to be addressed in the near future, especially given the documented adverse effects of policies that increase food transportation from one country to another. As mentioned above, about 40% of food is wasted in the food chain (Mont, 2008). These issues have also been taken up by experts in water footprinting, a field that highlights the degree to which embodied water resources reflect inequitable trade flows (Hoekstra, 2013).

Given the goals already adopted as part of SDSs and the more extensive objectives that have recently entered the debate, two requirements appear relevant for building a framework for sustainable food consumption and production: short-term action on the agreed problems and medium-term specification of how to redesign the food system(s) (see Table 1). Also needed is a parallel debate on a “European food model” and its common values (e.g., as regards GMOs and nanotechnologies) that includes the possibility of a green economy strategy for the food sector.

To this end, we now review existing and desirable policy instruments and suggest a way to combine them to maximize synergies.

### Analysis of Existing and Required Policy Instruments

Table 2 summarizes the food-policy instruments currently in use in EU member states and delineates how different types of tools can work in concert toward a single goal (table **rows**) and how they can be used to support different issues simultaneously (table **columns**).

#### Information-based Instruments

On the European level, a significant amount of food-related information and disclosure is already regulated. Consumers have become accustomed to packaging that includes “best before” dates, ingredients, health claims, origins, organic content, environmental details, serving suggestions, and recipes. Nevertheless, although product-based consumer-information tools are important, they often lead to overload, an old but frequently ignored insight (Miller, 1956).

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**Table 1 Short-term and medium-term requirements for a sustainable food-policy framework.**

<table>
<thead>
<tr>
<th>Timeframe</th>
<th>Short term</th>
<th>Level of Change</th>
<th>Implications for the Food System</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goals</strong></td>
<td>mostly agreed</td>
<td>System optimization through technical solutions, involvement of society, and incentive provision</td>
<td>Agree on definitions of sustainable foods and sustainable diets</td>
</tr>
<tr>
<td><strong>Means</strong></td>
<td>fairly clear</td>
<td></td>
<td>Identify measures to satisfy the criteria for a sustainable diet</td>
</tr>
<tr>
<td><strong>Problems</strong></td>
<td>getting all stakeholders moving</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Adopted from Mont (2008)**
Table 2 Framework of policy instruments to promote sustainable food systems.

<table>
<thead>
<tr>
<th>Instruments/Issues</th>
<th>Information-based</th>
<th>Market-based</th>
<th>Regulatory</th>
<th>Self-committing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health aspects</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Publicly question current meat and dairy consumption levels</td>
<td>Increase VAT on meat products or fat (fat tax, junk-food tax)</td>
<td>Limit advertising and other forms of stealth marketing for unhealthy food and drink</td>
<td>Reduce the number of meat dishes in public sector cafeterias</td>
</tr>
<tr>
<td></td>
<td>Integrate food-related SCP considerations into formal curricula</td>
<td></td>
<td></td>
<td>Increase share of organic and vegetarian food in public sector cafeterias</td>
</tr>
<tr>
<td>Organic food</td>
<td>Develop national organic labels</td>
<td>Provide subsidies for farms during conversion and those involved in organic production</td>
<td>Simplify distribution of organic products and foodstuffs</td>
<td>Increase share of organic food in public sector cafeterias</td>
</tr>
<tr>
<td></td>
<td>Highlight environmental consequences of individual food purchasing choices</td>
<td>Support marketing of organic products and foodstuffs</td>
<td>Introduce “green accounts” for farmers</td>
<td>Increase range of organic food available in retail markets</td>
</tr>
<tr>
<td></td>
<td>Integrate food-related SCP considerations into formal curricula</td>
<td>Implement tradable nitrogen quotas</td>
<td>Place a tax on harmful pesticides</td>
<td>Increase range of regional food available in retail markets</td>
</tr>
<tr>
<td>GHG emissions</td>
<td>Highlight environmental consequences of individual food-purchasing choices, e.g., via carbon labeling or the Nutrient Density to Climate Impact (NDCI) index</td>
<td>Tax food products with high emissions, e.g., higher VAT on meat and dairy products.</td>
<td>Develop CAP in a more sustainable direction.</td>
<td>Increase range of regional food available in retail markets</td>
</tr>
<tr>
<td></td>
<td>Promote food-waste reduction</td>
<td>Introduce CO2 taxes.</td>
<td>Introduce production quotas on meat and/or animal products.</td>
<td>Voluntary agreements on “buy one get one for free” campaigns</td>
</tr>
<tr>
<td></td>
<td>Integrate food-related SCP considerations into formal curricula</td>
<td>Implement tradable nitrogen quotas</td>
<td>Develop and implement clear sustainability targets</td>
<td>Increase range of regional food available in retail markets</td>
</tr>
<tr>
<td>Food waste</td>
<td>Design and carry out awareness campaigns, including school programs</td>
<td>Integrate pay-as-you-throw (PAYT) schemes for households</td>
<td>Critically test existing food-safety standards</td>
<td>Increase range of regional food available in retail markets</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eliminate legal barriers that can lead to wastage</td>
<td>Voluntary agreements on “buy one get one for free” campaigns</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Develop monitoring plans to ensure voluntary agreements are followed</td>
<td>Increase range of regional food available in retail markets</td>
</tr>
<tr>
<td>“Mind and markets” gap between food consumption and production</td>
<td>Integrate food-related SCP considerations into formal curricula</td>
<td>Phase out export subsidies</td>
<td>Increase range of regional food available in retail markets</td>
<td>Stimulate retailers to develop sustainable food strategies</td>
</tr>
</tbody>
</table>

1 See, ISO, 2012; Smedman et al. 2010.
2 According to a recent report, organic dairy farms produce much lower levels of GHG emissions than conventional farms (Benbrook et al. 2010). Similar advantages—with the exception of land use—have been found in organic crop farming (Nemecek et al. 2011). Source: The majority of instruments are based on Lorek et al. 2008. Additions are from Eionet, 2010a; Tukker et al. 2009b; Verburg, 2010c; EEA, 2008d; Danish Ministry of the Environment, 2009e; & Epstein et al. 2010f.
A number of practical barriers also exist, such as the readability and comprehensibility of the product information provided. As a rule, consumers tend to rely on front-of-the-package, easy-to-see, read, and understand signals, as well as shelf-display information like unit pricing (see Hersey et al. 2011). However, the secondary effects of such information tools are often at least as important as the primary effects of better individual choices. These include impacts on social norms (e.g., regarding packaging and food waste) and quality standards, which in turn steer the industry toward healthier product formulas and provoke public debate on relevant topics.

In politics, awareness campaigns and social marketing activities are promising methods of choice, particularly in combination with other policy tools such as limits on advertising. In industry and retail, labels are increasingly seen as a business opportunity because they allow companies to participate in growing organic and fair food markets. For many years, attempts have been made to reduce this complexity by developing metalabels, for instance, a combined socioecological “sustainability” label to cover all relevant aspects (e.g., Teufel et al. 2009; Eberle et al. 2011). However, as yet no such instrument has emerged.

**Market-based Instruments**

In terms of market-based instruments, governments apply both “carrot” and “stick” approaches, including, respectively, subsidies for healthier food-stuffs (e.g., reduced VAT for fruits and vegetables) and taxes and fees on harmful or unsustainable food and drink. The goal of these latter interventions is to create financial incentives that steer market-actor behavior. Such financial instruments are potentially powerful tools because, in the food domain, price is a key decision criterion for consumption and hence a critical competitive advantage. Hence, taxes serve as a stronger incentive than subsidies for consumers to switch to another product alternative and/or to another form of need fulfillment. Taxes and fees also bring in revenue that the state can use to finance in-formation- and education-based policies, for example, promoting organic food consumption by combining an organic label with reduced VAT for organic products (EEA, 2008).

Another widely used option is the introduction of subsidies for farmers who convert to organic practices and/or those currently involved in organic production. The policies introduced so far, however, have failed to adequately address the necessary reduction in animal-product consumption, despite ranging from taxation of food products with high GHG emissions or significant ecological footprints to a higher VAT on meat and animal products and even an additional “fat tax” on saturated fats in Denmark (Ekstrand & Nilsson, 2011; Smeds, 2012). The latter, for instance, although its outcomes have yet to be formally evaluated, most clearly affects lower SESs that spend relatively more on basic foodstuffs and tend to buy fattier meat.

**Regulatory Instruments**

One critical step in the pursuit of a sustainable food policy is for governments to define and enforce clear national (and supranational) sustainability targets in the food domain, such as a general reduction of GHG emissions or land-usage goals (EEA, 2008). Proper implementation and promotion of these targets must be ensured through independent monitoring. However, although some EU member states (e.g., the UK and Denmark) are spearheading such initiatives and devising goals, plans, actions, and processes, others remain only in the early stages of development.

The major framework shaping food supply and demand in Europe is the CAP which, as a medium- to long-term strategy for a sustainable food system, could adopt the phasing out of export subsidies for agricultural products and the shifting of those funds toward SME-scaled production for local and regional needs (BirdLife International et al. 2009). Such a strategy would strengthen rural economies by ensuring a viable livelihood for farmers, processors, retailers, and their employees. At the same time, the narrowing of the distance between production and consumption—both in minds and markets—would help to reduce not only food miles but also preferences for industrially prepared meals over fresh, local food. The most important contribution for lowering GHG emissions, however, would be reduced consumption of meat and dairy products, which would require consideration of (national) production quotas as an administrative instrument that could, according to preliminary estimates, lead to the fastest reduction in GHGs (Weidema et al. 2008).

One possible strategy for providing broader support and awareness for organic production among farmers, while retaining control and transparency for policy and civil society, would be to establish so-called “green accounts” for farmers (Eionet, 2010). Evaluations of such input-output accounting systems, developed to facilitate voluntary improvements in farm environmental performance in countries with intensive agricultural production, show that, in a broad spectrum of different agricultural operations and enterprises, they often lead to improvement in

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12 In Denmark, “green accounts” are part of a mandatory environmental reporting system that accounts for the physical flows of pollutants and resource efficiency.
nutrient and energy efficiency with no extra cost to farmers (Halberg et al. 2005).

With respect to food waste, one policy option would be to eliminate legal barriers and disproportionate food-safety standards that lead to high waste rates. Hence, food-safety standards—many introduced in the context of the mad cow-disease crisis—should be thoroughly reviewed (Verburg, 2010). In particular, the actual meaning of “eat-by dates” should be better communicated to consumers to avoid wasting food, without, of course, compromising their lives and health.

In addition, given the research evidence on the effectiveness of food advertising for fatty, salty, and sugary snacks and drinks (especially among children and the poorly educated), regulation, particularly during children’s programs, should be considered as a means to limit exposure to such communications. Although voluntary agreements are one option here (Forum for Foodvareréklamer, 2008; 2009), national regulatory bodies should have monitoring and sanctioning tools in place to ensure that such agreements are maintained.

Self-Commitment Instruments, Public Procurement, and “Nudging”

Today, a growing number of food retailers and producers want to participate in this interesting high-margin market for sustainable products, and even highly price-oriented discount retail markets have begun active promotional programs for sustainable products (Tukker et al. 2009). Public procurement of organic food has also become an appealing instrument for increasing sales of organic products in many (western) European countries, one promoting the idea that the public sector can be a role model as well as an opportunity for achieving economies of scale (Mikkelsen et al. 2006). Such public procurement serves a triple function: it supports organic farming, it can increase the acceptability of and preferences for organic food among cafeteria users via frequent exposure and habit formation, and it can help improve public health. Nevertheless, this distribution channel remains far below its potential (Lorek et al. 2008). Most particularly, despite the recognized environmental and health impacts of animal products, public procurement policies aimed at reducing meat consumption in public dining facilities are rare. The most prominent approach is a weekly “veggie day” that promotes vegetarian dishes.13 However, such choice restriction can trigger backlash and might be ineffective in the longer run.

To induce a shift toward healthier diets and lifestyles, behavioral economics-informed consumer policy has suggested and applied a toolbox of “nudges” that softly and voluntarily shift consumers toward “better choices” (Thaler & Sunstein, 2008; OECD, 2010a). Examples include efforts to create a health-supportive infrastructure, sustainable choice defaults (e.g., in public dining facilities), and access to affordable, healthier alternatives for all income groups (Wahlen et al. 2012; Reisch & Gwozdz, 2013), such as requiring students to pay cash for sweets while presenting healthier options more attractively. Such solutions lead to higher participation than simply banning junk food or sugar-sweetened beverages from school cafeterias (Downs et al. 2009; Just & Wansink, 2009; Taber et al. 2012).

A Final Thought

The production of good policy requires both policy-minded researchers and research-minded policy makers (Bogenschneider & Corbett, 2010), which is all the more important in the food domain where drafting effective policies to foster sustainable food consumption requires an understanding of the entire food system and all its interactions and dependencies. Its opposite, the tendency to view single aspects of sustainability as unrelated—to dissociate food production from nutritional behavior, economic aspects from social aspects, health aspects from environmental aspects, and everyday meal planning from other life areas like employment, housework, and leisure—is responsible for the limited success of many approaches tried so far (Eberle et al. 2006). A first priority, therefore, is to develop integrative, cross-sectoral, population-wide policies that address such issues as agriculture and food supply, availability and access to food, physical activity, welfare and social benefits, fiscal policies, and information and marketing, all important elements discussed in this article.

References


13 See, for instance, a recent Finnish campaign along these lines described at http://www.valitsevege.fi/node/2.


Due to the length of the text, the full citation is provided in the reference list at the end of the document.


Reisch et al.: Sustainable Food Consumption


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Does global meat consumption follow an environmental Kuznets curve?

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In this article, we use data on meat consumption, per capita income, and other socioeconomic variables for 150 countries to determine whether data support the hypothesis that per capita meat consumption follows a Kuznets-style inverted U-curve. In other words, as nations increase their real per capita incomes, while individuals at first consume more meat, ultimately, over time and with increased income, do they moderate their consumption? Our results signal that although there is evidence of a Kuznets relationship, the income at which our data suggests a deceleration of meat is large enough that for many countries this deceleration will not be reached in the foreseeable future. In a cross-section sample of low-income countries, we find no evidence of a Kuznets relationship. In a cross-section sample of high-income countries, we do find a potential Kuznets relationship and a deceleration of meat consumption at a per capita income of US$49,848. In the full panel-data sample combining high- and low-income countries, including data on land area and urbanization, our results suggest an inflection point in meat consumption at an income of US$36,375, still quite high for any realistic impact. Thus, our results highlight that effectively decelerating the global demand for meat may require aggressive and potentially controversial policy interventions, which, while leaving individuals with less choice, would address the otherwise devastating environmental impacts of increasing meat consumption.

KEYWORDS: income, socioeconomic aspects, environmental impact, meat production, food consumption

Introduction

Approximately three billion people are currently chronically malnourished while our agricultural systems are concurrently degrading land, water, and biodiversity, and altering climate on a global scale (WHO 2000; Foley et al. 2011). Despite malnourishment at the individual level, overall, increasing population and consumption are placing unprecedented demands on agriculture and natural resources (Pelletier & Tyedmers, 2010). Meat, the most unsustainable form of food that humans husband and consume in particular places a heavy strain on global resources. Factory-based farming has overtaken transportation as the largest contributor to global climate change, and the impacts on water, air, and soil are without parallel. In many developing countries, these natural resources are already compromised, turning the increased consumption of meat into a potential environmental disaster. It is clear, forecasting into the future, that global population growth will further stress global resources.

In this article, we emphasize another source of increasing demand for meat: per capita income growth, most significantly in developing countries such as China and India. We further investigate whether data from higher income countries reveals a projected deceleration of meat demand once a threshold income is reached. This deceleration could offer some hope of a natural moderation to an otherwise serious growth pattern in demand. The modeling of this pattern of deceleration takes on the potential form of a Kuznets curve.

In his seminal paper from 1955, economist Simon Kuznets first discussed the nonlinear relationship between a country’s stage of development, measured through income, and the income distribution within the country (Kuznets, 1955). According to Kuznets, as a country moves along its path of growth, it first experiences an increase in income inequality as wealth increases; however, later, with changing social preferences and the development of strong institutions empowered to redistribute wealth, income inequality decreases. Thus, graphing a measure of income inequality, for example the Gini coefficient, over time would result in a bell-shaped, quadratic curve showing an ultimate inflection point.1

1 The Gini coefficient is used to compare income inequality across countries and can take on values between 0 (perfect equality) to 1
This approach, that certain characteristics of economic growth are nonlinear, has been applied in other areas as well, most significantly in the study of the link between economic growth and pollution. The World Health Organization (WHO) established the Global Environmental Monitoring System (GEMS) and collected data on both water and air pollution to determine whether pollution in a developing country would have a similar inverted U-shape, called an environmental Kuznets curve (EKC). Later, Shafik & Bandyopadhyay (1992) and Grossman & Krueger (1993) both estimated cross-country relationships between income and air and water pollution, deforestation, and waste output. The former study concluded that airborne sulfur dioxide ($SO_2$) and smoke concentrations began to diminish after an income level of US$3,000–US$4,000 (in 1992 dollars) per capita was reached, and the latter found the same but with a turning point of US$4,000–US$6,000. Several other research studies have since verified this curve, with inflection points differing only slightly.

Later research focused on the question of how this shape consistently arises in individual countries as they develop. Copeland & Taylor (2003) recapitulate these studies, detailing four possible mechanisms by which EKC emerges: control not being implemented until pollution builds up to a discernible amount; strong increasing returns to scale in pollution abatement; reduced corruption in government enhancing abatement effort; and a natural origin, although the peak could occur at virtually any income level.

More recently, Deacon & Norman (2006) identify a gap in previous research: data had not been analyzed for individual countries, thus these researchers investigated time-series data by country for criteria pollutants including $SO_2$, smoke, and particulates to determine what impact development has on in-country environmental quality. Further, Deacon & Norman (2006) assert that EKC-consistent patterns are most likely to emerge if using three points, as then only four shapes are possible: monotone-increasing, monotone-decreasing, single-peaked, and single-troughed. The first three are potentially consistent with the EKC hypothesis and the fourth is EKC-inconsistent. Deacon & Norman (2006) found that many factors complicate the data and that only three of the 25 countries investigated followed this EKC hypothesis.

Several authors have extended the hypothesis of an EKC relationship into the general category of animal welfare and the specific relationship between income and meat consumption. Vinnari et al. (2005) considered the relationship between meat consumption and income in the European Union (EU) and found a potential apex at the per capita income of US$15,000. Using the broader definition of animal welfare, Frank (2008) considers the relationship between income and meat consumption as well as the impact of income on a more general “concern for animal welfare.” Frank considers a sample of high-income countries in his study—focusing on the United States—and his models seem more successful in finding linear relationships. Rather than showing a rigorous Kuznets curve, they provide more background as to why an apex in the relationship between income and meat consumption might exist. For example, Frank finds strong evidence that higher incomes result in better treatment of companion animals, implying a stronger emotional bond with and concern about animals.

Past studies on the Kuznets relationship and the environment highlight the complications of using cross-section versus time-series data to investigate what are supposed to be dynamic relationships. In general, time-series data following one country can be effective in understanding short-run deviations from a long-run process or path while cross-section data can be effective in understanding long-run stable relationships (with the assumption that long-run relationships are robust to the cross-section dimension). In our study, we use both cross-section and panel (time-series) data. Further, to build on the evidence suggested between income and meat consumption (and animal welfare) in high-income countries, we explicitly include developing countries in our data set. The rapidly growing populations and incomes in countries such as China and India, we believe, make understanding a potential Kuznets in such countries especially important. To begin our discussion, we review the environmental impact of meat husbandry and consumption.

Environmental Impact of Meat Consumption

Agriculture is a major force driving the environment beyond the boundaries of what the planet can produce (Rockstrom et al. 2009). Of all activities humans engage in on Earth, producing, distributing, and consuming meat has the largest environmental impact on scales ranging from local to global. The industrial, concentrated animal-feeding operation (CAFO) practices of raising animals for food in confined quarters with lax restrictions on resultant pollutants are responsible for unsustainable resource use and significant air pollution and resultant climate change, water overuse and pollution, land degradation, arable soil erosion, fossil-fuel use, climate
change, and biodiversity loss. Similarly, these environmental problems occur in developing nations, and biodiversity loss is particularly troubling in Earth’s rainforests. To meet the world’s future food security and sustainability needs, food production must grow substantially while, at the same time, agriculture’s environmental footprint must shrink dramatically (Foley et al. 2011).

**Air Pollution and Climate Change**

Estimates of greenhouse gases (GHG) emitted by CAFOs vary: in its book *Livestock’s Long Shadow: Environmental Issues and Options*, the Food and Agriculture Organization of the United Nations (FAO) (2006) estimates that the meat industry contributes 18% of all emissions of GHGs, although Koneswaran & Nierenberg (2008) report a 51% minimum of total emissions, which highlights the difficulty in constraining emissions totals. Even the conservative 18% FAO estimate means livestock are responsible for 40% more than all the cars, trucks, planes, trains, and ships in the world combined. In its 2006 report, the United Nations (UN) estimated that 7.8 billion tons/year of carbon dioxide (CO₂) are produced in the raising of meat animals. Globally, ruminant livestock (cows) produce about 80 million metric tons of methane annually, accounting for about 28% of global methane (CH₄) emissions from human-related activities (USEPA, 2006). This is in addition to the GHG emissions used in producing the crops fed to livestock (Parry et al. 2007; Verge et al. 2007).

Animals raised for human consumption are also responsible for nearly 70% of anthropogenic ammonia emissions, which contribute significantly to acid rain and acidification of terrestrial and aquatic ecosystems. The livestock sector emits 37% of anthropogenic CH₄ (with 23 times the global warming potential—or GWP—of CO₂)...[and] emits 65% of anthropogenic nitrous oxide (with 296 times the GWP of CO₂) (Parry et al. 2007).

**Water-Resource Use and Degradation**

Seventy percent of global freshwater withdrawals (80–90% of consumptive uses) are devoted to irrigation (Foley et al. 2011). Furthermore, rain-fed agriculture is the world’s largest user of water (Gordon et al. 2005). Livestock production also uses significant amounts of water and generates large volumes of water pollution. Sixty gallons of water are necessary to produce a pound of potatoes, yet a pound of beef requires over 12,000 gallons of water. An estimated 240 trillion gallons per year of water, equal to 7.5 million gallons per second of water, is used for livestock production (UN, 2006). Indeed, the UN states that “water used by the [livestock] sector exceeds 8 percent of the global human water use” (Parry et al. 2007).

Animal agriculture in the United States is responsible for 33% of overall water pollution, including the aquatic pollutants nitrogen and phosphorous, and half of its water pollution from antibiotics. In the United States, 80% of surface-water bodies are polluted due to livestock production, and nearly 17 billion tons per year (over a million pounds per second) of chicken, hog, and cow waste are produced globally. The world’s seven billion human inhabitants produce just 1/60th of this waste. This excrement makes the livestock sector the largest source of water pollution in the world, contributing to overfertilization (eutrophication) of surface waters, which creates, among other things, dead zones in coastal wetland ecosystems, irreversible destruction of tropical coral reefs, and human infectious diseases such as *E. coli* (UN, 2006). Fertilizer for crops fed to cattle also creates nutrient excess, which are especially large in China, Northern India, the United States, and Western Europe (Vitousek, 2009).

**Soil Erosion and Land Degradation**

Agriculture occupies about 38% of Earth’s terrestrial surface—the largest use of land on the planet (Ramankutty et al. 2008). Livestock in CAFOs are fed on grain, a highly inefficient method of obtaining calories, and estimates range from a 4:1 up to a 54:1 energy-input to protein-output ratio, meaning, for example, that the United States could feed up to 800 million people with the grain currently fed to livestock. Therefore, producing animal-based food is much less efficient than the harvesting of grains, vegetables, legumes, seeds, and fruits for direct human consumption. Meat consumption thus has staggering economic and environmental repercussions.

The production, distribution, and consumption of meat, dairy, and eggs is responsible for over half of the erosion that causes sedimentation of waterways, or 40 billion tons per year of soil loss (6 tons per year for every human on the planet). Of this outsized volume, 60% accumulates in surface waterways (rivers, streams, and lakes), making these water bodies prone to flooding and contamination from agrochemicals (inorganic fertilizers and petroleum-based pesticides) sorbed to sediment grains (Foley, et al. 2007). Further, lost soil may become windborne, thus increasing the volume of dust in the atmosphere. Finally, FAO (2005) concludes that expanding livestock production is one of the main drivers of the destruction of tropical rain forests in Latin America, which is causing serious environmental degradation globally (Foley et al. 2007; Gibbs et al. 2010). More food can be delivered on less land by changing our dietary preferences. Simply put, we can increase food availability (in
terms of calories, protein, and critical nutrients) by shifting crop production away from livestock feed, bioenergy crops, and other nonfood applications (Foley et al. 2011).

**Fossil-Fuel Use**

Significant amounts of fossil fuels are used in the production, distribution, and consumption (including refrigeration) of meat. In fact, using current factory farming methods, it takes more than ten times as much fossil fuel to make one calorie of animal protein as it does to make one calorie of plant protein. Fossil fuels are nonrenewable, finite resources that are highly polluting, responsible for CH₄, CO₂, mercury, arsenic, and radioactivity found in air and water.

**Land Use and Biodiversity Loss**

Over ten billion acres of the terrestrial portion of Earth is used to raise animals for food. According to *Livestock’s Long Shadow* (2006):

[L]ivestock production accounts for 70 percent of all agricultural land and 30 percent of the land surface of the planet…70 percent of previous forested land in the Amazon is occupied by pastures, and feed crops cover a large part of the remainder…about 20 percent of the world’s pastures and rangelands, with 73 percent of rangelands in dry areas, have been degraded to some extent, mostly through overgrazing, compaction and erosion created by livestock action.

A total of 836 million tons per year of grain (including corn) is grown to feed livestock. If this grain were used directly for human consumption, the human agricultural impact on the environment would be significantly lessened. Five million acres of Amazon rainforest are obliterated each year, either to graze livestock or to grow grains for their consumption. Over 90% of Amazon deforestation is due to raising animals for food. Over one thousand species go extinct every year due to animal-based agricultural activities.

Further, the FAO (2006) concludes:

[T]he livestock sector may well be the leading player in the reduction of biodiversity…livestock now account for about 20 percent of the total terrestrial animal biomass, and the 30 percent of the earth's land surface that they now pre-empt was once habitat for wildlife…An analysis of the authoritative World Conservation Union (IUCN) Red List of Threatened Species shows that most of the world's threatened species are suffering habitat loss where livestock are a factor.

As developing nations tend toward both Western-influenced, meat-rich diets and the agricultural techniques involved in procuring meat, the local, regional, and global consequences of this transition are sure to be felt. In short, we need better data and decision-support tools to improve management decisions (Zacks & Kucharik, 2011).

**The Economic Decision to Consume Meat**

For economists, the consumption decision at the household level presumes that the household chooses to spend its income in a manner that maximizes the household’s satisfaction. This decision-making process requires that a household use information on its income, the prices of the goods it considers consuming, and how tradeoffs between consumption goods affect its overall satisfaction to reach the choice to consume an optimal bundle of goods. Within this process, economists define economic goods as having certain properties relative to their own price and overall household income, and income elasticity respectively. Price elasticity measures the responsiveness of consumers, in the consumption decision, to price changes of a given good, and income elasticity measures the responsiveness of consumers, in the consumption decision, to changes in income. In this section, we discuss past empirical studies on the impact of price and income on the decision to consume meat, focusing on studies done in developing countries.

**Price Elasticity of Meat**

Gallet (2010) reviews past studies on meat-price elasticities. In general, Gallet’s summary of previous findings suggests that all meats have inelastic prices. The median value for past studies on meat in general is given as \( -0.710 \); the median estimate for beef is reported as \( -0.869 \) and pork \( -0.780 \). (Unit elasticity occurs when the percentage change in quantity demanded is equal to the percentage change in price, so \( E_d = -1 \), and relative elasticity occurs when the percentage change in quantity demanded is greater than the percentage change in price, so \( E_d < -1 \).)

Price elasticity becomes especially important in the case of a policy interest in moderating meat consumption through a tax; price elasticities are critical in evaluating the financial impact on consumers and producers. To the extent that general growth in demand for meat could in turn increase its price, a negative price elasticity suggests a potential source of moderation in overall meat consumption. For exam-
ple, a November 2011 news story from an online UK financial journal suggested that growth in China’s and India’s demand for meat caused a 25% increase in the price of turkey in the UK (Elliott, 2011).

**Income Elasticity of Meat**

Of more direct interest to this study is the relationship between income and meat consumption. We now investigate past evidence on that relationship. York & Gossard (2003) conducted a cross-national study of per capita meat consumption using economic and ecological variables. The data include 132 countries categorized as being from one of four cultural regions: the West, Africa, Asia, and the Middle East. The authors confirm that income, as measured in their study by per capita gross domestic product (GDP) purchasing power parity (PPP), increases per capita meat consumption by 2.67 kilograms (kgs) for each increase in income of US$1,000. They also find that the percent urbanization of a country’s population has a positive impact on meat consumption as well as land exploited per capita; the latter, they hypothesize, is due to the ecological requirements of animal husbandry. Consistent with a positive income-growth and meat-demand relationship, Gehlar & Coyle (2002) find that the composition of world agricultural trade has substantially changed in the past two decades; for developing countries, consumption and trade are shifting from basic staples toward higher value livestock products.

Other studies estimate income—or expenditures used for consumption and not saving—elasticity. Shono et al. (2000) measure expenditure elasticities for food-consumption products, including meat, using data from urban income groups in China, while Jiang & Davis (2007) estimate elasticities for rural Chinese households. The more aggregated urban data yield estimates for income elasticity for meat that are both positive and relatively inelastic. Jiang & Davis’s estimate for the income elasticity of pork is 0.462 and beef 0.496. The only food products which have estimates larger than one in their study—relatively responsive to changes in income—are fruits and dairy products, which the authors acknowledge are viewed as luxury goods in China. The authors’ overall conclusion about the change of demand for meat in China is that while meat demand is increasing with income, China is likely to follow a path closer to other Asian countries, rather than Western countries, which have higher consumption of seafood. In fact, the authors find the income elasticity of carp (0.856) and shrimp (0.762), the only seafood products in their study, to be higher than meat. In their study on rural meat consumption, Jiang & Davis (2007) use household-level data for 1,520 households in Jilin Province. The authors model the household-consumption decision in a first stage as allocating income across food and nonfood consumption, and in a second stage as taking the household-food budget and allocating it across four categories: grains, vegetable products, animal products, and other foods. In the final stage, the household takes the budget for each category and allocates purchasing decisions within the category. Given the household-data available for China, only the decision across animal products can be rigorously estimated for the family. Their estimate for income elasticity for meat is close to the urban estimates at 0.88. Interestingly, correcting for specific household characteristics does not substantively change the estimate, lowering it only to 0.87.

Several other studies estimate household-income elasticity for meat in other developing countries. Hendriks & Lyne (2003) consider data from 99 households in two communities of Kwa-Zulu Natal, South Africa. In their results, both overall food and specific meat elasticities are close to unity: the food elasticity for the community of Sawiyimana (46 households in the study) is estimated to be 1.09 and for meat 0.97; for Umzumbe (47 households) the estimates were 0.98 and 1.04 respectively. The authors recognize that preferences for increased meat consumption with increases in income could actually be higher than the estimates suggest, as consumption could be mitigated by the lack of refrigeration for these households. Another study, using data from 9,189 households, estimates income elasticities for meat in Viet Nam as 1.068 for rural households and 0.692 for urban households (Le, 2008). This interesting result on the rural/urban divide contrasts with results from the cross-national study by York & Gossard (2004). When the latter divided the households by income quintiles, they found that the income elasticity of meat increased for the wealthier quintiles, a result which certainly challenges the possibility of a Kuznets curve. The estimated elasticities for quintiles (poor to wealthy) are 0.22, 1.12, 1.86, 2.07, and 2.75. These estimates suggest that mean consumption for the wealthy in Viet Nam is highly elas-

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2 The use of “purchasing power parity” and “constant 2005 dollars” allows for two dimensions of the neutralization of price effects across countries and across time to facilitate direct comparison. “Purchasing power parity” adjustments in the data control for different prices across countries, accommodating for the fact, for example, that one could live much better on US$5,000 a year in Botswana than the UK. Using “constant 2005 dollars” converts the data from nominal values to real values, neutralizing the impact of a basic upward trend in prices over time.

3 For comparison purposes, the authors quote earlier results on urban areas in China (Huang & Bouis, 1996), which find overall income elasticity for meat to be closer to one, 0.967, with pork at 0.916, beef and mutton at 0.788, and poultry at 1.222.
tic and responsive to income, and further development in the country would cause great increases in the demand for meat.

The above studies should be seen as representative, not exhaustive, of the estimation of expenditure elasticities. All of the studies reinforce the notion of a positive response to meat demand as income increases in developing countries. However, the magnitude of the increase varies to some degree across the studies. Simply put, all these results acknowledge the first side of the hypothesized Kuznets relationship. A mechanism for an ultimate downturn in meat consumption, if anything, is challenging for these countries. The studies also raise other issues, such as a dominant role for rural versus urban location.

**Background to a Meat Consumption EKC**

In the justification of a Kuznets inverted curve for both income distribution and pollution, an initial burst of industrial activity is ultimately offset by a societal interest in mitigating income inequality and pollution primarily through strong, responsive, and responsible institutions. Changes in meat consumption, which would mitigate an upward trend, would be very different, structurally, from the narrative of a change in social values and desired intervention by strong institutions to either redistribute income or mitigate pollution. Rather, changes in the decision to consume meat depend on an increased awareness of the environment, animal rights, and human health, striking directly at individual consumer preferences and ideas that typically persist about what makes an individual “happy” or “better off.” Further, while the effects of pollution on society may be directly visible—such as smog-filled air or discolored water—the environmental impact of meat may be more abstract to individual consumers, making an argument predicated on social need or economic negative externality more difficult.

To fully follow a Kuznets pattern, the relationship between income and meat consumption must have a turning point, an income level after which the demand for meat decelerates. As is the case with the Kuznets curves described previously, this requires some structural change in the underlying relationship between income and the desire to consume meat. In a study on the social influences of meat consumption in the United States, Gossard & York (2003) discuss factors that may influence consumer demand for meat and cite the rise of vegetarianism in Western societies. Other factors such as the negative health effects of meat consumption, government subsidies for meat-producing industries, and cultural manipulation are all discussed as playing a potential role in American meat consumption. Due to data limitations, however, the authors are only able to model the impact of specific demographic variables—age, gender, race, weight, and region, as well as income, education, and occupation—in their regression analysis of meat consumption for a survey of 15,028 individuals conducted by the United States Department of Agriculture in 1996. Results from their study, which may add to the interpretation of cross-national data, include negative and significant relationships between age and education and meat consumption and the significant finding that women consume less meat than men. Finally, they find that social class influences meat consumption, a claim they substantiate with the finding that workers in professional occupations consume significantly less meat than those in laborer occupations. To the extent that income can capture education levels and class dynamics in the cross-section, and if the dynamics are indeed similar cross-nationally, it would allow potential for the nonlinear relationship we are hoping to find.

As discussed previously, Frank (2008) also finds that as incomes increase (in his set of developed countries) there tends to be more interest in animal welfare and empathy toward companion animals, which could extend to an overall interest in animal rights.

**Data Analysis**

In our study, we use data for 1980–2009 taken from the FAO to compute the per capita consumption of meat. Specifically, we use the data series for food-supply quantity (kilograms per capita) for bovine meat, pig meat, and poultry. Data for per capita GDP (PPP in constant 2005 dollars), the percent urbanization of a country’s population, and the percent of a country’s land area used for agriculture are taken from the World Bank *Indicators of Development* (2013). The measures for land area and urbanization are used to proxy the relative scarcity of agricultural and natural-resource-based land use and resultant relative high cost of animal husbandry within a domestic economy, as well as the socioeconomic phenomenon, dominant in most developing economies, of rural to urban migration.

By using a traditional ln/ln regression specification, using the natural log of meat consumption and natural log of income, we can report a point estimate for income elasticity, which provides an initial comparison of how our data perform with respect to previous studies. Specifically, the estimated slope coefficient in a ln/ln regression model can be interpreted as an elasticity. More importantly, to test our Kuznets hypothesis, we use a polynomial specification for income both to test the statistical significance of the
meat consumption for the 150 countries: approximately 41% of the nations in the dataset consume less than 25 kgs/capita/year; only 2% of the countries consume more than 100 kgs/capita/year (See Table 1). The average annual meat consumption within the data set is in the United States at 118.9 kgs and the highest meat consumption per capita per year in the data set is in Bangladesh at 2.6 kgs.

Table 1

<table>
<thead>
<tr>
<th>Kilograms</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–25</td>
<td>60</td>
<td>37.50</td>
</tr>
<tr>
<td>25–50</td>
<td>36</td>
<td>22.50</td>
</tr>
<tr>
<td>50–75</td>
<td>30</td>
<td>18.75</td>
</tr>
<tr>
<td>75–100</td>
<td>22</td>
<td>13.75</td>
</tr>
<tr>
<td>100+</td>
<td>12</td>
<td>7.50</td>
</tr>
<tr>
<td>Total</td>
<td>160</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Notable primarily for their current population and rapid economic growth are China, at 54.1 kgs/capita/year, and India, at 3.6 kgs/capita/year. Table 2 reports an estimate of the annual growth rate of per capita meat consumption for several countries, including China and India. In terms of per capita consumption, China clearly has an extremely large growth rate, 5.1%. India’s growth in consumption is much lower, less than 1%. Although our data do not investigate this dynamic, the ethnic and religious demographics (specifically, vegetarianism) in India may play a role in keeping this growth low (at least to date). Brazil, often mentioned alongside China and India for its high economic growth, has a growth rate of 0.62%, although Norway, a country with a higher per capita income than the United States in 2009, has a growth rate of 1.6%. This modest sample of five countries shows no discernible pattern; for example, it is not true that the wealthiest countries have a slower growth rate in meat consumption.

The Bivariate Relationship in the Cross-Section (2002)

A scatter plot of meat consumption and per capita income for 149 countries in 2009, with a fitted polynomial curve, reveals the possibility of a Kuznets relationship (see Equation 1). While a downward curve fits the data, it is clear that there is much variation about this curve. To rigorously consider the Kuznets hypothesis, we estimate the following regression in order to hypothesis test the significance of the coefficient on the polynomial term, which would distinguish the relationship from a basic linear form:

\[
\text{Meat} = \alpha + \beta_1 \text{Income} + \beta_2 \text{Income}^2 + \varepsilon
\]  

The estimates for “income squared” need at least six decimal places to appear non-zero.

Results from this regression for the high income and full sample reveal a statistically significant coefficient on income squared (see Table 3). Further, using these estimates we can solve for an apex or turning value for the full sample curve at approximately $0.18$ income.

Estimated meat consumption = \( a + b_1 \text{Income} + b_2 \text{Income}^2 \)

\[
d (\text{est-meat})/d(\text{income}) = b_1 + 2b_2 \text{Income}^* = 0
\]

Income* = \(-b_1/2b_2\).

Table 2 Growth in annual per capita meat consumption in pounds.

<table>
<thead>
<tr>
<th>Year/Rate</th>
<th>China</th>
<th>India</th>
<th>USA</th>
<th>Japan</th>
<th>Denmark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption</td>
<td>3.8</td>
<td>3.7</td>
<td>89.2</td>
<td>7.6</td>
<td>56.7</td>
</tr>
<tr>
<td>Consumption</td>
<td>52.4</td>
<td>5.2</td>
<td>124.8</td>
<td>43.9</td>
<td>145.9</td>
</tr>
<tr>
<td>Estimated Growth Rate (%)</td>
<td>5.51</td>
<td>0.92</td>
<td>0.65</td>
<td>3.88</td>
<td>2.84</td>
</tr>
</tbody>
</table>

Note: Growth rates estimated from data using a simple growth trend model, i.e., a ln/ln regression model.

Table 3 Dependent variable: per capita meat consumption.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Full group</th>
<th>Low Income</th>
<th>High Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>16.7198***</td>
<td>-1.4695</td>
<td>39.1747***</td>
</tr>
<tr>
<td>Income</td>
<td>0.0042***</td>
<td>0.0188***</td>
<td>0.0023***</td>
</tr>
<tr>
<td>Income squared</td>
<td>(-0)**</td>
<td>(-0)**</td>
<td>(-0)</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.59</td>
<td>0.22</td>
<td>0.30</td>
</tr>
</tbody>
</table>

N = 160

Note: standard errors reported in parenthesis. ***, ****, indicate p-values less than 0.10, 0.05, and 0.01 respectively. The estimates for “income squared” need at least six decimal places to appear non-zero.

\footnote{The “turning point” (or “apex”) income is computed from the polynomial regression output by solving for, and setting to zero, the first derivative of estimated meat consumption with respect to income. So that:

\[
\text{Estimated meat consumption} = a + b_1 \text{Income} + b_2 \text{Income}^2
\]

\[
d (\text{est-meat})/d(\text{income}) = b_1 + 2b_2 \text{Income}^* = 0
\]

Income* = \(-b_1/2b_2\).}
US$43,901, a value quite a bit higher than the US$15,000 suggested by Vinnari et al. (2005) for EU countries. In addition, with the full sample, the maximum meat consumption—the predicted meat consumption at the apex income of US$43,901—would be 89 kgs (Table 4). Because, as the results will discuss, the variables for urban population and agricultural land use may be significant in a regression for meat consumption, to check the robustness of the turning point estimate we re-estimated the equation, including those variables. With these variables included—and evaluating the expected meat consumption at the sample means for urbanization and agricultural land use—we find that meat consumption in the full sample decelerates at an income of US$45,263 (and annual meat consumption of 84 kgs). Taken together, the results from these two models show that a country would not be predicted to reach the Kuznets apex until it reached a per capita income of more than US$40,000, a long journey for many developing countries.

The clustering of observations at the low end of the income scale, however, suggests that dividing the dataset may allow for more insights (see Equations 2 and 3). Therefore, we re-estimate our regression model after dividing the data between “high-income” and “low-income” countries. We use US$5,000 per capita as the dividing income. The average annual per capita meat consumption within the low-income countries is approximately 18 kgs; within the high-income group the yearly mean is approximately 59 kgs. Notably China, within the low-income group, has an annual per capita meat consumption that is more than twice the low-income group average. The results of these split regressions are given in Table 3.

As we did with the full sample model, for the split models we solve both for the income at which the data suggests an inflection point (see Table 4), or downturn in meat consumption, and for the maximum meat consumption at the inflection point. According to these results, the low-income countries would not see a Kuznets curve relationship; in fact, for these countries, neither income variable is significant in the regression. For the high-income countries, with only the income variables in the regression, a turning point would be expected to occur at an income of US$49,848, with a predicted annual meat consumption of 88 kgs. When variables for urbanization and agricultural land use are again added to the model, meat consumption is expected to decelerate at a smaller income of US$39,809 with a predicted maximum meat consumption of 65 kgs per year.

To test the consistency of our results with previous findings in the literature, we further estimate income elasticities with the ln/ln regression specification:

\[
\ln(\text{Meat}) = \alpha + \beta_1 \ln(\text{Income}) + \varepsilon
\]  

(2)

Our overall results are largely similar to the literature-review values. In all cases, our estimates suggest that meat consumption is inelastic (< 1) with respect to income. The results for these elasticities are given in Table 5. According to our results, for the full set of countries, a 1% increase in income would increase meat consumption by 0.557%. Our point estimates suggest that income elasticity for high-income countries, at 0.487, is actually lower than for low-income countries, 0.525. As their confidence intervals overlap, though, we cannot rigorously conclude that the income elasticity is actually different across income groups.


In this section, we consider extending our results, both to a panel-data set for all our countries with a maximum of 30 years for each country, as well as to a broader regression specification. In this broader specification we add two variables, measuring overall land area and the percent of a country’s population living in an urban area. In our dynamic model, these variables fit our goal to model more critically both land and the spatial use of land within a country. By modeling the spatial use of land, we hope to capture a proxy for the potential cost of resources used for animal husbandry, land area, and, with the data on urbanization, a measure of population concentration and potential industrialization of the domestic economy. Beck & Sieber (2010) further discuss the importance of spatial land and its impact.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Full Group</th>
<th>Low Income</th>
<th>High Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inflection Income ($PPP)</td>
<td>$40,043</td>
<td>$3,566</td>
<td>$55,606</td>
</tr>
<tr>
<td>Maximum Meat Consumption (pounds)</td>
<td>100</td>
<td>32</td>
<td>102</td>
</tr>
</tbody>
</table>

Note: In the case of “high income” a linear relationship, i.e. no turning point in the data, cannot be excluded. The maximum meat consumption at the inflection point income.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Full Group</th>
<th>Low Income</th>
<th>High Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parameter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Min</td>
<td>0.5348</td>
<td>0.4607</td>
<td>0.2504</td>
</tr>
<tr>
<td>Max</td>
<td>0.6601</td>
<td>0.8524</td>
<td>0.4986</td>
</tr>
</tbody>
</table>

Note: Max and min form 95% confidence interval.
on human geography. We also add a time trend to estimate an average increase and growth rate over time. The panel-data approach allows us to consider information on the actual growth paths of our countries. For our panel results, we estimate the base regression for Model 1:

\[ \text{Meat} = \alpha + \beta_1 \text{Income} + \beta_2 \text{Income}^2 + \beta_3 \]  

\[ \text{Land} + \beta_4 \text{Urban} + \beta_5 \text{Time} + \epsilon \quad (3) \]

In Model 2, we estimate income elasticity by using the natural log of meat for the dependent variable and replace the variables for income and income squared with the natural log of income. Results are given in Table 6.

In Model 1, again income is positive and significant as well as the variables urban and land. The positive coefficient on land coincides with the notion that more land-rich countries may find animal husbandry less expensive. The positive coefficient on urbanization may indicate further impacts of market structures, transportation efficiencies, and industrialization, beyond simply income growth. It may also indicate a difference between tastes and preferences of urban versus rural residents, consistent with York & Gossard (2004)—but contrary to Le (2008)—in which urban residents prefer more meat consumption.

The polynomial term is negative and significant, again indicating an inflection point, and the magnitude is somewhat different from the cross-section: results from the panel regression suggest an inflection point at an income of US$36,375. Again these results, and indicated incomes, differ dramatically from the findings of Vinnari et al. (2005). For countries in the low-income group (which showed no deceleration in the tendency for meat consumption in the cross-section) there are potentially many years before a per capita income of over US$35,000 will be reached, meaning, based on these results, there can be no expectation of moderation in meat consumption for many countries in our sample. Interestingly, time is not statistically significant, indicating there is no robust estimation of an increase in per capita meat consumption.

In Model 2, our estimate for income elasticity, 0.577, is similar to the cross-section, still indicating that meat consumption is inelastic with respect to income. Using the ln (meat) model, the coefficient on urban, 0.006, can be interpreted as indicating that a one percentage point increase in a country’s population living in an urban area would result in a 0.6% increase in per capita meat consumption. Here the time trend is significant and the point estimate of 0.004 indicates an average growth rate per year of 0.4% in meat consumption for this panel of countries.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Model 1</th>
<th>Model 2 (ln)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.7548*</td>
<td>-0.6246***</td>
</tr>
<tr>
<td>Income</td>
<td>0.0028***</td>
<td>-0.1183</td>
</tr>
<tr>
<td>Income squared</td>
<td>(0)***</td>
<td>0</td>
</tr>
<tr>
<td>ln (income)</td>
<td>0.4041***</td>
<td>-0.0149</td>
</tr>
<tr>
<td>Land</td>
<td>0.0002***</td>
<td>(0)***</td>
</tr>
<tr>
<td>Urban</td>
<td>0.2764***</td>
<td>0.0112***</td>
</tr>
<tr>
<td>Time</td>
<td>-0.0345</td>
<td>-0.0008</td>
</tr>
<tr>
<td>N</td>
<td>3132</td>
<td>3132</td>
</tr>
</tbody>
</table>

Note: Standard errors reported in parenthesis. *", **", and *** indicate p-values less than 0.10, 0.05, and 0.01 respectively.

**Conclusion**

When considering the possibility of a Kuznets curve in cross-national meat consumption, our strongest results are found in the cross-section full group and high-income countries. In the full sample, our cross-section results suggest an inflection in meat consumption at US$45,263; however, our fuller sample results across time, including land area and urbanization, suggest a lower income of US$36,375, still not encouraging for those concerned about the resource cost of meat consumption. In our sample of 150 countries for 2009, only eight countries (or 5.4% of the sample) actually had a per capita income higher than US$36,375; only three countries had a per capita income higher than US$45,263. It may be true, however, that from a sustainability point of view, increasing food production in non-tropical zones might reduce pressures on tropical forests, as economic drivers hold great sway over deforestation, and ecologically friendly economic incentives could play an important part in slowing forest loss (Lambin & Meyfroidt, 2011).

These mixed results do not provide overall a compelling argument that consumer demand for meat experiences a structural change at an environmentally advantageous level along a country’s income path. If income growth brings with it higher education (and literacy) levels and increased labor participation in professional occupations, there is little evidence, in this cross-national study, to suggest that this has caused a change in behavior either due to a resultant broad understanding of the health or environmental consequences of meat consumption. Nor are we able to pick up any deceleration that could be caused by
the price impact of increased global demand. The results on the impact of urbanization in our panel study suggest even further that, in addition to income growth, rural-urban migration fuels meat consumption. This is especially concerning as, even stronger than the trend of income growth in low-income countries, has been the overwhelming urbanization in the developing world. An important area of future research would be to investigate whether age dynamics within developing countries influence meat consumption, as developing countries tend to have much younger populations than in higher income countries; a negative relationship was found for the United States by Gossard & York (2003). The 2003 study concluded higher meat consumption occurs in youthful countries with growing economies.

The lack of what appears to be an encouraging inflection point in meat consumption opens the door to a broader public-policy debate. Free-market advocates suggest that markets should take care of themselves: higher demand for meat should drive prices for meat products higher and, as was found in earlier studies, consumers do respond to price in their choices to consume meat. As the environmental consequences of meat on land, air, soil, and water resources have far-reaching, global consequences, however, policy makers may find it more compelling to intervene in the formation of consumer demand either through direct policies further targeting the price of meat through taxes or through indirect policies of broad environmental education and health awareness, as well as the elimination of subsidies for the meat industries. Importantly, while many concerns suggested above relate to income and urbanization growth in developing countries, our results strongly indicate no reason to neglect the patterns of meat consumption in high-income countries either. The social factors and preferences that may drive a Kuznets curve in different measures of pollution seem still absent in meat consumption in these countries. Reasons for this difference can be hypothesized: perhaps air pollution is more visible and obvious than the environmental damage caused by animal husbandry, or perhaps the issues of animal rights and ideological vegetarianism obscurates, for many, the need to consider this issue beyond the individual choice to eat meat.

References


Meat-consumption statistics: reliability and discrepancy

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Interest in meat consumption and its impact on the environment and health has grown markedly over the last few decades and this upsurge has led to greater demand for reliable data. This article aims to describe methods for producing meat-consumption statistics and discuss their limitations and strengths; to identify uncertainties in statistics and to estimate their individual impact; to outline how relevant data are produced and presented at the national (Swedish), regional (Eurostat), and international (FAOSTAT) levels; to analyze the consequences of identified discrepancies and uncertainties for estimating the environmental and health effects of meat consumption; and to suggest recommendations for improved production, presentation, and use of meat-consumption statistics. We demonstrate many inconsistencies in how meat-consumption data are produced and presented. Of special importance are assumptions on bone weight, food losses and waste, weight losses during cooking, and nonmeat ingredients. Depending on the methods employed to handle these ambiguous factors, per capita meat-consumption levels may differ by a factor of two or more. This finding illustrates that knowledge concerning limitations, uncertainties, and discrepancies in data is essential for a correct understanding, interpretation, and use of meat-consumption statistics in, for instance, dietary recommendations related to health and environmental issues.

KEYWORDS: meat production, food consumption, statistical analysis, environmental effects, public health

Introduction

Quality national and international data are essential for understanding social dynamics that are often the foundation for scientific research and policy development. Recent decades have given rise to growing interest in meat consumption and its effects on the environment and health, leading to a greater demand for reliable meat-consumption data. Such statistics are used in research to assess present and historical nutrient intake and environmental impacts, but also to predict future trends. Data on meat consumption are also used to develop guidelines, policy programs, and strategic interventions regarding health, climate change, and land-use issues.

Methodologies for producing consumption statistics suffer from a number of limitations and uncertainties that affect the overall reliability of the data. Lack of harmonization of definitions and regulations concerning how data are obtained and presented further complicates the combination and comparison of data from different countries and regions (e.g., EU by Eurostat) and globally (e.g., by FAOSTAT). Examples of factors that influence meat-consumption data are whether bones are included in weight calculations, waste is accounted for at different stages along the food chain, weight refers to raw or cooked meat, and whether ingredients of nonmeat origin in mixed processed-meat products and ready meals are included. Awareness of inclusions and exclusions in the data, and of its limitations and uncertainties, is essential for correct understanding, interpretation, and use of such statistics. This article seeks:

- To describe the methods for producing meat-consumption statistics and discuss their limitations and strengths.
- To identify uncertainties in statistics and estimate their individual impact.
- To outline and compare how meat-consumption statistics are produced and presented at the national (Swedish), regional (Eurostat), and international (FAOSTAT) levels.
- To analyze consequences of identified uncertainties and discrepancies for assessments investigating the environmental and health impacts of meat consumption.
- To suggest improvements in the methodology for producing, presenting, and handling meat-consumption statistics.

Methodology and Assessment Approach

This study relies on data and other information from scientific articles, statistical reports, online databases, and personal communication with authorities in the field. We analyzed, processed, and categorized information and data as outlined below to formulate relevant comparisons and conclusions.
The categorization is based on the following:

- Type of survey methods (see Methods for Producing Meat-Consumption Data): whether data are based on agricultural supply, household-budget surveys (HBSs), or individual dietary surveys (IDSs). This section describes ways of producing meat-consumption data, limitations and strengths of existing methods, and appropriate usage of data produced with different methods.

- Type of meat data (see Uncertainty Factors in Meat-Consumption Data): whether meat-consumption data i) refer to carcass weight or bone-free weight, ii) are adjusted for food losses and waste, iii) refer to raw or cooked meat, and iv) include or exclude nonmeat components in mixed-meat products and prepared meals. This section describes factors contributing to discrepancies in meat-consumption data, explains how different types of survey methods deal with this variability, and estimates their individual impact.

- Type of statistical sources (see Meat-Consumption Statistics on National, Regional, and International Levels): whether meat-consumption data are provided at the national (Sweden), regional (Eurostat), or international (FAOSTAT) level. This section describes how meat-consumption data are produced and presented, discrepancies among statistics at the different levels, and factors affecting accuracy and reliability.

Results from previous research are used to discuss and illustrate the consequences of variability in data for assessments investigating the environmental and health impacts of meat consumption.

Results

Methods for Producing Meat-Consumption Data

There are several methods of producing data on meat consumption. The specific method should reflect the purpose for which the data will be used and will influence how they should be interpreted. Data on food consumption can be derived from agricultural supply, HBSs, or IDSs (Naska et al. 2009; SFA, 2011a). Table 1 provides a summary of methods used for generating meat-consumption data and the factors that determine their correct use and interpretation.

Food-Consumption Data Based on Agricultural Supply

Per capita consumption data are generally based on agricultural and trade information and provide insight into the average quantity of the commodity in

question available for use within a country or region (FAO, 2001; SFA, 2011a). Food-balance sheets (FBSs) at regional (e.g., Eurostat) and global (e.g., FAOSTAT) levels provide standardized supply data and represent an important knowledge base that permits comparative analyses over time.

In agricultural statistics, meat refers to the flesh of animals used for human food and hence excludes meat unfit for human consumption (EC, 2009; FAO, 2011a). The available supply of meat in a country is typically calculated as (national production + import + opening stocks) – (exports + usage input for food + feed + nonfood usage + waste + closing stocks). Per capita supply data are obtained by dividing the national available supply by the number of inhabitants (FAO, 2001; EC, 2011a). Although the data in agricultural statistics only provide information on the available per capita supply of meat, these data are often used, due to economic constraints and lack of other data, as a proxy for per capita meat consumption.

Agricultural supply data can either be presented as the available supply of raw material per person (i.e., cereals, milk, sugar), or as the available supply of food per person (i.e., bread, cheese, candy) (Eidstedt & Wikberger, 2011; SFA, 2011a). Depending on how data are presented, adjustments for food losses (beginning of the food chain) and waste (end of the food chain) may or may not be accounted for. Factors affecting the reliability of agricultural supply data include the risk of incomplete and/or inaccurate underlying national statistics (e.g., in certain developing countries), limited information on losses and waste along the food chain, and incomplete reporting of noncommercial products (e.g., game) (FAO, 2001; Hawkesworth et al. 2010).

Agricultural supply data makes it possible to study consumption trends over time and to compare consumption across different regions and countries. The data are useful for evaluating a country’s agricultural situation (and thus to projecting future demand and supply of food), setting targets for agricultural production and trade, and evaluating national food and nutrition policies (FAO, 2001). As the data are based on the available supply per person, they are not completely accurate in describing what people actually eat (SFA, 2011a). The available supply of food thus represents only the quantities reaching the consumer (after losses and waste during harvest, storing, processing, distribution, and retail) and it does not take into account household wastage during storage, preparation, and cooking. Furthermore, agricultural supply data provide no specific insights.

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1 Usage input for food refers to the amount of originating meat required for obtaining an output of a derived meat product.
Table 1 Appropriate use of meat-consumption statistics and factors of importance for the correct use and interpretation of data produced by different methods.*

<table>
<thead>
<tr>
<th>Method</th>
<th>Appropriate Use</th>
<th>Important Factors for Correct Use and Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data based on agricultural supply (e.g., FBSs)</td>
<td>• For description of the average quantity of meat available for use within a country. &lt;br&gt; • For studying consumption trends over time and for comparing consumption in different countries and world regions. &lt;br&gt; • Less accurate for describing what people actually eat and consumption characteristics in different national populations groups and regions.</td>
<td>• Is consumption of noncommercial meat accounted for? &lt;br&gt; • Have the data been recently updated? &lt;br&gt; • Are food losses and waste accounted for? &lt;br&gt; • How is meat content in processed products and prepared meals reported?</td>
</tr>
<tr>
<td>Household Budget Surveys (HBSs)</td>
<td>• For comparison of consumption between different regions and socio-economic groups. &lt;br&gt; • For monitoring changes in consumption patterns over time. &lt;br&gt; • More appropriate for studying food intake in a population than for individuals.</td>
<td>• Is the selection of participants representative of the population studied? &lt;br&gt; • How good/bad is the participation rate? &lt;br&gt; • Is there a risk of under-, over- or mis-reporting? &lt;br&gt; • Has the method been internally or externally validated? &lt;br&gt; • Are the food categories used comparable? &lt;br&gt; • Do the data account for meat consumed outside the household? &lt;br&gt; • Is food waste in the household accounted for?</td>
</tr>
<tr>
<td>Individual Dietary Surveys (IDSs)</td>
<td>• For description of individual consumption. &lt;br&gt; • Provides information about the amount of meat actually eaten. &lt;br&gt; • For mapping dietary habits, studying the relationship between diet and health, and quantifying determinants and consequences of food choices.</td>
<td>• What survey method has been used to obtain the data? &lt;br&gt; • Is the selection of participants representative of the population studied? &lt;br&gt; • How good/bad was the participation rate? &lt;br&gt; • Is there a risk of under-, over- or mis-reporting? &lt;br&gt; • Has the method been internally or externally validated? &lt;br&gt; • Has food waste in the household been accounted for? &lt;br&gt; • Does the consumption refer to raw or cooked weight?</td>
</tr>
</tbody>
</table>

*For references, see Methods for Producing Meat-Consumption Data

about consumption characteristics in different populations, regions, socioeconomic groups, or among individuals in households (FAO, 2001). Despite these limitations, agricultural supply data are often used to describe food consumption.

There is currently no international regulatory framework for how statistics on agricultural supply should be produced (Eidstedt, 2011), although global recommendations and guidelines exist for appropriate approaches to obtain and present data (FAO, 2001; De Henauw et al. 2002; EC, 2011b; European Statistical System, 2011). This means that national data on agricultural supply from different time periods may not be comparable if methods used to produce the data changed over time and that accurate comparisons across different countries may be difficult (Serra-Majem et al. 2003; Eidstedt, 2011; SFA, 2011a).

**Food-Consumption Data Based on Household Budget Surveys**

HBSs are generally conducted by national statistics offices and provide information on how much money is spent on different foods per household and sometimes also on the quantity of food purchased per household (Naska et al. 2009; SFA, 2011a). The data can either be obtained from trade-sales figures or from self-reported household expenditures.

Statistics based on these surveys are useful for comparing expenditures on different foods and consumption across different regions, populations, and socioeconomic groups. These data generally provide no information about what happens to food after purchase (i.e., whether the food is eaten or not, or how consumption is allocated among individuals in the household) (Hawkesworth et al. 2010; SFA, 2011a). Consumption data based on HBSs are therefore more appropriate for studying food intake in a population than in individuals (Naiken, 2003; Serra-Majem et al. 2003). Furthermore, data based on HBSs are often expressed as food categories rather than individual foods, which may cause difficulties due to lack of harmonization of categories in different surveys (Serra-Majem et al. 2003).

Like other self-reporting methods, HBSs are challenged by various uncertainties, such as recall and reporting errors. To study food consumption using HBSs, data should ideally be collected both on
food consumed in the household and away from home. If household expenditure is used to estimate food intake, there is a risk that food eaten outside the home will be excluded. Other reliability issues arising from the use of these surveys include the difficulty of accounting for food consumed by guests in the household and of adjusting for food that is purchased and stored without being consumed during a recall period (as well as the reverse, if food is consumed that was purchased prior to the recall period) (Smith, 2003; Hawkesworth et al. 2010). The representativeness of data based on HBSs further depends on the participation rate and whether the sampling consists of a uniform distribution between, say, urban and rural areas, poorer and wealthier households, and single and multi-individual households (Hawkesworth et al. 2010). The reliability of HBSs can be increased by covering longer recall periods and by conducting multiple rounds, as well as by collecting complementary information about food habits in the household (Smith, 2003).

### Food-Consumption Data Based on Individual Dietary Surveys

IDSs provide data on the amount of food actually eaten by individuals and groups and are one of the most accurate (and costly) methods for obtaining data on food consumption (Naska et al. 2009). These data are typically used to map dietary habits, to study the relationship between diet and health, and to quantify determinants and consequences of food choices (Naska et al. 2009; SFA, 2011a).

There are several methods for studying eating habits. The most common approaches are 24-hour recall, dietary history interviews (DHIs), food-frequency questionnaires (FFQs) (retrospective methods), and dietary records (prospective methods). Twenty-four hour recall and DHIs entail interviewing participants about the amount and type of food previously eaten. In a 24-hour recall, only food eaten during the past day is reported, while DHIs typically are used to inventory food consumption over a longer period. Reported intake that deviates from the person’s average consumption is presumed to average out across the whole sample. FFQs are based on instruments in which participants report information on the quantity and type of food eaten. Dietary record methodology can vary, but the basis is that the participants report in writing all food eaten during a specified period. The amount of food consumed can either be estimated or weighed and the survey period can vary. The reported intake in dietary records is assumed to be representative of the person’s average food consumption.

Statistics based on IDSs offer the possibility of matching consumption patterns with specific characteristics such as gender, age, employment, and cultural and ethnic background. Unlike data based on agricultural supply and HBSs, IDSs usually refer to food intake after adjustment for household waste and may also provide insight on methods of preparation. It is well known that existing methods used to assess dietary intake on an individual level are hampered by various limitations and inherent errors that affect reliability. Sources of errors can be divided into random and systematic errors. Random errors refer to problems such as day-to-day variability of food intake and seasonal variations (i.e., that reported food intake in dietary surveys is not representative of average consumption). The risk of random errors can be reduced by increasing the number of surveyed days and subjects. Systematic errors, such as problems with under-, over-, and misreporting, are common in retrospective methods that require a good memory and sincerity (Ferro-Luzzi, 2003; SFA, 2011b). To overcome uncertainties in data and to enhance the quality of data on food consumption based on IDSs, internal or external validation of the method used is recommended (Ferro-Luzzi, 2003). A more detailed summary of recommendations for the improvement of the quality of IDSs can be found in De Henauw et al. (2002).

### Uncertainty Factors in Meat-Consumption Data

The previous description of existing methods for producing meat-consumption data makes clear the various factors that may affect reliability and accuracy. To be aware of the factors that contribute to uncertainty and to know their individual impact facilitates accurate interpretation and use of the resultant data. Based on the previous description of methods and the summary in Table 1, we have identified four main uncertainty factors affecting the accuracy and reliability of meat-consumption statistics. Table 2 provides an overview of these issues and their estimated impacts.

#### Weight of Bones

Agricultural statistics on meat consumption and production are generally presented as carcass weight or as bone-free carcass weight. The carcass weight typically refers to the total weight of the slaughtered animal’s body after removal of inedible body parts (e.g., skin, offal, slaughter fats, head, feet, tail, and genital organs) and body parts used for nonfood pur-

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2 Examples of validation methods are comparing data against results produced by another method, using biomarkers, or relating energy-intake levels with measurements/estimations of energy expenditure.
Food Losses and Waste

Food losses and waste can occur at virtually any stage along the food chain. At the global level, it is estimated that between one third and one half of all food produced is spoiled before or after it reaches the consumer (Lundqvist et al. 2008; FAO, 2011b). The magnitude of these estimates illustrates the importance of accounting for food spoilage in consumption statistics. Where in the supply chain food losses occur and how large proportions are lost vary by commodity as well as by country and region. For example, in developed countries food waste at retail and consumer levels accounts for a sizable fraction of food losses, whereas losses in the early stages of the supply chain (e.g., storage and distribution) are more common in developing countries (FAO, 2011b).

Various sources, including enterprises and manufacturing surveys, provide information on losses occurring along the food chain. Food losses refer to “the decrease in edible food mass along the supply chain leading to edible food for human consumption,” and thus exclude meat intended for nonfood uses (e.g., feed and industrial uses) and inedible parts (FAO, 2011b). Products originally intended for human consumption that end up being used for a non-food purpose may, however, be categorized as food loss. Food waste refers to losses occurring at retail or consumer levels. The estimated losses and waste of meat after agricultural production (e.g., postharvest handling, storage, processing packaging, distribution, retail, and consumption) ranges between 15–21% of the total production, depending on global region (FAO, 2011b).

Postfarm losses and technical losses in processing up to the retail stage may or may not be accounted for in meat-consumption data based on agricultural supply, depending on the country concerned. In addition, household-food waste is not taken into account in agricultural supply data, such as that provided by FAOSTAT. Furthermore, in consumption statistics based on HBSSs and IDSs, waste at the household level is in general not accounted for. However, this depends on the specific design of the method used to obtain the data. Food waste in the household is estimated to account for about 25% of all food purchased (by weight) in the UK (WRAP, 2009), for 8–11% of the meat purchased in industrialized regions, and for 2–6% in developing regions (FAO, 2011b).

Raw or Cooked Weight

Data on meat consumption can either be presented as raw weight or weight after cooking. One kilogram (kg) of raw meat is roughly equivalent to 700 grams (g) of cooked meat. However, the conversion factor may vary between 0.5 and 0.8 depending on, for example, the cut of meat, proportions of lean to fat, as well as method and extent of cooking (KF & ICA Provköök, 2000; WCRF/AICR, 2007). The weight difference is due to the water content, which partially evaporates during cooking. The water content in beef, pork, and chicken is approximately 58–73%, 65–75%, and 53–75%, respectively (Amcoff, 2011).

Meat-consumption statistics based on agricultural data and HBSSs in general refer to the raw weight of meat, whereas statistics based on IDSs, as well as nutritional recommendations, can be reported either as raw or cooked weight, depending on the design of the method.

Mixed-Meat Products and Prepared Meals

Meat is often eaten in the form of mixed-meat products, such as sausages and other mixed-charcuterie products and prepared meals. A Swedish Board of Agriculture (SBA) (1998) study examined...
the meat content in processed meat products on the Swedish market and showed that the average meat content in mixed-charcuterie products and prepared meals was 53% and 41%, respectively. Despite the fact that the meat content is considerably less than 100% in these products, the total weight of such products is commonly reported in meat-consumption statistics (Eidstedt, 2011).

In statistics based on agricultural supply, only the meat content in mixed-meat products and prepared meals is generally included in figures for the total consumption of different types of meat. By contrast, in the cases where meat consumption is reported as products of a higher degree of processing (e.g., “direct consumption” in Swedish statistics), consumption often refers to the total weight of the mixed products and prepared meals. Furthermore, in consumption statistics based on IDSs, mixed-meat products and prepared meals in general refer to the total weight of such products. If meat-consumption statistics are based on data that do not distinguish between meat and nonmeat components in mixed-meat products and prepared meals, consumption risks being overestimated (Riley & Buttriss, 2011).

### Meat-Consumption Statistics on National, Regional, and International Levels

Statistical institutes at national, regional, and international levels publish per capita meat-consumption statistics. Consumption statistics at different levels are produced by various methods based on nonstandardized assumptions and thus vary in reliability and accuracy. Being aware of the procedures used to collect data, the assumptions on which they are based, and the discrepancies between meat-consumption data at different levels will improve the prospects for correct understanding, interpretation, and use of this information. The following sections describe how per capita meat-consumption statistics from Sweden, Eurostat, and FAOSTAT are produced and presented. The statistics are based on agricultural data and thus refer to the available supply for human consumption, i.e., excluding meat for nonfood purposes. Table 3 provides a summary of methods and assumptions used to produce meat-consumption statistics at national, regional, and global levels.

### Swedish Statistics on Meat Consumption

Sweden has three different sources of meat-consumption statistics: agricultural data provided by SBA, HBSs developed by Statistics Sweden, and dietary surveys carried out by the Swedish Food Agency (SFA, 2011a). This section describes meat-consumption statistics distributed by SBA, which are used to calculate Swedish per capita meat consumption.

Swedish meat-consumption statistics are either presented as “total meat consumption” or “direct meat consumption.” “Total meat consumption” refers to the overall supply of raw meat (including bones) available for human consumption at the farm gate.

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**Table 3 Methods and assumptions used to produce meat-consumption statistics in Sweden, Eurostat, and FAOSTAT.**

<table>
<thead>
<tr>
<th>Weight of Bones</th>
<th>Food Losses and Waste</th>
<th>Raw or Cooked Weight</th>
<th>Mixed-Meat Products and Prepared Meals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Swedish Agricultural Statistics</strong></td>
<td>• Total meat consumption, including bone weight.</td>
<td>• Total meat consumption: no deduction for losses/waste between slaughter and consumption.</td>
<td>• Total meat consumption: exclude weight for nonmeat content of processed products.</td>
</tr>
<tr>
<td></td>
<td>• Direct meat consumption, excluding bone weight in beef and pork (25% and 15.2% of carcass weight), including bone weight in poultry.</td>
<td>• Direct meat consumption: assumed losses/waste between slaughter and retail corresponds to 5% of bone-free carcass weight.</td>
<td>• Direct consumption: total weight of the processed product.</td>
</tr>
<tr>
<td><strong>Eurostat</strong></td>
<td>• Consumption refers to carcass weight, i.e., including bones.</td>
<td>• Losses/waste between slaughter and retail is adjusted for.</td>
<td>• Mixed products made up of meat from several species are included in the &quot;other meat&quot; balance.</td>
</tr>
<tr>
<td></td>
<td>• No information found on assumed bone weight in relation to carcass weight.</td>
<td>• No information found on assumptions for food losses and waste.</td>
<td></td>
</tr>
<tr>
<td><strong>FAOSTAT</strong></td>
<td>• Consumption refers to carcass weight, i.e., including bones, unless otherwise stated.</td>
<td>• Meat-supply data are adjusted for food manufacture and losses/waste up to the stage of retail.</td>
<td>• Food-supply data include both primary commodities and processed-food products.</td>
</tr>
<tr>
<td></td>
<td>• No information found on assumed bone weight in relation to carcass weight</td>
<td>• No information found on assumptions for food losses and waste.</td>
<td></td>
</tr>
</tbody>
</table>

*For references, see Meat-Consumption Statistics on National, Regional, and International Levels*
Global Statistics on Meat Consumption

Global statistics on meat consumption in different countries and regions are provided on a yearly basis by the Food and Agriculture Organization of the United Nations (FAO) and are freely available via the online database FAOSTAT. FAO’s FBSs provide statistics on domestic supply quantities, defined as “the total quantity of the foodstuff produced in a

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country added to the total quantity imported and adjusted to any change in stocks (from production to retail and all actors holding a stock of a meat-based commodity) that may have occurred since the beginning of the reference period.” In addition, the domestic use of each commodity is presented, with a distinction made between quantities fed to livestock (feed), used for seed (seed), processed for food and nonfood uses (processed), lost during storage and transportation (waste), available for human consumption at the retail level (food), and other use (other utilization). Food-supply data, expressed in metric tons or as kilograms per capita per year (kg/capita/year), are provided in FAOSTAT both under the category of “food supply” and in the FBSs (food-supply quantity, food). The food-supply data refer to the domestic supply quantity after a deduction for feed, seed, food manufacture, and waste (FAO, 2001; Jacobs & Sumner, 2002; FAO, 2012a).

In FAO’s FBSs, the supply of meat is expressed as carcass weight (i.e., weight including bones, unless otherwise stated, excluding pieces unfit for human consumption as well as inedible offal and unused fats) (FAO, 2011a; Westhoek et al. 2011). Food-supply data are adjusted for losses and waste at all stages between the level of production and household (i.e., during storage, transportation, processing, and retail). Data on average carcass weight in relation to live weight and on waste of supply of crops and derived products are presented in FAO’s publication on technical conversion factors for agricultural commodities (FAO, 2012b). However, no information has been found regarding the assumed proportions of bone weight in relation to carcass weight or assumed magnitude of losses and wastage of meat supply. FAO food-supply data include both the supply of primary commodities and processed foods derived therefrom, expressed in amounts of the original farm commodity. The amount needed to produce a processed food product is quantified based on technical conversion factors provided per commodity and country (FAO, 2012b).

Underlying data in the FBSs are based on a wide variety of sources of varying quality, including both official and unofficial documentation such as national trade and agriculture statistics, sample surveys, questionnaires, censuses, administrative records, and best estimates. Missing data are often estimated on the basis of surveys as well as technical expertise available at FAO (2001; 2012a).

The accuracy of data in FAO’s FBSs to a large extent depends on the quality of the underlying data in official national statistics. Factors affecting accuracy and reliability of national agricultural statistics have previously been described. As supply data from different countries may be produced via different methods and based on different assumptions, they may not be appropriate for direct comparison. To allow for international comparisons, data are adjusted by FAO before being disseminated (FAO, 2001; 2012a; Jacobs & Sumner, 2002).

**Discussion**

The purpose of this article is to identify uncertainties and discrepancies in meat-consumption statistics and to discuss their potential impact on assessments of environmental and health effects of dietary patterns. The results show various uncertainty factors in how these data are produced and highlight issues that encourage more subtle understanding and interpretation. We also find the transparency of information pertaining to methods and assumptions in the generation of food-consumption statistics deficient on Swedish, European (Eurostat), and international (FAOSTAT) levels.

The importance of accounting for uncertainties in consumption statistics has previously been noted and discussed. Serra-Majem et al. (2003), for example, identified significant differences in consumption data produced by different methods. One example was that the quantity of food consumed, indicated by data based on HBSs, in general is lower than that from FBSs, and that FBS data often overestimate food and nutrition intake compared to data based on IDSs. Other studies, which confirm that quantities indicated by data based on HBSs are typically lower compared to those predicated on FBSs, suggest that the differences are at least 20% (Sekula, 1993; Serra-Majem et al. 1993; Naska et al. 2009). Naska et al. (2009) compared food-consumption statistics from FBSs and HBSs in eighteen countries and demonstrated that the correlations between data derived from FSBs and HBSs are quite strong for vegetables, fruit, fish, and oil (+0.69 – +0.93), whereas the correlation is lower for meat and meat products (+ 0.39).

To interpret consumption statistics correctly, one must remember that per capita data refer to the average intake level in a population. Per capita consumption data thereby conceal considerable inherent variation among different groups, such as between men and women, adults and children, and across socioeconomic groups (especially in developing countries). To draw general conclusions and formulate recommendations within a population based on per capita figures can thus lead to certain errors of interpretation. For example, it is well known that men generally consume more meat than women (Beardsworth et al. 2002; Kubberød et al. 2002; Prättälä et al. 2007). Results from Swedish nationwide nutrition surveys have shown that average meat intake among men is 35% higher than among women (Becker &
Differences in meat intake, as well as in nutrient requirements among population groups, has implications for the quantity of meat that can be considered healthy and should thus be taken into account when designing recommendations for meat consumption.

An incomplete understanding of meat-consumption data entails the risk that the statistics will not be used appropriately, which could have widespread implications for research findings and recommendations. One direct effect of the several existing definitions of meat consumption, which are based on varying methodologies and assumptions, is that meat-consumption data vary depending on the statistical source. For example, the official figure for per capita meat consumption in Sweden is 83 kg per year (data for 2009) (Eidstedt & Wikberger, 2011). However, estimates based on IDSs show that annual per person meat consumption in the country is only 66 kg (Lagerberg-Fogelberg, 2008) and according to FAO’s FBSSs the figure is 75 kg (data for 2009) (FAO, 2012c). The calculation of nutrient intake and environmental impact from Swedish meat consumption will thus be heavily dependent on which data set is employed. Furthermore, meat-consumption statistics do not include information on production systems, which will have a significant impact on the environmental performance of various types of meat (i.e., from grass-fed cattle or indoor grain-fed cattle) (De Vries & De Boer, 2010).

When using meat-consumption statistics, it is thus important to know what the data actually represent, specifically whether i) consumption refers to agricultural supply, purchased amount, or actual intake, ii) consumption refers to bone-free weight, iii) food losses and waste are accounted for, iv) consumption refers to raw or cooked weight, and v) weight of nonmeat ingredients in mixed-meat products are accounted for. Methodological descriptions providing this information are, however, often difficult to find and to interpret. An accessible and clear presentation of meat-consumption data, which outlines the procedures used to generate the information and documents the underlying assumptions, would facilitate appropriate usage and interpretation.

The factors that contribute to discrepancies in meat-consumption data may individually affect the data by 15–50%. A simple quantitative example illustrates how these factors can influence meat-consumption data. As previously mentioned, annual per capita meat consumption in Sweden was 75 kg in 2009 according to FAO supply data. However, the actual intake of meat, after adjustment for bone weight, household-food losses and waste, and weight reduction in cooking, is markedly lower. If the intake were adjusted for bone weight, annual per capita meat consumption in the country would be reduced to approximately 53 kg (assuming that bone-free weight represents 70% of carcass weight). If adjusted for household-food spoilage and waste (assumed to represent 11% of purchased weight) (FAO, 2011b) and weight reduction by cooking (assumed to be 30% of raw weight), the actual annual per capita intake of cooked, bone-free meat in Sweden would be approximately 33 kg.

On one hand, in environmental assessments, meat-supply data, expressed as raw meat including bones, are often used as the basis for calculations. When studying health effects or nutritional intake, on the other hand, data on actual consumption, expressed as uncooked or cooked meat, are generally employed. The example above shows that annual per capita meat consumption may differ by a factor of two or more depending on the data series. There is an obvious risk of mixing these data when consumption statistics are used for subsequent calculations of, for example, environmental and health effects. In environmental assessments of meat and in dietary recommendations, it is thus crucial to specify the functional unit and to define whether it refers to meat, including or excluding bones, and whether it is after weight reduction by cooking, as well as if losses in distribution and consumer level are included. The choice of meat-consumption data should further correspond to the functional unit in calculations used to formulate recommendations and policy decisions.

Conclusions and Recommendations

We have discussed the reliability of meat-consumption statistics with the aim of identifying limitations, strengths, and uncertainties in methods and data. The results show various discrepancies regarding how meat-consumption data are produced and presented, awareness of which is important for a correct understanding and interpretation of the statistics. Increased attentiveness to these issues, in turn, will have a significant impact on diet recommendations and policy tools related to health and environmental issues, such as climate change and land use.

We advance several recommendations to improve the production, presentation, and use of meat-consumption statistics. First, the definitions of meat consumption and supply on national, regional, and international levels should be standardized and harmonized to the greatest extent possible. Second, methods for obtaining meat-consumption data should be of the highest possible quality to ensure high statistical validity. Third, relevant national, regional, and international statistical agencies should enhance the transparency of meat-consumption data. Fourth, assumptions regarding weight of bones and other
inedible body parts of the animal, food losses and waste in the stages up to and after retail sale, weight reductions due to cooking, and nonmeat components in mixed-meat products and prepared meals, should be presented in a more accessible and straightforward manner. Finally, limitations, uncertainties and discrepancies in meat-consumption data should be addressed for correct utilization in subsequent calculations of, for instance, the environmental and health effects of meat.

Acknowledgement
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References


ARTICLE

Designing lifestyle-specific food policies based on nutritional requirements and ecological footprints

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Expanded understanding of the trends and determinants of food consumption is needed to reduce the ecological impacts of the contemporary agro-food system while also being attentive to broader issues pertaining to health and the environment. Incorporating these additional aspects and formulating meaningful dietary recommendations is a major challenge. This article seeks to highlight differences in ecological footprint (EF) by activity level for various social groups to meet suggested physiological requirements by nutritionists versus actual food consumption. The study is based on a combination of healthy diet requirements (as expressed by national guidelines) and a survey of a representative sample of 1,013 Hungarian adults using a bottom-up approach for calculating EFs. Students and women with small children have a higher than average food-related EF due to their higher nutritional needs. At the same time, the elderly are characterized by lower footprints. Perhaps most interesting is our finding that people with sedentary forms of employment have higher food footprints than those with jobs that require physical labor. We offer recommendations for food-policy planning based on encouraging dietary changes for individuals, differentiated by the nature of their work. The research suggests that dietary policy that improves health often has environmental benefits.

KEYWORDS: food consumption, diets, nutrition, environmental impact, health policy, occupational health

Introduction

Food consumption has become an increasingly critical challenge for policy makers and diet more generally is now a target for explicit consumption-related policies. McMichael et al. (2007) argue that in recent years the focal point of interaction between food, energy, and health has shifted radically. Food provides energy and nutrients, but its provisioning requires concomitant energy expenditures. For example, intensive agriculture and overconsumption give rise to a difficult array of challenges harming both the environment and human health. At the same time, ensuring access to adequate food is vital, although overeating and the subsequent consequences of high levels of obesity have reached epidemic proportions in some subpopulations. For example, in the European Union more than 53% of the population has been estimated to be overweight (IASO, 2008) and this fraction is increasing (WHO, 2008). Reductions in meat consumption could lower the risk of obesity, as well as heart disease and cancer (EEA, 2010).

From a global perspective, consumption of energy-dense foods has increased during the last few decades. Disproportionate intake of nutrients and an unbalanced diet indicate low fruit and vegetable consumption and excessive reliance on junk food and meat, which has been linked to neuropsychiatric disorders, high cholesterol levels, and, because of related patterns of physical inactivity, excessive weight and obesity (Duchin, 2005). These conditions impose high health-related costs on society and decrease individual well-being (EEA, 2010). According to the European Environment Agency (2010), increasing calorific intake, together with sedentary lifestyles, is the root of the problem. Contemporary modes of food consumption and production also increase environmental burdens in terms of land and water use, biodiversity loss, and greenhouse-gas (GHG) emissions (Lorek & Spangenberg, 2001a; Tukker et al. 2006; Jackson & Papathanasopoulou, 2008; Druckman & Jackson, 2010; Reisch et al. 2010; Reisch et al. 2011; Tukker et al. 2011; Csutora, 2012).

Overconsumption of meat is of special concern. Thirty-five percent of global GHG emissions generated by agriculture are associated with livestock production. As for the environmental impacts of meat consumption, it has been extensively demonstrated that a heavy meat-based diet requires three times as much land area as a vegetarian diet, due to the resource intensiveness of meat production (Durning & Brough, 1991; Ehrlich et al. 1995; Goodland 1997; Pimentel et al. 1997; Subak, 1999; York & Gossard, 2004).

The linkages among physical activity, food consumption, and environmental impacts have to date
received quite limited attention. While researchers have explored the relationship between actual and healthy food consumption (e.g., Wallén et al. 2004; Collins & Fairchild, 2007; Frey & Barrett, 2007; McDiarmid et al. 2011; Vieux et al. 2012), there are few examples of work that have deployed a differentiated approach to consider the nutritional demands of various occupational groups. This article seeks to fill this gap by applying a consumption-based approach both regarding the methodology and the research question, differentiating between the ecological footprints from food consumption of different occupational groups. The next section defines “sustainable food consumption” and “healthy food” and reviews prior studies measuring the environmental impact of food consumption. It is followed by the methodology and the research results.

**Defining Sustainable Food Consumption**

Different definitions of “sustainable food consumption” and “sustainable diet” have been advanced over the past few decades. Erdmann et al. (1999) claim that the sustainability of food consumption is predicated on four dimensions: economic, environmental, health, and social. However, they give no guidance as to how these facets should be weighted when putting sustainable food consumption into practice. Leitzmann (2003) contends that sustainable food consumption should be defined as the preference for meatless or reduced meat diets along with organically, regionally, and seasonally produced foods that are minimally processed, ecologically packed, tastefully prepared, and fairly traded. Duchin (2005) claims that a sustainable diet should have a low environmental impact and contribute to preserving human health. Wallén et al. (2004) argue for low-energy input per food item, but also call for a diet that provides nutrients and energy necessary to maintain good health. The definitions of the UK Sustainable Development Commission (Levett-Therivel Sustainability Consultants, 2005) and Lefin (2009) incorporate environmental, health, and social aspects regarding the sustainability of food consumption.

This cursory overview indicates that prior efforts to define sustainable food consumption focus not only on environmental aspects, but also indicate that the health and social dimensions are important. It is moreover clear that the sustainability of food consumption goes beyond just the environmental aspects, as food is a consumption domain with internal impacts on human health and external impacts on the environment. It should be noted as well that the definitions engage with meat consumption in different ways, with the focus variously being either the maximum amount of red meat consumed or a minimum amount to produce a nutritious diet.

The present study uses Wallén et al.’s (2004) definition of sustainable food consumption, understood to be based on the nutritional requirements proposed by the National Nutritional Institute of Hungary (Rodler, 2004) where the aim is not to minimize meat consumption but to develop a healthy diet and measure its environmental impacts. We assess environmental impacts using the ecological footprint (EF) method, which has been demonstrated to be one of the most useful indicators of sustainability. The EF makes the interpretation of environmental issues and their communication in policy, education, and environmental campaigns easier, so it represents a useful tool for communicating about resource consumption. It must be noted that the EF comprises land use and carbon emissions and other related impacts of food consumption such as methane emissions and water use are not included. However, the EF appears to capture the most important natural resource uses—energy and land use—associated with food consumption (Lorek & Spangenberg, 2001b).

**Measuring the Impact of Food Consumption: A Literature Review**

Researchers have devoted considerable attention to the relationships between food consumption and land requirements for food provisioning under different scenarios. Gerbens-Leenes & Nonhebel (2002a) calculated per person land allocations using production data from the Netherlands and conducted an international comparison of fourteen countries that specified the amount of land associated with the largest food categories and identified major consumption patterns reflected in these data. The authors call attention to the fact that future land needs might increase due to population growth in developing countries, changing consumption patterns, and shifts to a diet higher in meat. In other research, Gerbens-Leenes & Nonhebel (2002b) introduced a methodology designed to define the land requirements of more than 100 food categories that can be fit to different dietary patterns. They conclude that large land inputs are due to food consumption among the affluent, for instance of dairy products, wine, beer, coffee, and fats.

Other research has employed the EF concept to determine the agricultural land and natural resource requirements of food consumption. For example, White (2000) compared the EF of meat- and plant-
based diets, showing the significantly higher impact of meat consumption. Chen et al. (2010) conducted an analysis of the environmental impacts of food consumption in rural China using the EF method that showed that the environmental load of food consumption has increased continuously over the past 30 years, particularly because of growth in meat consumption, which has resulted in a greater demand for fodder. Improvements in productivity have compensated for some of the increases in land requirements. In addition, Pimentel & Pimentel (2003) examined the differences between meat- and plant-based diets, showing the higher impact of meat consumption measured in land use [in hectares (ha)], energy use [in kilocalories (kcal)] and water use (in liters). Consumption of food in the United States accounts for 50% of the total land, 18% of non-renewable energy sources, and 80% of water use. Pimentel & Pimentel (2003) found that a meat-based diet requires more embodied energy than a plant-based diet so they regard the latter to be more sustainable. The authors stated that American agricultural production is not sustainable, partly because it is based on excessive reliance on fossil fuels. Significant structural changes would be required if the number of people who eat meat-based diets were to decrease. On the basis of this experience, the current study deploys the EF as an indicator.

The environmental impacts of healthy food consumption have begun to attract increasing attention. Gussow & Clancy (1986), Herrin & Gussow (1989), and Gussow (1999) were the first to argue for aligning environmental and health policy with respect to food consumption. Herrin & Gussow (1989) also analyzed local food consumption from health and environmental perspectives, developing an example for a healthy diet comprising only locally grown food items in the American state of Montana. The authors claimed that even though locally produced food consumption is realizable, it is not evident that consumers would know which food items to select and might not be willing to do so. They emphasize the need for a sustainability-based dietary guide that would be differentiated by region according to the availability of locally produced food types. Gussow (1999) lists the environmental and health advantages of local food consumption.

The direct scientific antecedents of this study are Frey & Barett (2006; 2007) and Collins & Fairchild (2007) who use EFs to measure the impact of food consumption and to investigate linkages between actual and healthy diets. These authors claim that the EF could be reduced significantly through widespread adoption of healthy diets and the consumption of more local products. However, consuming goods that have been proximately produced does not always entail a smaller impact as, for instance, growing local vegetables in a greenhouse can have higher environmental impacts than importing the same products (Fuchs & Lorek, 2000). Peters et al. (2007) investigated the land requirements of 42 diets by measuring the impact of fat and meat consumption. They observed almost a fivefold difference (0.18–0.86 ha) in per capita land requirements across the diets and noted that a high-fat vegetarian diet can have greater land requirements than lower fat diets containing meat. Wilkins et al. (2008) examined the land requirements of low-carbohydrate, high-protein diets and that of a diet based on official nutritional recommendations in the United States. The high-protein diet had twice the land requirement of the recommended diet. Stehfest et al. (2009) claim that global carbon-dioxide (CO₂) emissions could be decreased by as much as 20% by mass shifting to a healthier diet. Friel et al. (2009) and Fazeni & Steinmüller (2011) have similarly demonstrated the potentially significant environmental effects of dietary changes through healthier food consumption. According to Cowell & Parkinson (2003), Stehfest et al. (2009), Risko-Norja et al. (2009), and González et al. (2011), adjusting the structure of food consumption could appreciably reduce environmental impacts. Wilkins et al. (2010) claimed a need to integrate food-system awareness into professional practice and to highlight the importance of jointly managing the health and environmental dimensions of food consumption.

Tukker et al. (2011) analyzed the food consumption clusters of the EU-27 countries and examined the potential impact of a shift toward a Mediterranean diet. The study reported that the greater the reduction in meat desired from a dietary perspective, the more drastically changes are needed in consumption structure, leading to environmentally healthier agricultural practices. Macdiarmid et al. (2011) claimed no significant differences between a healthy diet and a low-impact diet concerning health and environmental impact, which could mean the existence of new synergistic opportunities.

In sum, previous studies have not differentiated the structure of diets according to occupational activity, and so did not account for different nutritional demands. It is this issue that the current article seeks to address.

**Research Methodology**

**Calculation of the EF of Different Occupational Activities**

This study is based on a survey of 1,013 Hungarian adults carried out using the random-walk method combined with the so-called Leslie Kish key, which provides a clear and fixed statistical methodol-
ogy for choosing the household as well as the specific person within the household (Kish, 1949; 1965). The survey was conducted in 2010 in 80 Hungarian communities and is representative in terms of residence, gender, age, and education levels. It comprised several detailed questions about food-consumption patterns and the quantity and frequency choices from eleven food-consumption categories (cereals; tea and coffee; milk; other nonmilk dairy products; potatoes and rice; pasta; meat; cold cuts, ham, and eggs; fruit and vegetables; and bread and bakery products). The survey enabled identification of food consumption in a detailed way, with consumption defined as the amount of food eaten, not accounting for wasted food. To quantify the EF of food consumption, these data were linked to a separate data series that provided footprint intensities. We calculated the EF of food consumption using the following formula.

\[ \text{EF of food consumption} = \text{quantity consumed (kilograms per week)} \times 52 \text{ weeks} \times \text{EF intensity (global hectare/kilogram)} \]

In the analysis, the calculations of cropland, carbon-uptake land, and EF intensities were based on Global Footprint Network (2008) data specifically for Hungary, where primary data is given at a product level for Hungarian food production and imports. For each food-consumption category, we calculated the ecological and carbon-footprint intensity per one ton or kilogram (kg) and data for product levels were aggregated and weighted according to the food-consumption statistics of the Hungarian Central Statistics Office (HCSO) (KSH, 2012a). In the EF, both the actual land area required to produce the food items and the carbon footprint were quantified. This is of special importance as a significant fraction of CO₂ emissions are due to an increased production of meat, with clear climate-change ramifications.

\[ \text{EF} = \text{carbon footprint + cropland footprint} \]

(2)

Based on the data from the food-consumption patterns reported in the survey and the footprint intensities, we calculated EFs. The EF shows a hypothetical land requirement that allows comparison of results from other countries. Real land use is not considered in this study as the aim is to express the EF requirements due to food consumption. Monetary data were collected for the main household-expenditure categories so that environmental impact could be calculated both from monetary and physical data, and this provided a control for the reliability of the results.

As the aim of this study was to examine food consumption and EF discrepancies associated with different occupational activities, footprints were calculated for sedentary workers, people engaged in both light and heavy physical labor, students, retirees, and women on maternity leave. Regarding representation of the different levels of physical exertion, the survey results were compared to data from HCSO (KSH, 2012b). According to the survey, people engaged in light and heavy physical labor included both agricultural and nonagricultural workers, while skilled workers were nonagricultural blue-collar workers. Sedentary workers comprised people engaged in occupations not requiring physical exertion. Physical laborers lived mainly in outlying villages and towns rather than Budapest. Sedentary workers tended to be urbanized, with 31% living in Budapest (a further 50% live in other Hungarian cities). As for the skilled workers, 78% of them resided in villages and cities; they are less present in Budapest where 11.3% live. Their living conditions determined their occupational work to a great extent.

**Calculation of a Diet Based on Nutritional Needs**

The aim of the study was to examine food consumption across different occupational activities and, furthermore, to quantify and compare the EF of actual food consumption and the EF of a healthy diet differentiated by occupational activity. For this reason, we sought to quantify the structure of a healthy diet and its associated footprint based on energy requirements.

According to James & Schofield (1990), habitual physical activity and body weight are main determinants for the diversity of energy requirements of adult populations with different lifestyles. In calculating energy requirements, physical activity level (PAL) of adult-population groups was multiplied by the corresponding Basal Metabolic Rate (BMR) measured in kcal per day (kcal/day) (FAO/WHO/UNU, 1985). This method was used to define the energy requirements for the different occupational activities. Nutritional requirements for a healthy diet were based on the recommendations of the FAO/WHO/UNU (1985) and Rodler (2004). According to the National Nutritional Institute of Hungary, this guideline is the most current and was developed according to the nutritional requirements of the Hungarian population.

An average, substantial diet for a Hungarian man is 2,400 kcal/day (for sedentary work). We modified this diet by using the energy factors and nutritional demands suggested by Bíró & Lindner (1988) and took into account the different nutritional require-
ments and FAO/WHO/UNO (1985) guidelines. After specifying the healthy diet for different levels of occupational exertion, we calculated the EF of these diets. The Appendix shows the energy and nutritional requirements according to activity and age.

**Results**

We first calculated footprint intensities. Figure 1 shows these measures in global hectares per ton (gha/t), as well as the land-use and carbon-footprint intensities.

Meat products and cold cuts (e.g., salami and ham) clearly have the highest footprint-intensity values, so the consumption of these food-product groups has high relative impact on the environment as a result of the extensive amount of land required to grow fodder and the energy used in agricultural production.

Next in comparative footprint intensity are dairy products and bread and bakery products. A major part of the total EF is due to land-use requirements and a minor part to carbon emissions. The carbon footprint-intensity values are relatively high for meat products and for pasta. For vegetables, the carbon-footprint intensities are higher than the land-use intensities because of the high energy requirements to operate greenhouses.

Knowledge about EF intensities can help us to quantify which food categories have the largest footprints and carbon intensities and where changes in the quantity and structure of diets can make the most difference. The total average EF of a Hungarian adult is 1.22 global hectares (gha), while the carbon footprint is 0.33 gha (i.e., about a quarter of the total EF). A significant part of the overall EF is attributable to meat (33%), cold cuts (13%), and dairy consumption (14%), while the impact of bread and bakery products (17%) is also quite significant. The major part of the footprint comprises land use (crop and grazing land), but the carbon footprint should also be taken into account, especially if we consider biocapacity limits. In the Hungarian case, the extent of agricultural land is not a binding constraint, while the carbon emissions of fossil-intensive production exceed the carbon-sequestration potential.

In a subsequent step, we decomposed the EF to investigate footprints for the different occupational groups (Figure 2).

The footprints of laborers and sedentary workers are nearly equal despite significant differences in their respective levels of physical exertion. Laborers have average EFs of 1.22 gha, while the average EF of a white-collar worker with a sedentary lifestyle is 1.23 gha. The footprint of skilled workers is also higher than that of laborers. The food consumption of sedentary workers is characterized by a high intake of cereals and fruits and vegetables. These food items belong to the healthy and less footprint-intensive food categories, though the increase in the quantity of their consumption contributes markedly to EF. Meat
consumption is higher for laborers and skilled workers (due largely to greater consumption of fats and carbohydrates). The same can be said about consumption of bakery products, which is higher for laborers and skilled workers. The EF and food consumption of sedentary workers is larger due to food items typically recognized for their healthfulness, though their higher-than-recommended level of consumption causes a significant footprint increase.

The EF of seniors is less than average due to lower levels of food consumption across all categories, though their meat consumption is slightly higher than nutritional guidelines. Being on maternity leave may require up to a 20–25% higher energy intake; thus, consumption increases for bakery and animal products. However, intake of fruits and vegetables is lower than recommended. These items are not a major source of energy, but contribute significantly to a healthy diet. The high energy demand of students 19–30 years of age is well represented by their increased consumption of food and its associated footprint, which is part of a healthy diet and higher metabolic demands.

One of the aims of our work is to quantify and analyze differences in the EF of food consumption by different levels of physical exertion. It is obvious that individuals who work at jobs that require more energy need to supply this additional energy through food consumption. To define and calculate an example of the ideal level and type of food consumption (as advanced by nutritional recommendations), we analyzed the guidelines of the FAO/WHO/UNO (1985) and Rodler (2004) and developed a healthy diet for a sedentary worker consuming 2,400 kcal/day. The Appendix shows the recommended energy intake for different levels of activity and the additional energy and additional fat, protein, and carbohydrate needs over sedentary activity. Using these factors, we developed and calculated a healthy diet that considered the increased nutritional demands due to energy expended and quantified the footprints of these diets.

Figure 3 displays the differences due to the variable intensity of work activities. The figure represents the healthy food-consumption footprint according to guidelines developed by the World Health Organization (WHO, 1985) and the National Institute for Food and Nutrition Science (Rodler, 2004), and Hungarian calorie-related data. These sources show that an increase in the consumption of fruits and vegetables is needed. In contrast, meat consumption and cold-cut consumption should be decreased. Thirty-three percent of the typical actual food footprint for Hungarian adult men engaged in sedentary work derives from meat consumption, which is problematic from both a health and environmental perspective.
A healthy diet is generally characterized by extensive consumption of fruits and vegetables and modest intake of meat (with some milk and dairy products). Considering energy needs, it is light laborers and sedentary workers who should have the lowest EFs and heavy laborers who should have the highest EF, according to standard nutritional guidance (Figure 4).

Growth in the use of energy is mainly connected to increased consumption of breads and cereals for optimal healthy consumption (i.e., carbohydrates) and to increases in consumption of meat and dairy products. Moreover, as the level of physical exertion rises, consumption of bread, cereals, and meat increases. The EF grows in parallel, with elevated meat consumption significantly influencing the overall footprint.

We also note that sedentary workers and medium-intensity laborers consume more and have a larger footprint than heavy laborers, and they have a significantly higher footprint than nutritional guidance suggests is appropriate. The largest gap between recommended and actual diets is observable in sedentary workers, where actual footprints are 24% higher than recommended standards. Heavy physical laborers have the smallest deviation (Figure 5).
As for the overall composition of the Hungarian food-consumption footprint, overconsumption is not systemic with respect to all food items. Meat consumption is higher than nutritional guidance recommends, while milk consumption is significantly below dietary targets (according to the Hungarian nutritional recommendations which are relatively high), while the ecological footprint of milk is comparatively high compared to vegetables. This appears to be one instance where footprint and health benefits diverge. There is great variance in the consumption of bakery products. For laborers in Hungary, consumption of food in this category is less than healthy diet standards.

Discussion

This study has sought to increase appreciation for the health and environmental implications of different patterns of food consumption and to enhance understanding of the EFs associated with various levels of occupational exertion. Results regarding the EFs of different occupational groups show appreciable differences. A seeming paradox is that the food-related EF of sedentary workers is higher than that of physical laborers despite the fact that less active individuals have lower nutritional needs and energy levels than their more active counterparts.

Similarly unexpected is our finding that in Hungary skilled workers appear to have higher food-related EFs than physical laborers. However, consumption of food fulfills not only physiological demands, but serves social and cultural roles. This observation may help to explain the higher consumption levels of sedentary workers. There are some food categories with great differences across occupational groups, notably fruit and vegetable consumption. We found such consumption higher among sedentary workers; however, vegetable consumption is lower with skilled and physical workers and should be increased.

To sum up, the composition of the food-consumption footprint is far from healthy or optimal. Our results show that sedentary workers and medium-intensity laborers would have to do more to decrease their food-related EFs than heavy laborers, whose consumption can be attributed to their higher energy requirements. Reducing consumption of meat, with its high footprint intensity, and increasing consumption of fruits and vegetables, with their low intensity, would have a double dividend: a lower food-related EF and a healthier population.

We used the consumption data from HCSO (KSH, 2012c) to examine the relationship between income status and healthy consumption and how this relates to the previous results. To explore this correlation, we divided households into five income quintiles. We discovered that as income rises, people tend to eat more unhealthy food (e.g., sugar, fats), and the consumption of healthy fruits and vegetables increases only minimally (Table 1). The consumption of meat especially rises along with income levels. Evidence of a healthier diet is only found among the wealthiest 20% of the Hungarian population that consumes less sugar and fat and relatively more fruits and vegetables. There is an apparent tendency to maintain comparatively high consumption of fats, sugars, and meat even in middle-income families while making supplementary additions of fruits and vegetables.
Table 1 Annual food consumption per capita in Hungary by income quintiles (kg) in 2010 (KSH, 2012c).

<table>
<thead>
<tr>
<th>Food Consumption (kg per capita)</th>
<th>1st Quintile</th>
<th>2nd Quintile</th>
<th>3rd Quintile</th>
<th>4th Quintile</th>
<th>5th Quintile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>74.3</td>
<td>73.1</td>
<td>78.7</td>
<td>80.1</td>
<td>75.7</td>
</tr>
<tr>
<td>Meat</td>
<td>41.1</td>
<td>45.1</td>
<td>50.5</td>
<td>56.9</td>
<td>57.9</td>
</tr>
<tr>
<td>Fish, fresh and canned</td>
<td>0.7</td>
<td>1.2</td>
<td>1.4</td>
<td>2.2</td>
<td>2.6</td>
</tr>
<tr>
<td>Milk, liter</td>
<td>40.2</td>
<td>44.4</td>
<td>51.6</td>
<td>52.3</td>
<td>58.4</td>
</tr>
<tr>
<td>Yogurt, sour cream, liter</td>
<td>7.3</td>
<td>8.7</td>
<td>10.6</td>
<td>12.7</td>
<td>16.5</td>
</tr>
<tr>
<td>Cheese, cottage cheese</td>
<td>3.0</td>
<td>4.1</td>
<td>5.2</td>
<td>6.1</td>
<td>7.9</td>
</tr>
<tr>
<td>Eggs (number)</td>
<td>113</td>
<td>121.1</td>
<td>138.2</td>
<td>149.2</td>
<td>143.8</td>
</tr>
<tr>
<td>Fats</td>
<td>12.5</td>
<td>13.8</td>
<td>15.9</td>
<td>17.1</td>
<td>17.0</td>
</tr>
<tr>
<td>Fruits</td>
<td>18.6</td>
<td>26.2</td>
<td>33.5</td>
<td>38.4</td>
<td>49.2</td>
</tr>
<tr>
<td>Vegetables and potatoes</td>
<td>52.1</td>
<td>60.1</td>
<td>70.8</td>
<td>79.4</td>
<td>79.2</td>
</tr>
<tr>
<td>Sugar</td>
<td>9.8</td>
<td>11.6</td>
<td>12.1</td>
<td>13.9</td>
<td>12.0</td>
</tr>
</tbody>
</table>

Vegetables. Such practices foster overconsumption and increase food-related EFs.

Conclusion

One aim of our research was to examine food consumption and its EF according to different types of activity. Comparing the suggested footprint (based on nutritional needs and a healthy diet) with data on actual footprints shows large differences. As a general comment, the footprint of each group is higher than the suggested one, which means that “overconsumption” and intake of unnecessary energy is occurring. Overall, we find that it is not heavy workers who have the highest footprint; rather, food consumption by sedentary workers is far higher than it should be (based on dietary recommendations). As for heavy laborers, higher footprints would be justified because of their higher energy demands (indeed, our results suggest that their footprint is on average smaller than that for sedentary workers). Comparing the structure of healthy and actual diets for the different occupational groups, we find that meat consumption is higher than recommended for all occupational groups, and changing the dietary structure toward more plant-based food consumption would have both environmental and health benefits. Limitations of the research include that a nutritious and healthy diet may vary due to other determinants which are not taken into account in the present study.

Our results demonstrate significant discrepancies between the EFs of actual diets and healthier alternatives based on nutritional recommendations. The divergence is greatest for sedentary and skilled workers, who could be expected to be more informed and interested in both nutritional and environmental issues. However, these groups typically have higher income levels that likely explain the higher than recommended food consumption. For this category, there seems to be too much emphasis on what to eat and too little on how much to eat.

Several policy recommendations follow from this investigation. First, there is potential to realize a double dividend by harmonizing environmental and health goals. Such an integrated approach would entail less meat consumption and increased fruit and vegetable consumption, as a diet oriented toward these priorities would likely lead to lower food-related EFs and a healthier population. Second, there is an opportunity to enhance the quality of public communication about healthy diets as—in addition to physical activity—social factors have a strong influence on diet. Food choices not only influence individual health but societal and public health as well because in the long run obese and unhealthy people increase costs to the health system. Third, to induce behavior change adjustments are needed in the composition of diets along with an overall reduction in the quantity of food consumed. However, altering the structure of food consumption is made more difficult by the lock-in effect, which is why public-policy support is needed to transform consumption patterns. Policy and community-based initiatives could help to change how food is consumed, including healthy food and sport initiatives, awareness-raising about footprint and health aspects, and education about healthy living and proenvironmental behavior.

The considerable environmental impacts associated with food consumption constitute a promising area for further research and policy. Major benefits may occur simultaneously for national health systems and food consumption and production systems, moving society toward a more sustainable path.

Acknowledgement

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References


Appendix: Energy and nutritional requirements according to activity (FAO/WHO/UNO, 1985; Bíró-Lindner, 1988).

<table>
<thead>
<tr>
<th>Additional Intake (basis = sedentary activity 2400 kcal)</th>
<th>Energy (kcal)</th>
<th>Energy</th>
<th>Protein</th>
<th>Fats</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medium work</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19–30</td>
<td>3200</td>
<td>123%</td>
<td>124%</td>
<td>123%</td>
<td>123%</td>
</tr>
<tr>
<td>31–60</td>
<td>3050</td>
<td>127%</td>
<td>127%</td>
<td>132%</td>
<td>127%</td>
</tr>
<tr>
<td>60–</td>
<td>2800</td>
<td>127%</td>
<td>128%</td>
<td>127%</td>
<td>127%</td>
</tr>
<tr>
<td><strong>Heavy work</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19–30</td>
<td>3700</td>
<td>142%</td>
<td>142%</td>
<td>151%</td>
<td>137%</td>
</tr>
<tr>
<td>31–60</td>
<td>3500</td>
<td>146%</td>
<td>146%</td>
<td>156%</td>
<td>141%</td>
</tr>
<tr>
<td>60–</td>
<td>3300</td>
<td>150%</td>
<td>151%</td>
<td>149%</td>
<td>150%</td>
</tr>
<tr>
<td><strong>Very heavy work</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19–30</td>
<td>4200</td>
<td>162%</td>
<td>162%</td>
<td>183%</td>
<td>150%</td>
</tr>
<tr>
<td>31–60</td>
<td>4000</td>
<td>167%</td>
<td>167%</td>
<td>190%</td>
<td>155%</td>
</tr>
<tr>
<td><strong>Pregnant women and breastfeeding women</strong></td>
<td>+143–550</td>
<td>125%</td>
<td>125%</td>
<td>120%</td>
<td>120%</td>
</tr>
</tbody>
</table>
Meat is critical with respect to sustainability because meat products are among the most energy-intensive and ecologically burdensome foods. Empirical studies of the meat-consumption frequency of Dutch consumers show that, apart from meat-avoiders and meat-eaters, many people are meat-reducers that eat no meat at least one day per week. Meat-consumption frequencies provide empirical evidence for different modes of “flexitarianism,” including light, medium, and heavy flexitarians. In particular, the existence of heavy flexitarians suggests that the customary position of meat and other animal-based dietary products in the food hierarchy is not inviolable. To improve our understanding of meat reduction, cluster analysis adds information about differences across flexitarians. Given the enormous environmental impact of animal-protein consumption and the apparent sympathy of consumers for meat reduction, it is surprising that politicians and policy makers demonstrate little, if any, interest in strategies to reduce meat consumption and to encourage more sustainable eating practices.

KEYWORDS: food consumption, diets, food preferences, consummatory behavior, public policy, meat

If we’re to have any chance of meeting future food demand in a sustainable fashion, lowering our meat consumption will be absolutely essential.
Paul Roberts, The End of Food (2009)

Introduction

Diet and sustainability are closely connected. Food choices, eating habits, and food-consumption patterns affect climate change, biodiversity, and the use of oil, water, and land, to mention only a few of the most critical environmental issues. Although consumers do not generally realize that their “foodstyles” are part of a broad sustainability framework, scientists contend that prevailing eating practices run alarmingly into the planet’s environmental limits. In particular, the consumption of animal-based food products—apart from meat these include dairy, eggs, and fish—is widely recognized to be environmentally harmful. A landmark study acknowledging the multiple impacts of meat production on ecosystems is the report Livestock’s Long Shadow by the United Nations Food and Agriculture Organization (FAO) (Steinfeld et al. 2006; see also Steinfeld, 2009). With respect to meat consumption—which is not Livestock’s Long Shadow’s primary focus—there is a strong scholarly consensus that plant-based foods are much better from both environmental and energy-efficiency perspectives than animal-based foods (e.g., Pimentel & Pimentel, 2003; 2008; Duchin, 2005; Baroni et al. 2007; McMichael et al. 2007; Marlow et al. 2009; Tukker et al. 2011). Therefore, reducing the consumption of meat and dairy products (we will not focus on the latter here) is crucial for making our diets more sustainable and reducing the ecological footprint of food systems (Lang & Barling, 2013). As Peter Dauvergne (2008) notes, “Consuming so much meat is casting ecological shadows over rural ecosystems, global water and food supplies, tropical rainforests, and the earth’s climate.” Thus, from a sustainability standpoint, there is ample reason to assign much weight to meat consumption.

The main premise of this article is that consumption cannot be ignored in the sustainability discourse. Scholarly attention through a flood of scientific papers demonstrates that consumption is integral to the contemporary sustainability debate and this observation also holds for the realms of food and meat consumption (Durrant, 2009; Foresight, 2011; Garnett, 2011; Grunert, 2011; Van Trijp & Fischer, 2011; Westhoek et al. 2011; De Bakker & Dagevos, 2012; MacMillan & Nordgren, 2012; Oosterveer & Sonnenfeld, 2012; Spaargaren et al. 2012; Sutton et al. 2013).

Against the backdrop of the consumer-inclusive viewpoint, this article focuses on meat consumption. On a global scale, increasing meat-consumption levels is a paramount consideration, as the following section briefly elaborates. Notwithstanding this manifest trend, the two empirical studies underlying work reported here reveal that substantial numbers of Dutch consumers do not eat meat regularly. Different consumer groups have eliminated meat to varying degrees. So-called “meat-eaters” dine with meat on
their plate (almost) every day of the week, while a surprising number of “meat-reducers” (or “flexitarians”) consume meat only several days per week. The existence of these flexitarians suggests that the cultural dominance of meat may be less robust than normally thought. The three subsequent sections discuss these matters and present research results. This treatment is followed by consideration of a few topics of future investigation in the uncultivated field of flexitarianism.

The article’s two final sections are devoted to policy issues. The great variety of meat-reducers suggests the need for a broad view on public policy. As yet, the necessary policy involvement is nearly nonexistent in the Netherlands and Europe more generally. To activate attention, we advocate first concentrating on the development of a politics of meat reduction using engagement and exemplification as the main policy instruments rather than relying on enabling and encouraging (to use the four “E-words” of the model developed by Defra, the UK’s Department of Environment, Food, and Rural Affairs). This course provides reason for optimism with respect to enhanced policy involvement in the near future and hope regarding food consumers’ willingness and ability to behave as engaged agents of sustainable change, both in the Netherlands and other European countries. Given the considerable environmental impacts associated with meat consumption and the prioritization of sustainability as a policy objective in Europe and among European Union (EU) member states, it is essential that research and policy making take up the challenge of reducing meat consumption.

Off-Trend: Reducing Meat Consumption

Despite many reports and persistent messages about the environmental effects of meat consumption or problems with animal welfare in factory farming in recent decades, for many people, meat eating remains quite acceptable. In addition, in almost every country and culture, meat becomes more attractive and desirable as a rising standard of living makes it affordable. Consumers who are getting wealthier are going to eat more meat, a pattern that few people in today’s world will escape. In the words of Michael Carolan (2011), “[E]ating large quantities of meat has become a cultural imperative throughout much of the world, having become a sign of affluence and modernity and a ‘right’ of consumer choice.”

The worldwide trend of increasing meat consumption is part of a broader process known as the nutrition transition, which has been unfolding since the early 1990s (see Popkin, 2001). The concept of a nutrition transition refers, among other things, to a rise in the consumption of livestock products as societies become more affluent. This increase in animal-protein consumption is accompanied by dietary shifts away from grains and vegetables. As a result, the nutrition transition is diametrically opposed to the scientific consensus that reduced meat consumption is highly advisable from a sustainability viewpoint. This prevailing understanding recognizes that meat products are among the most energy-intensive and ecologically burdensome food options. On a global scale, it is unlikely that the ecological footprint of food consumption (“foodprint”) will decline as long as the nutrition transition is occurring. As the consumption of (more) meat is an important element of this concept, the nutrition transition effectively confirms the iconic status of (eating) meat. In this context, efforts to encourage sustainable food consumption by reducing meat consumption is decidedly off-trend and therefore, to put it mildly, a challenge.

Are food consumers inclined to rise to this challenge? It is striking that to date few scholars have raised this question. With the exceptions of Nicola Richardson and colleagues (1994a; 1994b), Susan Baker (2002), and recent research by a handful of Nordic scholars (Vinnari et al. 2010; Latvala et al. 2012; Nordgren, 2012), scant academic attention has been devoted to meat-reducers. In the Netherlands, Hanna Schösler and colleagues (2012) have given attention to contemporary practices of meat consumption and we have conducted two consumer studies on eating meat and meat reduction.

Consumer Surveys

For the initial study reported here, we recruited participants through a research agency. The samples were representative of the Dutch population in terms of gender, age, and education level. Data gathering was performed between October 30–November 4, 2009 (first survey, N=800) and October 14–25, 2011 (second survey, N=1253) as detailed in Table 1.

We asked respondents to complete an online questionnaire. At the beginning of each survey, the participants answered questions about how they would identify themselves (meat-eater, flexitarian, vegetarian, vegan), and how many times per week they ate meat with the main meal of the day (mostly this is dinner in the Netherlands). The vegetarians and vegans in the sample were excluded from further analysis because the surveys pertained specifically to meat eating and meat reduction. All other respondents answered an extensive series of questions regarding their meat consumption; intentions and motives to consume more or less meat; assessment of meat alternatives, meat substitutes, and meat attributes; and judgment of the sociocultural significance of (eating) meat. Validated scales were used when
possible (for further details, see De Bakker & Dagevos, 2010; Dagevos et al. 2012).

When participants were asked how many times per week they normally ate meat at dinner, substantial numbers responded that they did not eat meat regularly. In the first survey in 2009, a large majority (69.5%) did not eat meat at least once per week. A minority consisting of slightly more than one quarter (26.7%) of respondents said that they ate meat every day of the week. These groups of meat-eaters and “meat-lovers” contrast with the small group (3.9%) of vegetarians and vegans (“meat-avoiders”). Inter-spersed between these two archetypes are meat-reducers who are consumers accustomed to one or more meatless days each week. These part-time vegetarians, or flexitarians, clearly show that a commitment to one or more meatless days per week was at the time becoming relatively common practice for many Dutch consumers. That is, eating meatless meals appears to be part of the ordinary food-consumption practices of a sizeable number of people.

Figure 1 demonstrates that the second survey (conducted in 2011) confirmed the general results obtained two years earlier. The similar shape of the distribution is noteworthy. In addition, the differences between the two sets of results are striking with respect to meat reduction. Figure 1 shows that the number of heavy meat-eaters fell sharply in comparison to the first study: full-time carnivores declined from 26.7% (2009) to 18.4% (2011). At the other end of the spectrum, the number of heavy meat-reducers—those for whom meat is on the menu one or two days per week—rose from 11.6% (2009) to 14.8% (2011). When we used a light definition of meat-reducer (people who eat a meat-free dinner at least once per week), the number of meat-reducers rose nearly 10% compared to the 69.5% in 2009. A total of 77.1% of the surveyed consumers in 2011 were

<table>
<thead>
<tr>
<th>Table 1 Demographics of the two surveys performed in 2009 and 2011.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Survey 1 (2009)</strong></td>
</tr>
<tr>
<td><strong>N = 800</strong></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td><strong>Age (years)</strong></td>
</tr>
<tr>
<td>18–35</td>
</tr>
<tr>
<td>35–45</td>
</tr>
<tr>
<td>45–65</td>
</tr>
<tr>
<td>&gt; 65</td>
</tr>
<tr>
<td><strong>Education level</strong></td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Medium</td>
</tr>
<tr>
<td>High</td>
</tr>
</tbody>
</table>

Figure 1 Weekly meat-consumption frequency.
meat-reducers when defined in this manner.

Although one may be reticent on the basis of these data to interpret the sustainability motives of those light flexitarians who abstain from eating meat at dinner once or twice per week, this reluctance is hard to maintain with respect to the medium and heavy meat-reducers (27.7% and 14.8% respectively in the 2011 survey). Taken together, 42.5% of the respondents reported being serious meat-reducers who eat no meat at dinner at least three days per week. When we add the 4.5% of the population that are vegetarians and vegans, or meat-avoiders, to the 14.8% that are heavy meat-reducers, the share of surveyed consumers that have meat-free or low-meat consumption patterns approaches one-fifth. From a meat-reduction perspective, it is also telling that this group is approximately of equal size to its counterpart at the other end of the spectrum. In other words, 18.4% are heavy meat-eaters, while 19.3% are either meat-avoiders or heavy flexitarians.

These figures demonstrate that many Dutch consumers do not eat meat for dinner every day. Further, many of them forsake meat for their evening meal on multiple days during the week. However, note that we have asked respondents to report how many times they eat meat for dinner on a weekly basis. That is to say, the data are about the meat-eating frequency of Dutch consumers, not about reduction in the amount of meat they eat. National statistics for the Netherlands indicate that meat consumption per capita has been generally stable since the mid-1990s (near the current consumption level of 43 kilograms per year), positioning the Netherlands in the middle of the range for European countries. This evidence suggests a meat paradox distinct from the one defined by Steve Loughnan et al. (2010) indicating that many people simultaneously dislike hurting animals and like eating meat. The intriguing meat paradox we encounter here is that absolute meat-consumption levels remain almost unchanged—with only a small reduction of a little more than one kilogram per year in the last two years—while a considerable number of people claim to abstain from eating meat several days per week. In other words, evident tendencies in individual meat-consumption practices are not yet visible in aggregate consumption figures. While it is important to continue to find consistency in this meat paradox, it seems unwise and premature to conclude that nothing is changing in terms of meat-consumption modes and consumer perceptions for meat.¹

¹ Can this paradox be resolved by methodological concerns regarding the well-known discrepancy between self-reported assessments and actual behavior? That is, are respondents' reported levels of meat reduction higher than the true values? Another contributing factor might be a growing division between heavy and light users.

Hierarchy of Foods

Evidence that consumers’ perceptions of meat products are less rigid than frequently supposed is revealed in respondents’ answers in the second survey when they were asked to rank fifteen protein-rich food products.² This specific question in the 2011 survey was inspired by Twigg’s (1983) hierarchy of foods in which meat (red meat and poultry) is at the top, followed by fish, eggs, and cheese. The animal-based foods are higher in status than fruit, vegetables, and cereals, which are at the bottom of the hierarchy. Despite the belief that this hierarchy of foods, reflecting the central or peripheral positioning of foods on the plates and in the consumption patterns, has universality (Boersema & Blowers, 2011; Schösler et al. 2012), closer scrutiny reveals subtle differences when the rankings of full-time meat-eaters (meat on the dinner menu for seven days per week) are compared with the hierarchy of foods by heavy flexitarians (meat for dinner one or two times per week). Table 2 shows the unsurprising result that for meat-lovers; products of animal origin are on top in the food hierarchy. Twigg’s original hierarchy is corroborated, as the top ten is completely made up of animal foods, and the top four are all meat products. More interesting, however, is that the ratings of the heavy flexitarians differ greatly from Twigg’s original hierarchy of foods.

First, the highest status is not reserved for a meat product, but rather for another (animal) product: cheese/cheese products. Second, plant-based protein products such as mushrooms, nuts, and pulses rank higher than some meat products, most notably beef. This ranking differs greatly from Twigg’s hierarchy. From a sustainability viewpoint, this finding is important because replacing meat or other foods of animal origin with plant foods reduces the ecological footprint. Third, it is interesting to observe that sev-

² The fifteen protein-rich food products were presented randomly to the respondents. Online-survey analysis offers the opportunity to ask participants to select products with a click of the mouse. With respect to this question, respondents were invited to vote on the products by giving their less-favored products the lowest value (by ticking the box belonging to 1, 2, and so forth) and the most-favored products the highest value (by ticking the box belonging to 15, 14, and so forth).
Table 2 Hierarchy of foods by meat-eaters and meat-reducers.

<table>
<thead>
<tr>
<th>Hierarchy of foods by heavy meat-eaters</th>
<th>Hierarchy of foods by heavy meat-reducers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chicken (breast)</td>
<td>1. Cheese / Cheese product</td>
</tr>
<tr>
<td>2. Beef</td>
<td>2. Chicken (breast)</td>
</tr>
<tr>
<td>3. Meatball</td>
<td>3. Egg</td>
</tr>
<tr>
<td>4. Chop (pork)</td>
<td>4. Salmon</td>
</tr>
<tr>
<td>5. Egg</td>
<td>5. Mushrooms</td>
</tr>
<tr>
<td>7. Fried fish fillet</td>
<td>7. Pulses</td>
</tr>
<tr>
<td>8. Salmon</td>
<td>8. Beef</td>
</tr>
<tr>
<td>10. Minced-meat hotdog</td>
<td>10. Meatball</td>
</tr>
<tr>
<td>11. Mushrooms</td>
<td>11. Vegetarian meat substitute</td>
</tr>
<tr>
<td>13. Pulses</td>
<td>13. Tofu</td>
</tr>
<tr>
<td>15. Tofu</td>
<td>15. Minced-meat hotdog</td>
</tr>
</tbody>
</table>

general meat products are in the lower portion of the hierarchy, according to heavy flexitarians. For them meatballs, hamburgers, pork chops, and minced-meat hotdogs turn out to be much lower in status than various products of plant origin. The apparent fact that meat products are not necessarily deemed superior to non-animal food products suggests that consumers’ appreciation of meat products is not unconditionally stronger than their appetite for the protein-rich plant foods in the presented ranking list. While the dominant position of meat in most contemporary food cultures is clearly evident, our findings suggest that its status is not indomitable (a suggestion also made by Holm & Mohl, 2000; Assadourian, 2010; Carolan, 2012; Ruby, 2012).

**Modes of Meat Reduction in Future Research**

Although being a meat-eater (a carnivore) is considered natural and normal, we do not observe a uniform meat-consumption pattern. Our survey data reveal that different consumer groups can be distinguished on the basis of meat-consumption frequency and modes of meat moderation differ across groups. Even if we leave the vegetarians and vegans (meat-avoiders) to the side, we are still able to identify distinct consumer groups with heavy meat-eaters (meat-lovers) at one extreme of the continuum and heavy flexitarians at the other. Between these groups are the medium and light meat-reducers. These flexitarians abstain from meat on multiple occasions each week.

There has to date been a lack of clarity pertaining to these (heavy, medium, and light) meat-reducers and future explorations in the new field of flexitarianism may benefit from scholarly thinking that divides other consumer segments in a tripartite fashion. As the issue of meat consumption is a specific part of sustainable food consumption, we could improve our understanding of the characteristics of meat-reducing consumers by taking note of a number of other tripartite classifications. For instance, the three approaches to sustainability as described by Hopwood et al. (2005); the three groups of sustainable consumers as divided and defined by Seyfang (2007), McDonald et al. (2012), and Verain et al. (2012); or the three forms of voluntary simplicity developed by Etzioni (2003) are possibly helpful to further research that tries to gain insight into flexitarians.

When we opt to classify consumers into two groups of flexitarians—one making minor adjustments to habitual meat-consumption patterns and another undertaking radical transformations—another suggestion for future studies may be to consider the notions of weak sustainable consumption (wSC) and strong sustainable consumption (sSC), in which wSC is about choosing products that are less burdensome for the environment while sSC refers to fundamental changes in consumption patterns (i.e., reduction of consumption levels) (Fuchs & Lorek, 2005; Scholl et al. 2010; Lorek & Fuchs, 2013; see also De Bakker & Dagevos, 2012). The division between wSC and sSC makes a difference between quality—consuming differently and efficiently—and quantity—consuming less. This distinction may, in turn, be reformulated in terms of an (eco-) efficiency approach and a sufficiency approach (Boulanger, 2010; Freibauer et al. 2011) in which the first one emphasizes meat-reduction strategies through consumers opting for meat-free or low-meat products, while the other approach stresses behavioral change.

These conceptualizations are intriguing for future research into sustainable food consumption and, more specifically, reducing meat consumption. In trying to answer how realistic it is to encourage the further reduction of meat eating, the empirical evidence has clarified the importance of recognizing distinctive consumer groups that adopt different strategies for achieving more sustainable consumption practices. Consumers can be supportive only of moderate alterations of their meat-based dietary patterns, which results, at best, in a slow decrease of their meat-consumption frequency. However, food consumers...
also can take major steps to convert meat-centered foodstyles and reduce meat-eating frequency rather drastically.

Anticipating future research, we have attempted to improve our insight into different types of flexitarians by conducting a cluster analysis, including multiple variables and sociodemographic characteristics, of the segmentation based on meat-eating frequencies outlined above. We used a centroid clustering method with the squared Euclidean distance as the dissimilarity measure. Table 3 presents the items we have included in the cluster analysis, as well as the five clusters that resulted from this procedure (for further details, see Dagevos et al. 2012; for a comparison with another recent cluster analysis, see Vanhonacker et al. 2012).

The first group—termed “conscious flexitarians”—comprises consumers who make active decisions about reducing their meat consumption. These people feel obligated to reduce the amount of meat in their diets due to ethical concerns, health considerations, and personal norms. This category consists of a large percentage of females (70%) and is characterized by its high level of education, a finding concordant with the stereotype that flexitarians are mostly educated women. The second group is “unconscious flexitarians” and consists of participants whose score is low on motives centered on the ethical considerations and health effects of meat consumption. They have positive views of vegetarian meals and do not think that eating meat is associated with higher social status. Males and females are equally distributed, and the higher education level (college, university) is underrepresented. The third group of “extravert flexitarians” is made up of people who reduce their meat consumption despite believing that it enhances social status. For this group, health concerns associated with meat consumption and the origins of meat are important. These extravert flexitarians are generally younger than the conscious flexitarians, suggesting that younger consumers are more attracted to meat reduction as something special (prestige) than as a moral act (principle). The fourth group of so-called “disengaged meat-eaters” consists of participants who often eat meat but also substitute fish or other alternatives on a regular basis. They do not score high on particular motives or personal norms for meat reduction, and this could mean that these consumers just eat meat routinely. Their commitment to reducing meat is only moderate, but their attachment to eating it is relatively low. In principle, this group could become medium flexitarians as they do not have strong motives for meat consumption. The final group consists of steadfast meat-eaters. Consumers in this group of meat-lovers do not intend to reduce their meat consumption and they confirm the stereotype of eating meat as a masculine phenomenon: a salient characteristic is an overrepresentation of men (62%).

The cluster analysis supports the segmentation based solely on meat-consumption frequency. Comparable groups were found based on the segmentation analysis and the cluster analysis. The conscious flexitarians and the segment eating meat one to two days per week are of a similar size (15%). The disengaged meat-eaters and the meat-lovers together have about the same share as the segments characterized by meat consumption five or more days per week (48% and 53%, respectively). The extravert and unconscious flexitarians are comparable with the segment that eats

Table 3 Results of the cluster analysis (mean cluster centers).

<table>
<thead>
<tr>
<th>Items</th>
<th>Conscious Flexitarians</th>
<th>Unconscious Flexitarians</th>
<th>Extravert Flexitarians</th>
<th>Disengaged Meat-Eaters</th>
<th>Meat-Lovers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current meat consumption</td>
<td>3.0</td>
<td>2.7</td>
<td>4.5</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>Past meat consumption</td>
<td>2.5</td>
<td>3.3</td>
<td>3.7</td>
<td>3.8</td>
<td>4.0</td>
</tr>
<tr>
<td>Intentions to eat meat</td>
<td>2.6</td>
<td>3.5</td>
<td>3.8</td>
<td>3.7</td>
<td>4.1</td>
</tr>
<tr>
<td>Personal norm</td>
<td>5.8</td>
<td>2.7</td>
<td>4.0</td>
<td>3.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Eating meat gives status</td>
<td>1.7</td>
<td>1.9</td>
<td>3.7</td>
<td>1.8</td>
<td>2.3</td>
</tr>
<tr>
<td>Commitment to meat reduction</td>
<td>6.0</td>
<td>4.3</td>
<td>4.1</td>
<td>4.4</td>
<td>2.5</td>
</tr>
<tr>
<td>Attachment to meat consumption</td>
<td>1.5</td>
<td>2.1</td>
<td>4.0</td>
<td>2.1</td>
<td>3.7</td>
</tr>
<tr>
<td>Positive health effect of meat consumption</td>
<td>4.0</td>
<td>2.7</td>
<td>3.7</td>
<td>2.7</td>
<td>2.0</td>
</tr>
<tr>
<td>Animal friendly and environmental friendly meat production</td>
<td>5.6</td>
<td>3.6</td>
<td>4.3</td>
<td>4.9</td>
<td>3.7</td>
</tr>
<tr>
<td>Ethical concerns about animal origin of meat</td>
<td>3.6</td>
<td>2.5</td>
<td>3.5</td>
<td>2.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Price: meat is not expensive</td>
<td>3.0</td>
<td>3.0</td>
<td>4.0</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Value for money of meat</td>
<td>4.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
<td>6.0</td>
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</tbody>
</table>
meat three to four times per week. Despite these similarities, the added value of the cluster analysis is that along with meat-avoiders and meat-eaters, several subgroups of flexitarians can be identified. These three subgroups have different motives and sociodemographic compositions that improve the profiling of flexitarians. Remarkably, the majority of the flexitarians in all three groups do not identify themselves as such; most consider themselves meat-eaters. A minority of the flexitarians is conscious of their meat consumption and has strong motives to reduce it. Motives can be either intrinsic, such as ethical concerns or personal norms, or extrinsic, such as the status associated with meat consumption or price. The difference in scores on intrinsic motives demonstrates that flexitarians do not reduce their meat consumption only in response to ethical reasons or personal norms, but also because of health concerns and price or value for money. All in all, the cluster analysis shows that understanding flexitarianism by identifying consumers’ motives and practices is a promising field of research, a pursuit currently in its infancy in science and of low priority in policy making.

Policy Involvement from the Ground Up

The heterogeneity among meat consumers opens up opportunities for policy engagement. However, attracting and activating policy attention for meat consumption is anything but straightforward. Despite ample scientific evidence that indicates the ecological problems raised by current meat-consumption patterns and levels, meaningful political attention is conspicuously absent. Apart from some interest on the part of the European Commission (EC, 2011) or an occasional member of the European Parliament who tries to put meat consumption on the political agenda, European policies regarding the moderation of meat consumption are effectively absent. Environmental campaigner Jonathon Porritt (2010) is not exaggerating when he notes, “Policy makers’ attention to...meat eating is as close to zero as it is possible to get.” Lang et al. (2010) and Westhoek et al. (2011) express similar sentiments about the current situation in which interest in and initiatives regarding meat policies are practically nonexistent and seem politically taboo.

The intriguing fact that issues of meat and, more generally, food are apparently so sensitive for European policy makers adds to the significance of the Dutch survey results. The most relevant finding is that a majority of flexitarians are making progress toward more sustainable foodstyles by reducing their meat-consumption frequency rather than by giving up meat completely. This means that policy makers—irrespective of whether they are stationed in Brussels or located in government circles in European member states—could conceivably pursue policies that encourage reductions in meat consumption (an eat less meat approach) without endorsing initiatives to drastically cut or even ban it (a no meat approach) (see also Nordgren, 2012). Consumer receptivity to such a “war on meat” is unlikely because the great majority do not regard vegetarianism as an attractive alternative. Apparently, giving up meat is not easy, particularly in a carnivorous food culture. However, evidence suggests that reducing the number of weekly meat meals is a moderate way to induce behavior change that is acceptable and attainable for many consumers. A radical change is not required. For millions of Dutch food consumers, eating low meat or nonmeat meals regularly is already becoming a feature of everyday food-consumption patterns; for a sizeable group of people, such meals are currently regarded to be just as normal as those that include meat.

Perhaps the size of this group of meat-reducers, and the opportunities their consumption patterns offer for evolutionary sustainable change, could help to generate policy interest in addressing meat consumption. Of course, there are credible and urgent arguments that moderate or mainstream approaches to reducing meat consumption are not sufficient to attain a sustainable food system that respects our planet’s ecological limits (see e.g., Roberts, 2009; Tukker et al. 2011; Vinnari & Tapio, 2012; Schösl er et al. 2012; Lang & Barling, 2013). From this perspective, the mitigation of meat consumption may not be a sufficient solution but it would be a major step forward if policy makers were to embrace cautious initiatives regarding the unsustainability of present meat-consumption patterns.

Conclusion: Toward an Incremental Strategy

There has been a dearth of powerful public-policy actions thus far at both the national level of European countries, such as the Netherlands, and in the EU as a whole with respect to reducing meat consumption. Under current circumstances, an alternative consumer-oriented policy approach that addresses meat consumption in a varied manner seems more realistic than seeking to implement consumption taxes on meat or public-policy interventions in the consumer arena. Whatever the importance of such policy initiatives in principle, they likely would be regarded as overreaching in practice given that a meat-centered paradigm still prevails. As a consequence, scholarly justification for more vigorous policy involvement may not be very helpful at the present time. In addition to relevant academic discus-
visions about the importance of public-policy engagement and the role governments could play in addressing meat eating as an ecological challenge (Nordgren, 2012; Vinnari & Tapiola, 2012), we suggest that the practical reality of current European policy making should be explicitly taken into account. As public-policy interest in meat reduction, as well as support for policy measures to reduce meat consumption, are currently scarce in European countries—not to mention other parts of the world—an incremental strategy appears appropriate.

A possible inspiration to develop such a gradualist strategy is provided by the four E’s policy framework developed by Defra in the UK (see e.g., Dolan et al. 2010). This model consists of a series of governance interventions to move toward more sustainable consumption patterns: enabling, encouraging, exemplifying, and engaging.

Enabling and encouraging both concentrate on changing the institutional or structural conditions that influence consumers’ food choices. Enabling is about reorganizing provisioning infrastructures to make them more suited to facilitate the accessibility, affordability, and availability of more sustainable products. Encouraging refers primarily to price interventions as a policy instrument. Enabling-like and encouraging-like arguments are frequently heard in regard to the need to change the context, or “choice architecture,” in which consumption occurs to shape conditions to facilitate low-meat or non-meat choices. However, from the standpoint of political strategy it seems premature to push these two dimensions forward at the start. Enabling and encouraging need market-based and regulatory policy instruments, but the dominant tendency in the current supply structure and food culture is to enable and encourage the consumption of meat rather than to hinder and discourage it. Both conditions suggest that in the longer run it is more purposeful and effective to follow a strategy that starts with soft policies of engaging and exemplifying rather than with hard policies of enabling (e.g., laws, rules, nudges) and encouraging (e.g., taxes, subsidies). This recommendation is not, however, meant to suggest that hard policies cannot be effective when appropriately applied.

With respect to current challenges surrounding sustainable food consumption, engaging and exemplifying would deploy information-based instruments to raise consumer awareness, to develop understanding, and to realize commitment by consumers with respect to meat-eating and meat-reduction practices. Such an approach could prepare the ground for more assertive policy initiatives designed to enable and encourage. Engage and exemplify are directed at sociocultural conditions. Exemplify highlights that government policies are instrumental in setting a good example for consumers. More concretely, this could mean that “governments and public bodies can themselves act as role models and market makers by choosing sustainable alternatives by default” (Reisch et al. 2011). Engaging is an even more people-oriented policy approach. Participation and interaction are its lifeblood. Engage and exemplify remind us that political negligence toward meat eating and its environmental impacts is counterproductive to raising consumer awareness about this important issue. Both notions might also stimulate public-policy initiatives that could guide and educate food consumers, such as supporting or subsidizing a vegetarian day every week (e.g., Meatless Monday, Thursday Veggie Day, see Leenaert, 2010; Wahlen et al. 2012). In addition, these schemes could spur policies recognizing that the meat politics of the near future should give much more attention to the cultural underpinnings of the dominant meat-eating pattern—for example, meat symbolizing masculinity, human mastery of nature, luxury, festivity, social and economic progress (see Lang et al. 2010; De Bakker & Dagevos, 2010; 2012).

A starting point for the suggested incremental approach is to direct attention to the commitment of politicians and policy makers and to heighten their motivation to develop greater interest in meat reduction. This commitment could be inspired by well-informed nongovernmental organizations (NGOs), cutting-edge consumers, and innovative businesses in the domain of new protein foods. Improved self-awareness will precede credible public policies of engaging and exemplifying aimed at influencing the mindsets and motivations of meat consumers themselves. As long as politicians and policy makers lack commitment, official advice and recommendations about meat reduction will not attract much attention or will be rejected by consumers as hypocritical. However, the implementation of policies, such as awareness-raising campaigns, targeted at consumer recognition of meat eating as unsustainable, is an important precondition for encouraging consumers to accept more invasive instruments. Such circumstances will create much stronger synergies between policy engagement and meat-reduction tendencies in consumption practices than currently exists. As a result, these public-policy initiatives will facilitate and stimulate the role of food consumers as change agents in the process of sustainability.

This policy posture will better connect with a reality of emerging flexitarianism, of consumer, media, and NGO interest in reducing meat consumption, and of companies’ involvement in making meat substitutes more attractive and accessible. These aspects surely belong to today’s Dutch context. Whether these circumstances compare to other European
countries is hard to determine at present due to the absence of much (comparative) research. (An initial example of the type of research that is needed is an exploratory study by Laestadius et al. (2013) that focuses on the role of NGOs, particularly in the United States and Canada, in encouraging reduction of meat consumption.) As mentioned above, more recently a few Nordic studies have explored meat reduction as a consumer phenomenon. Associations of vegetarians elsewhere in northern Europe also observe that flexitarianism exists. Regardless of whether flexitarianism will grow into a major European foodstyle as a third way alongside carnivorism and vegetarianism, lowering our meat consumption is too important to be ignored by politicians and policy makers who aim to realize a sustainable Europe.

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Developing and disseminating a foodprint tool to raise awareness about healthy and environmentally conscious food choices

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This article describes the development and dissemination of an ecological footprint tool that provides a concise and scientifically grounded summary of the environmental impact of personal food choices. Developed to be easy to use and available to consumers via online social networking platforms, the tool aims to raise awareness and to provide an impetus for behavior change. The foodprint tool communicates scientifically informed and customized practical advice on how individuals can reduce their ecological footprint (EF) (or “foodprint”). The first part of the article describes the process of developing this tool, the choice of indicator, the goals, and the results. Among other aspects, the tool enables users to understand that the largest contributors to their foodprint are sources of animal protein: dairy, meat, and fish. The second part of the article describes the strategy guiding the tool’s design and implementation, which is based on a combination of contextual communication, feedback from peers, and intrinsic motivation. In this footprint tool, a focus on food patterns, interactive feedback, and social media plays a key role. The tool consists of a survey with fifteen questions about personal food choice that allow users to receive individualized feedback, including five suggestions for reducing personal foodprints. Users can also share their results through customary social media. Due to an effective outreach campaign, a total of 90,000 Dutch consumers used this tool over a period of four months, with 1% indicating that they intended to change behavior.

KEYWORDS: food preferences, diets, management tools, communication, social behavior, internet, environmental impact

Introduction

Geographical Boundaries of Food Production

In recent decades, researchers have proposed several indicators to characterize the environmental impact of cities, countries, and populations. Though already in use in the early 1920s, the concept of a foodshed (Hedden, 1929; Peters et al. 2009b), introduced to designate a rural territory structured around supplying a city with agricultural products, provides a useful framework for analyzing the local production capacity of individual cities (Peters et al. 2009a). European and North American cities and their surrounding areas are characterized by concentric rings of farming activity devoted to the city’s food supply, beginning with market gardening and dairy farming, followed by forestry, cereal production, and finally cattle farming, as Von Thünen described in 1826 (Billen et al. 2012). These scientists developed various methods for mapping and assessing potential foodsheds, meaning land areas that could theoretically feed urban centers. The resultant approaches evaluated how the location of food production in relation to its consumption affected the environment and the vulnerability of the overall food system (Peters et al. 2009b). In today’s increasingly globalized world, the foodsheds of European and North American cities are coming under pressure, not least from conflicting land uses, such as suburbanization, leisure areas, and natural parks.

Recent years have seen the development of a number of indicators to assess the global scarcity of land, water, and energy. For instance, Wackernagel & Rees (1996) developed the now classic concept of the ecological footprint (EF) based on a comprehensive estimate of the total productive area required to sustainably produce the resources consumed by a city, given the current state of agricultural technology, as expressed in “global hectare equivalent” units. Hoekstra & Chapagain (2004) introduced a method for calculating water footprints, representing all direct and indirect water use associated with urban consumption of commodities. In turn, the carbon footprint (Wiedmann & Minx, 2008) quantifies the overall emission of greenhouse gases (GHGs) resulting from urban activities, while the nitrogen footprint (Leach et al. 2012) relates to the corresponding introduction of reactive nitrogen into the biosphere (Billen et al. 2012). In this study, we use the EF as a means...
of representing the geographical and ecological boundaries of food production.

**The Problem: Our Footprint Exceeds Available Biocapacity**

The capacity of the Earth—our ecological system—is under pressure. There is strong scientific evidence that we have surpassed the limits of climate change and biodiversity and changes in land use are no longer within the boundaries of what is safe for the planet (Rockström et al. 2009). A large share of the human EF is attributable to our food production and approximately one third of the human impact on climate and land use is related to our diet and the food chain (Dutilh & Kramer, 2000; Tukker et al. 2006; Garnett, 2011). These effects are larger than the impacts of leisure, housing, and labor (Vringer et al. 2010). Climate change mitigation policies tend to focus on the energy sector, paying the livestock sector surprisingly little attention, despite the fact that the latter accounts for 18% of worldwide GHG emissions and 80% of total anthropogenic land use (Stehfest et al. 2009). The problem is that the per capita EF of food, or “foodprint,” in many developed countries, including the Netherlands, is higher than the world average and is higher than the foodprint technologically available on a global scale. It is even higher than the total worldwide per capita available biological capacity for food, shelter, mobility, goods, and services combined (GFN, 2010).

**The Footprint is Dominated by Personal Food Choices**

The EF is largely determined by food consumption and personal dietary choices. The average per capita EF in the Netherlands is 6.1 global hectares (gha), of which 34% can be attributed to the foodprint (2.1 gha). This exceeds global biocapacity, which is 1.8 gha per capita (GFN, 2009b). Food is a basic human need and its EF therefore cannot be diminished by a share equal to a factor such as the entire transport sector. Based on the availability of different land types (GFN, 2010), the current foodprint to EF ratio (Deumling et al. 2003), and the EF of a healthy diet (Frey & Barrett, 2007) an estimated 50% of total biocapacity must be reserved for food. Therefore, we propose the maximum allowed foodprint per world inhabitant is roughly 0.9 gha. This is the estimated available biocapacity for food production if total global biocapacity were to be equitably allocated.

The Dutch Ministry of Economic Affairs, Agriculture, and Innovation has stated that “although the ‘foodprint’ of Dutch food is limited in absolute terms,” due to the country’s small size, “this is certainly not the case on a per capita basis” (LNV, 2009). The use of a global reference point emphasizes that if the world population were to adopt affluent Western lifestyles, we would be confronted with a shortage of land and energy, even more than is currently the case. With both the number of middle-class consumers and meat consumption expanding globally, this is a critical issue (Franz & Papyrakis, 2011). The disparity between the actual personal foodprint of about 2.1 and the available food biocapacity of 0.9 gha per capita is the main imperative for sensitizing consumers.

**Most Consumers Are Not Aware of Their Foodprint**

The foodprint is related to consumers’ personal food choices and behavior. Research shows little awareness among consumers of the environmental impact of what they eat, but many would likely be open to making more sustainable choices if it were easy to do so. Simpler, user-friendly information and advice about sustainable choices is therefore needed (Davies, 2011). A significant part of daily eating behavior is directed by habit, one of the most powerful predictors of eating behavior. Intentions, as opposed to habits, can be important determinants of nonhabitual eating behaviors. Habitual eating behaviors have a variety of determinants, one example being situational cues. Thus, an approach focusing on situational factors, self-regulation skills, and circumstantial factors may effectively target habitual eating behavior (Riet et al. 2011). A tool based on this idea could give consumers insight into these factors and make them aware of their dietary options and of possible ways to change their behavior. An integrated calculator can then demonstrate that their situation is unsustainable and offer insight and solutions for a sustainable food-consumption pattern.

The policy of the Dutch Ministry of Economic Affairs, Agriculture, and Innovation is aimed at reducing the per capita EF (LNV, 2009). According to the Ministry, “Particularly children and young people can learn to consciously think about what they eat and what effect it has on their health and ‘foodprint.’ The aim is to motivate them to opt for more sustainable and healthier food, now and in the future.” The foodprint concept is thus meant to raise awareness, and thereby contribute to a more environmentally friendly and healthier diet. While existing EF tools provide a measure of the extent of excessive con-
It not only yields a footprint score, but this figure is also comparable to a clear and relevant limit—available land—as opposed to CO₂ emissions, which have no such strict boundary (GFN, 2009b).

We developed the foodprint tool as a variation on the EF, basing it on Dutch data and creating it in compliance with the Ecological Footprint Standards 2009 (GFN, 2009a), designed to ensure that footprint assessments are produced in a consistent manner, according to community-proposed best practices, and that they are conducted and communicated in an accurate and transparent way. The Ecological Footprint Standards provide guidelines for factors such as the use of source data, derivation of conversion factors, establishment of study boundaries, and communication of findings. The standards apply to all footprint studies, including those targeting products. For a more detailed discussion regarding the EF as an integrated indicator, see the section of this article entitled Shortcomings and Strengths of the EF Method.

**Customized for Consumers**

The foodprint tool uses consumption-based accounting (CBA) (Galli et al. 2012). After years of debate, CBA is becoming increasingly accepted as it provides various handholds for policy and decision-making processes. CBA is a useful complement to territorially based approaches to ecological footprinting because it incorporates all the factors associated with the consumption activities driving demand on ecological assets. This method can be used to monitor the effects of decoupling consumption volume and ecological impact and to design strategic policies for sustainable consumption and production at the national, regional, and local levels (Galli et al. 2012). By integrating CBA, the EF tool may help the average individual understand her or his own EF and provide a useful indicator of global ecological overshoot, as per Sutcliffe et al. (2008).

**Summarizing Personal Food Choices**

Calculating an individual’s foodprint requires first compiling a concise summary of her or his personal food choices. The standard calculation method to determine an individual’s EF is published in the Calculation Methodology for the National Footprint Accounts, 2010 edition (Ewing et al. 2010). The foodprint tool was designed with a bottom-up CBA approach, based on data about the average consumption of a Dutch consumer. This approach is characterized by a sum of consumption activities, whereby each is the product of a consumption quantity (kilograms of food, kilowatt hours of energy, or kilometers of transportation as units of consumption) with a footprint intensity (gha per unit of consumption). These footprint intensities factor in yields on renewable products, life cycle analysis, data on the embodied energy of goods, direct CO₂ emissions from heating and mobility, and footprint data about agricultural land use (GFN, 2009a; Bellows et al. 2010; Ewing et al. 2010).

The foodprint consists of four components: cropland—accounting for more than half the total foodprint, grazing land (pasture), fishing grounds, and energy land (see Equation 1). These four components account for all the meat, fish, grain, and vegetables consumed directly by humans, as well as all of the meat, fish, grain, and energy used to feed, harvest, and ship food products. As stated, the EF is measured in a common unit called a global hectare, which is a unit of area with global average biomass productivity (see Footnote 1). Expressing EF in global hectares allows every footprint to be compared...
with local or global biocapacity, including across regions that have different qualities and mixes of cropland, grazing land, and forest (Deumling et al. 2003). This also makes it possible to account for factors such as CO₂ sequestration by forests and oceans, to which end, in the case of forests, the Global Footprint Network (GFN) has determined a world average carbon sequestration factor (3.6 tons CO₂/ha). Other types of land are converted to global hectares by multiplying them by the corresponding equivalence factors, as calculated by Equation 1.

\[
\text{EF food product} = A_{\text{cropland}} \times 2.51 + A_{\text{pasture}} \times 0.46 + A_{\text{fishing grounds}} \times 0.37 + (A_{\text{built-up land}}) + \text{Em CO}_2 / 3.6
\]  

Where,

\( A = \) world hectares (wha)  
\( \text{EF} = \) global hectares (gha) = \( A \times \) equivalence factor (Eqf) [gha wha\(^{-1}\)]  
\( \text{Em} = \) emissions CO₂ in tonnes (the factor is used to calculate the compensation area of forest)  
** Built-up land should be included, but little data is available in practice (built-up land represents only 2% of a typical Dutch person’s EF) (GFN, 2009a; Ewing et al. 2010).

**System Boundaries: Measuring the Impact of Food Choices**

The average foodprint of a Dutch consumer is 2.1 gha, which includes the EF of food (products), food waste, and energy use for cooking, packaging, and transport related to food consumption. Each factor is included in this foodprint calculator to make consumers aware that they have a significant influence on the household EF.

Consumers can use the foodprint tool to calculate their own foodprint by adapting an online description of a food pattern to their personal situation. This description is comprised of sentences with a colored (purple) section and linked to a multiple-choice pop-up screen (see Figure 1).

There are fifteen multiple-choice questions, based on a comprehensive selection of the system boundaries for the environmental impacts of food production and consumption. To make the foodprint tool as complete as possible, all the factors that have an impact on the EF and can broadly be attributed to food consumption are included: food and drink production and transport, food waste, energy use for cooking, mobility for grocery shopping, and packaging. The selected fifteen issues that contribute substantially to the foodprint are as follows: portion size; meat consumption; fish consumption; use of regional products; use of seasonal fruits and vegetables; source of energy for cooking; cooking energy-use behavior; food waste; consumption of dairy; snacks; alcoholic drinks; coffee, tea, and water; juices and all other drinks; shopping behavior; and use of packaging.

The different answer options were designed to best reflect Dutch consumption behavior and described as clearly as possible so as to avoid overlap and ambiguity and to clarify the assumptions used to make the calculations; for example: “I eat meat on a regular basis: about 70 grams a day (500 grams a week).” At the same time, this design allowed an explicit description of the amounts used to calculate the environmental impact of meat consumption using the EF indicator.

These fifteen questions were then inserted into a formula for calculating the total foodprint (EF food), shown below in Equation 2.

\[
\text{Total EF food} = \sum (\text{EF meat} + \text{EF dairy} + \text{EF fish}) + (\text{EF drinks} + \text{EF alcohol} + \text{EF coffee & tea}) + \% \text{ portion size} \times (\text{EF basic products region} + \text{EF fruits & vegetables season} + \text{EF snacks} + \text{EF packaging}) + \text{EF shopping behavior} + (\% \text{ energy use} \times \text{EF energy source}) + \text{EF food waste}
\]  

As shown in the formula above, the total foodprint (EF food) is calculated in six steps. The first
step measures the quantitative consumption of animal products that have the highest EF. The yearly consumption quantities (in kg/person/year) of the food products are multiplied by the corresponding footprint intensities (in global square meters/kg). The footprint intensities can be found in the National Footprint Accounts data tables (2010 edition) for the year 2007 (GFN, 2010). The calculation methodology used by GFN to assess the yield factors and the footprint intensities per product are described in the GFN methodology paper (Ewing et al. 2010).

According to these data, the following EFs have been determined: for meat 68 gm²/kg, for milk 18 gm²/liter, for cheese 180 gm²/kg, and for vegetables 7 gm²/kg. These footprint intensities include the use of agricultural land (cropland, grazing land, and fisheries area (when fish are used as feed)) as well as CO₂ emissions from production, excluding transport. The consumption quantities (in kg/year) are then multiplied with corresponding footprint intensities.

The second step is a semi-quantitative calculation of beverage consumption by frequency, which is translated to consumption quantity (liters/year) again and multiplied with corresponding footprint intensities.

Other food products are added up in the third step and multiplied by a factor for portion size (percentage). The consumption quantities in this third step are gauged by the consumption data for the Netherlands from the food-balance sheets produced by the United Nations Food and Agriculture Organization (FAO) (FAOSTAT, 2010). A portion size of 100% therefore corresponds with the consumption pattern of an average person in the Netherlands. Someone who eats more than an average person is assigned a higher percentage.

A separate question in the calculator is about the origin of the food products. The CO₂ emissions for transport (from producer to wholesale and retail) are translated in an energy-land footprint, based on transport data from Écolife (based on SWOV, 2010).

The above three steps comprise the food-products footprint, which includes the food wasted by Dutch households. Food-waste data are used to gauge the values in a separate question in the calculator on disposal (CREM, 2010).

Next to the footprint of the food products and food waste, the calculator also includes the energy-land footprint related to packaging and two consumer activities: consumer transport (shopping) and cooking at home. To calculate these factors, footprint-intensities data (energy-land per kg of packaging, per transport distance, and per kilowatt hour of cooking energy) from Écolife (based on GFN, 2010), together with household-survey data (from TNO, 1998; SWOV, 2010; CBS, 2011), are used to gauge the values in the calculator. For cooking, two factors determine total energy use: the energy source and the efficiency. For someone on a raw food diet, for example, no energy use has to be accounted for. For someone who pays no attention to energy use while cooking (using no lids for example), by contrast, we multiply the average use per year per energy source with an efficiency factor of 120%.

This calculation method was developed in 2011 by Écolife; website designers at 3PO created the interface for the tool (see Figure 1).

Methodology Regarding Communication Strategy: Features of the Foodprint Tool

Communication through Social Media

Social networking is beginning to make an appearance on environmental websites. Awareness about environmental issues among social network members easily spreads throughout the entire network, and social media can be used to accelerate the diffusion of information and to expand possibilities to influence behavior. “Word-of-mouth marketing” and “viral marketing” (of which the “Voeroe” is an example; see the Section Customization of the Tool and Reaching the Consumer Context) seeks to join consumers in social networks and to use key people in these networks to launch a social epidemic (Tiemeijer et al. 2009). An approach that leverages popular social networking websites could have a powerful impact among individuals. Such platforms make possible frequent reminders and motivators, as well as, in this case, feedback about how well users score on their relative foodprint (Mankoff et al. 2007). Social networking websites are driven by bottom-up processes in which people organize themselves, share information and invest it with meaning (Tiemeijer et al. 2009). These are all factors that our communication strategy takes into account.

Easy to Use and Share

A crucial feature is that a foodprint tool should be easy to use and share through social networks. An important social environment factor is that people often consciously or unconsciously use simple decision rules to guide their choices. Cialdini (2001) calls this the “principle of social proof,” with an important consequence that ideas, norms, and behaviors can only spread through society if they are supported by social proof (Cialdini, 2001). Following from this idea, the tool includes a feature that allows users to

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2 Social proof, also known as informational social influence, is a psychological phenomenon where people assume the actions of others in an attempt to reflect correct behavior for a given situation.
share their scores through social media (Twitter, Facebook, and the latter’s Dutch equivalent, Hyves) after completing the questions. Additionally, users can see in real time how changing their food choices affects the environment. Thus, by modifying their input in the tool, users can see which choices would lead to a lower foodprint. An additional screen provides advice on how to lower a user’s foodprint, based on the five areas in which she or he obtains the highest scores. Here the tool gives up to five customized suggestions on how to reduce the personal foodprint, presented in random order. Users can use this advice to see how they might lower their score. Finally, they can share their personal foodprint through social media such as Twitter and Facebook and ask their network, “How big is your foodprint?”

**Role of Consumer Context in Influencing Behavioral Intentions**

Our communication strategy is based on the theory of contextual communication (Galimberti et al. 2001). In effect, our goal is to use peer groups and opinion leaders operating in their own online social “context” to influence personal intentions and choices and to set a social standard. The term “context” here is chosen because it ties in all the important elements related to an action (Galimberti et al. 2001). The core principle of contextual communication is that it starts with the consumer and her or his context, and not with the sender’s message. Context also includes all elements in the environment that determine how a consumer perceives and interprets communication by public bodies (Tiemeijer et al. 2009).

The foodprint tool can be used not only to raise awareness but also to influence behavioral intentions. Food choices mostly consist of habitual and planned behavior. According to the theory of planned behavior, first proposed by Ajzen & Madden (1986) and widely used in this domain, especially by social campaigns, several factors work together to determine behavioral intention. Crucially, this theory takes account of multiple points for influencing people’s behavior: motivation (i.e., healthier diet), environmental influence (i.e., use of social networks), and perceived values (i.e., the average available footprint). This theory is therefore the basis of our contextual approach to communication.

**Raising Awareness through Proactive Reflection and Feedback**

Various footprint tools are already available on the Internet, including those of the Centre for Sustainable Economy and GFN (Franz & Papyrakis, 2011). While most of these EF calculations involve only a static questionnaire, incorporating dynamic information about the positive and negative externalities of individual behavior on collective outcomes is important for defining the causal relationships between human activities and environmental outcomes. Reflexivity is essential, as transparency regarding the methods by which the EF is determined can further increase proactive reflective behavior among consumers (see the Section Feedback is Crucial and Helpful). If such aspects could be more readily incorporated, the EF calculator would be more constructive, furnishing a tool that includes local circumstances and connections between environmental goods and services and human use, and at the same time improving personal accountability (Saravanamuthu, 2009).

Our foodprint tool is intended to provide that additional interactivity and reflectivity. For instance, if users change their preferences, the orange button indicating the score changes accordingly, thereby providing feedback on eating choices and habits. Mankoff et al. (2007) propose an approach that integrates feedback about EF data into existing social networking sites and Internet portals. Integrating such feedback into popular, commonly used sites would allow regular feedback about foodprint performance, while also facilitating an exploration of the motivational schemes that drive group membership (Mankoff et al. 2007). The tool has therefore been designed to allow comparisons of personal scores with the “fair Earth share” of food, 0.9 gha, and the average Dutch foodprint of 2.1 gha. A global reference is also provided, formulated along the following lines: “If everyone on the Earth had the same foodprint as you, we would need 2.7 Earths.” This type of reflection is an effective means of raising awareness (Franz & Papyrakis, 2011).

**Intrinsic Motivation and Conditions for Effectiveness**

Care for the Earth can be considered an external motivation for reducing one’s footprint. Yet, over time, this motivation can also be internalized. This is because healthy food can only be generated by a healthy Earth and decreasing an individual’s share and footprint affects her or his operating space and possibilities. An unequal share affects someone’s feelings of guilt and competence, which are extrinsic motivators. Ryan & Deci (2000) point out that social contextual conditions that support our feelings of competence, autonomy, and relatedness form the basis for maintaining our intrinsic motivation (doing something because it is inherently interesting or enjoyable) and for growth in self-determination as regards extrinsic motivation (doing something because it leads to a separable outcome). We have drawn on this self-determination theory in designing.
our foodprint tool, and specifically on Ryan & Deci’s (2000) taxonomy of motivation, which sets out several stages moving successively from external to more internal motivation (Figure 2).

Results

The Tool Confirms the Problem: 95% Exceed Available Foodprint

The foodprint tool provides more than one billion possible outcomes, with a lowest possible score of 0.41 gha and a highest of 3.80 gha. The average score obtained using the tool was 1.83 gha (see Table 1). This amount comes close to the actual Dutch per capita average of 2.07 gha. The distribution in scores was close to normal, but slightly skewed toward a lower foodprint. This is probably to be expected, as tools of this kind often reach people who are most aware of sustainability issues and eat more sustainably. Granting a normal distribution, the 2.5% lower limit is close to the available foodprint per world citizen (0.88 gha versus 0.9 gha). This means that more than 95% of Dutch consumers likely have a foodprint above the available gha. It is worth noting here that, in the majority of available indices included in existing tools, even selecting the most environmentally friendly options still results in footprints exceeding the planet’s biocapacity levels (Franz & Papyrakis, 2011). In this tool, by contrast, it is also possible to score under this level.

The Tool Gives Practical Advice for a Healthy, Low Footprint Diet

The aim of the tool is not only to raise awareness about lowering the footprint through dietary behavior, but also to give practical advice about healthy eating. The tips provided in the tool’s feedback component were formulated to address both aspects. The most important contributors to the average Dutch consumer’s EF are animal products (50%), particularly dairy (22%), meat (17%), and fish (11%) (see Figure 3). Basic plant-based consumption, including local and seasonal production, contributes 24%. Packaging is also important, contributing 9%. Because shopping and cooking involve no direct land use, their share in the footprint is relatively small, only factoring in CO₂ releases (4%). If we look at the broader spectrum of household food-related GHG emissions, the total share is approximately 17% (Marinussen et al. 2010).

In 2011, the Dutch Health Council published Guidelines for a Healthy Diet: The Ecological Perspective (Health Council of the Netherlands, 2011) as
a supplement to its existing Dutch Dietary Guidelines (Health Council, 2006). The accompanying report highlights two practical win-win guidelines that deliver both health and ecological benefits with respect to land use and GHG emissions:

1. Switch to a diet less reliant on animal products and more oriented toward plant-based products, with fewer dairy products and more whole grain products, legumes, vegetables, fruit, and plant-derived meat substitutes.

2. Reduce energy intake for those with an excessive body weight, in particular by eating fewer nonbasic foods such as sugary drinks, sweets, cakes, and snacks.

As meat and dairy account for 39% of the foodprint and nonbasic foods for 9%, most of the Health Council’s guidelines are key to these products.

By contrast, the guideline for fish (11% of the foodprint) may yield health benefits but could also be ecologically detrimental, particularly to marine biodiversity:

3. Eat two fish portions per week, including at least one portion of oily fish (Health Council, 2011). Even though the indications are that a single portion of oily fish per week is enough to lower the risk of cardiovascular disease, this recommendation of a single portion is still ecologically detrimental.

The foodprint tool was developed in conjunction with these science-based guidelines, which provided the parameters for the tool’s questions, choices, and advice.

Customization of the Tool and Reaching the Consumer Context

We aimed to reach consumers in their own context through the Internet, social media, and games. Relying on what is known in the literature as “contextual communication” (see Methodology section), the tool approaches consumers in a manner key to their environment and personal setting and packages the message in an appealing manner, such as: “Suppose you consume…”

The tool was launched in August 2011 at the Lowlands cultural festival, where the famous Dutch comedian and environmental advocate Dolf Jansen was invited to be the first person to fill in the foodprint questionnaire (Figure 4). He subsequently tweeted his result of 1.2 gha to his 37,000 followers, generating media attention and a large number of visitors to the foodprint-tool website. In the final count, a total of 879 people shared their personal footprints through Twitter, achieving a reach of 452,475 Twitter users.

### Table 1

<table>
<thead>
<tr>
<th>Question</th>
<th>Average Score</th>
<th>Dutch Ecological Guidelines</th>
<th>Average Netherlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Quantity</td>
<td>Normal portions</td>
<td>No more than necessary</td>
</tr>
<tr>
<td>2</td>
<td>Region</td>
<td>Don’t know</td>
<td>All fruits &amp; vegetables</td>
</tr>
<tr>
<td>3</td>
<td>Season</td>
<td>Frequently/depends</td>
<td>Almost all</td>
</tr>
<tr>
<td>4</td>
<td>Snacks, fruits</td>
<td>Sweet/snack 1–2X per day</td>
<td>Fruit 1–2X per day</td>
</tr>
<tr>
<td>5</td>
<td>Packaging</td>
<td>Responsible</td>
<td>Limited/recyclable</td>
</tr>
<tr>
<td>6</td>
<td>Dairy</td>
<td>Daily some</td>
<td>1–2X per week</td>
</tr>
<tr>
<td>7</td>
<td>Meat</td>
<td>Frequently (500g per week)</td>
<td>1–2X per week (200g)</td>
</tr>
<tr>
<td>8</td>
<td>Fish</td>
<td>1–2X per week (200g)</td>
<td>1–2X per week (200g)</td>
</tr>
<tr>
<td>9</td>
<td>Juices, soft drinks</td>
<td>1 glass per day</td>
<td>Sometimes, mostly water</td>
</tr>
<tr>
<td>10</td>
<td>Alcohol</td>
<td>Frequently (1 unit per day)</td>
<td>2X per week</td>
</tr>
<tr>
<td>11</td>
<td>Coffee/tea/water</td>
<td>Coffee &amp; tea</td>
<td>Tea</td>
</tr>
<tr>
<td>12</td>
<td>Shopping by</td>
<td>Car (1X per week)</td>
<td>Bicycle/feet</td>
</tr>
<tr>
<td>13</td>
<td>Cooking</td>
<td>Responsible</td>
<td>Saving energy</td>
</tr>
<tr>
<td>14</td>
<td>Energy source</td>
<td>Natural gas</td>
<td>Natural gas</td>
</tr>
<tr>
<td>15</td>
<td>Food waste</td>
<td>Sometimes</td>
<td>Almost never</td>
</tr>
<tr>
<td></td>
<td><strong>Total score</strong></td>
<td><strong>1.83</strong></td>
<td><strong>0.96</strong></td>
</tr>
</tbody>
</table>
In December 2011, we launched the “Voeroe” (a compound of the Dutch words for “food” and “guru”) as an innovative form of viral marketing. A fabricated Twitter personality, the “Voeroe” sent out 100 personal tweets with video messages to opinion leaders in the field of food and nutrition and to Dutch celebrities selected on the basis of their total number of Twitter followers. This resulted in a further 548 tweets and reached approximately 268,634 consumers.

In the last quarter of 2011, 90,000 consumers used the tool, a large number for an online environmental instrument. In total, news of the tool’s existence reached 721,000 consumers through social media (one in ten households in the Netherlands), of whom 12.5% actually used it. On average, the fifteen questions were answered in less than three minutes (the average webpage visiting time was two minutes, four seconds). Around 1% of users shared their outcome through Twitter or Facebook.

Discussion

Beyond the Dutch Health Council study (Health Council of the Netherlands, 2011), considerable additional international evidence points to the need for dietary changes aimed at healthier and more environmentally friendly consumption. Research conducted by Frey & Barrett (2007) shows that a diet that follows nutritional recommendations can significantly reduce the EF, with further reductions possible by choosing plant-based over animal-based foods and locally produced over imported food. Eshel & Martin (2009) identified red meat, and to a lesser extent the broader animal-based portion of the diet, as having the greatest environmental impact, with clear nutritional parallels. Carlsson & Gonzales’ (2009) suggestion that changing diet to include more plant-based foods, meat from animals with little enteric fermentation, and foods processed in an energy-efficient manner offers an interesting prospect for mitigating climate change that has yet to be fully explored. Wolf et al. (2011) state that final consumption of food products is among the largest contributors to harmful environmental impacts in Europe, while the production of beef and pork at the agricultural level is responsible for the largest negative effects in the food-supply chain. A diet reflecting the healthy and ecologically friendly recommendations of the Health Council guidelines—with less meat and dairy, one portion of fish per week, no snacks between meals, and no food waste—would result in a foodprint of 0.96 gha (see Table 1). This figure is very close to the current available global capacity.

The recommendation of consuming less dairy can cause a dilemma. The Dutch nutritional recommendation for dairy consumption is 450–600 milliliters of milk and 30 grams of cheese per day (Voedingscentrum, 2011). This recommendation has a major influence on the foodprint. To keep within the limits of global capacity, dairy consumption actually needs to be reduced to once or twice a week, which conflicts with the health guidelines. This is one of the major sticking points for reaching a foodprint of 0.9 gha. One possible solution would be to shift the focus of dietary guidelines for calcium toward plant-based diets. The American Dietetic Association presents sound arguments for achieving this goal (Craig et al. 2009). A vegetarian diet that is varied and rich in wholegrain products, vegetables, pulses, and fruit, and that includes moderate amounts of dairy products and eggs, can meet the requirements of a healthy and wholesome diet. This diet can reduce the footprint by 40%, to a level less than 0.9 gha (Frey & Barrett, 2007).

The foodprint tool focuses on supporting more environmentally friendly dietary choices regarding the major food groups, but gives no advice about the environmental impacts of specific products. For example, the user can choose seasonal fruits and vegetables, but cannot see the exact impact of choosing lettuce from heated greenhouses or apples from New Zealand (Milà i Canals et al. 2007). This is a shortcoming of the tool, in that it cannot aid in product-level decision making at the point of sale. Rather, the

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3 Other studies confirm the impact of animal products, which make up 50% of the average foodprint. Such products are also typically responsible for around 50% of GHG emissions; other basic food groups contribute 31% (Kramer et al. 1999). British studies have found GHG emissions for animal products ranging from 50% (Garnett, 2008) to 71% (Macdiarmid et al. 2011). Another British study attributed 61% of the EF of food to meat and dairy products; however, this work only included food production (not transport or cooking) (Collins & Fairchild, 2007).
tool gives useful recommendations for general dietary composition and specific behavioral tips, such as to drink tap water instead of coffee. Though we looked into possibilities for expanding the tool with different agricultural production methods, such as organic production, not enough conclusive data were available on the organic farming footprint (see e.g., Leifelt, 2012; Seufert et al. 2012).

A few scientists have criticized both the EF’s concept and calculation method, leading to the conclusion that the EF is not as comprehensive and transparent a planning tool as has been assumed by Wackernagel, Rees, and others from the GFN (Van den Bergh & Verbruggen, 1999). In 2010, Van den Bergh & Grazi raised six main concerns about the EF. These relate to the calculation method, applications, and interpretations. The standard defense is that the EF is in its appearance simplified to a communication tool that converts unbelievers into believers in terms of recognizing the seriousness of environmental problems. However, a tool built on weak methodological foundations that offers false concreteness is compromised in providing a robust approach to creating consensus-based political support for environmental policies (Van den Bergh & Grazi, 2010). We have responded to the issue of false concreteness in the foodprint tool by using an indicative scale with only one decimal place (for instance, 1.8 gha).

Fiala (2008) argued that the EF does not account for greenhouse-gas emissions other than CO₂, which may not be ex ante optimal, and arbitrarily assumes national boundaries as system boundaries, which makes extrapolating from the average ecological footprint problematic. According to Fiala, the footprint cannot take into account intensive production, and so comparisons to biocapacity are erroneous. While the creators of the EF agree that EF calculation methods can always be improved, they also state that Fiala (2008) has misunderstood several key points relating to the intended purpose and accepted appropriate use of EF calculations (Kitzes et al. 2009). In 2010, the method was adapted by GFN to incorporate new data, address the above criticism, and update the figures to make them more specific. The most significant change is in calculations relating to livestock and grassland (with respect to food), with the calculation of feed improved to reflect individual country practices rather than the universal average (including more species and more import/export data). The same applies to energy use per country (Ewing et al. 2010).

In a recent survey, experts concluded that it is time to be clearer about the EF and to recognize it as a powerful tool for communicating about human over-consumption, though at the same time remain-
implementation), as demonstrated in multiple studies of consumer-energy conservation (Mankoff et al. 2007), and now also borne out with the foodprint tool. Particularly useful in this regard is the information the tool provides after each question about why a certain option is “greener” than another. This directs consumers to make better choices to reduce their global footprint (Franz & Papyrakis, 2011).

Our application of self-determination theory in developing this tool is experimental, and may not hold as true in practice. After all, choices can also be determined by other factors, such as social pressure or intrinsic motivation. Studies concerning the impact and accuracy of health and other information disseminated via social networks are only beginning to be published, and our comprehension of the potential of social media is still in its infancy (Eytan et al. 2011). This article seeks to contribute to this understanding. Though the science of how networks can be used to accelerate behavior change is still in its incipient stages (Valente, 2012), the existing evidence indicates that network interventions are effective. Where the design of public campaigns is concerned, there are still few evidence-based guidelines on the use of online interventions.

In a review across all studies, Cugelman et al. (2011) found that the overall impact of online interventions is small but statistically significant, also providing the advantage of lower costs and greater reach. Time proves critical, with shorter interventions generally achieving larger impacts and greater adherence. In their psychological design, most of the effective interventions draw on the trans-theoretical approach and are goal oriented, deploying numerous influence components aimed at showing users the consequences of their behavior, assisting them in reaching goals, and exerting normative pressure. Inconclusive results suggest a relationship between the number of influence components (neither too many nor only a single one) and intervention efficacy (Cugelman et al. 2011). As demonstrated, the foodprint tool incorporates all three categories of influence components that we expect to result in a (small) significant impact on voluntary habitual behavior. Although actual behavior change has not been measured, we know that the tool reached 721,000 consumers through social media (one in ten households in the Netherlands) and 12.5% actually used it. Approximately 1% of the users shared their outcome through Twitter or Facebook, a step that can be interpreted as an intention to change food-choice behavior.

Given the large reach and low cost of online technologies, the stage may be set for a growing number of public health campaigns that blend interpersonal online methods with mass-media reach. Such a combination of approaches could enable individuals to achieve personal goals to improve their individual well-being, while at a state level contributing to healthier and more sustainable societies (Cugelman et al. 2011), as we show in this study.

Conclusion

We have successfully developed the foodprint tool, which is different from existing EF tools in terms of 1) its focus on food only; 2) its innovative design that encourages interaction; and 3) its integration of recommendations for a healthy diet with a lower foodprint. We succeeded in developing a food choices-based tool, with science-based indicators, that is custom-made for consumers by summarizing someone’s personal food choices and measuring the impact of these choices. The well-chosen communication through social media strategy shows in practice that the foodprint tool is easy to use and share, available in the context of the consumer. The tool raises awareness by means of proactive reflection and feedback, using intrinsic motivation and conditions for effectiveness. Intervention through social media makes it possible to induce behavioral change with respect to food choices by showing users the consequences of their behavior, assisting them in reaching their goals, exerting normative pressure, and providing reference values and feedback.

The food tool results show that 95% of Dutch consumers are above the available foodprint. It gives practical advice for a healthy and low-footprint diet and proves to be custom-made in the context of the consumer. The built in feedback is critical. The foodprint tool is powerful in that prompted food choices are both healthier and lower impact, although there seems to be a dilemma regarding the consumption of dairy. We have addressed the previously mentioned shortcomings of the ecological footprint methodology, although improvements are possible on the level of detail. This study confirms that the foodprint is an appealing indicator for communication about the relationship between food consumption and its ecological impact on food production. Using social media appears effective and affordable for intervening in consumers’ awareness and intentions.

In conclusion, the foodprint provides a concise means of summarizing the environmental impact of individual food choices and can thereby help to raise awareness about over-consumption and set a social standard for environmentally friendly and healthy food choices.
van Dooren & Bosschaert: How Big is your Foodprint?


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ARTICLE

Beating unsustainability with eating: four alternative food-consumption scenarios

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This article describes the future of food consumption from the consumer’s point-of-view, emphasizing the appropriation of sustainability by everyday life. The authors use a scenario process to analyze four food-consumption alternatives for 2030 from the perspective of sustainable food consumption. The evaluative process has three aims: 1) to show some possible outcomes of the future of food consumption from the consumers’ standpoint, 2) to produce new information about the different sustainability aspects by evaluating food-consumption scenarios innovatively, and 3) to reflect on the uses and possibilities of a scenario method as a tool for organizing complex qualitative data in a multi-actor process. One of the study’s conclusions is that consumers’ ideas of sustainable futures have not gained enough attention in policy recommendations. We show how the scenarios could be used as flexible tools employing consumer insights for future policy processes and public discussions. For further implementation, the most interesting alternatives and new ideas can be found at the intersection of all four scenarios. It is this area that shows an option worth striving for, a space for dealing with different sustainability challenges simultaneously.

KEYWORDS: food consumption, environmental awareness, public policy

Introduction

Global driving forces such as climate change and population growth affect the international food system, as do trends such as the growing consumption of meat and the use of grain in biofuel production. Numerous scholars have identified these developments as possible future causes of major changes and even crises (von Braun, 2007; Nelson et al. 2010; Brown, 2011). Analyzing relevant environmental, social, and cultural changes allows researchers to form alternative scenarios for the future and helps to understand the consequences and links among possible futures for food consumption. Futures thinking, and the use of long-term visioning exercises, has become part of strategic forecasting in many companies and organizations (see e.g., Sedlacko & Gjotski, 2010; Lakkala & Vehmas, 2011; Reisch et al. 2011).

This article uses a scenario process conducted between 2006 and 2008 as a starting point and then analyzes the scenarios from the perspective of sustainable food consumption in everyday life (Kirveennummi et al. 2008a). The methodological aim is to demonstrate how the scenarios can be used as flexible tools to evaluate, and even re-evaluate, the perspectives and ideas of different actors. The four scenarios were originally developed during a multi-actor research process, set up to enhance the competitiveness of the Finnish food sector. We subsequently describe the methodological approach and the background of the overall process and characterize both the scenarios of future food consumption and the different aspects of sustainability present in each of them. Finally, we discuss ways to handle these different forms, contents, and meanings of sustainability, which could also consider consumer aspects and local solutions.

Designing the Scenarios

Scenarios are ways of organizing our knowledge and understanding of possible futures. Scenario methods produce information for strategic use, such as problem solving and policy making, by simply enabling us to ask better questions. Scenarios can also work as tools for simulating and exploring emerging issues by highlighting trends and major changes for creative innovation processes and identifying alternative pathways to different futures (see Schwartz, 1991; Godet, 2001; van Notten et al. 2003).

Our scenario process for food consumption in Finland in 2030 worked originally as a tool for identifying the alternative consumption patterns that were then being discussed among actors in the food system (e.g., experts, consumers, company representatives,
policy makers). In our case, it meant creating a toolbox for futures thinking using environmental scanning and consumer studies as well as scenario tools for collecting food-consumption insights in Finland. Our aim was to develop a flexible scenario method, simulating screenplays or scripts to collect and interpret partly overlapping information and to design scenarios for further uses (e.g., increasing future awareness and product development). The goal was thus not to predict but to analyze the intertwining relationships among the many trends and aspects of food consumption. The scenarios offer a method of dealing with the complexities of the future and its uncertainties by providing context for seeing the effects of planning or not doing anything and allowing markets and individual choices to ultimately render an outcome. This approach provides a unique way of clarifying the many potential futures and thus even opening eyes to present possibilities and challenges (Másini, 1993).

The main parts of the scenarios were published in “Star Maps of Future Food Consumption” (Kirveennummi et al. 2008a) and actively discussed in the media. They were also used for further research and to provide information about the various consumer perspectives when designing Finnish food consumption policies (see e.g., MAF, 2010). We also offered some observations about the uses of the outcomes as tools for strategic thinking or product development by the food companies.

The background research of the scenario process was conducted as part of a multi-actor study and some of the results have been reported earlier (e.g., Kirveennummi et al. 2008a; 2008b; Vinnari & Tapio, 2009; Tapio et al. 2011) (Figure 1). We conducted our study by combining expert knowledge (including participation by representatives of nongovernmental organizations) with consumer knowledge: our two-round Delphi study on the future of food consumption contained expert interviews (N=39) followed by an expert questionnaire. The unique feature of our project was that we invited both experts (N=21) and consumers (N=177) to answer the same questionnaire. These questionnaires were then followed by six workshops with 53 Finnish consumers recruited from a consumer panel maintained by the National Consumer Research Center. The panel was comprised of volunteer participants interested in consumer issues rather than a representative sample of Finns (Pulliainen, 2009).

The whole process was iterative, meaning that feedback from the previous rounds provided the information used in creating the next part of the study. The expert interviews revealed the major driving forces and focal questions for both the expert and consumer questionnaires. The answers to the questionnaires enabled us to identify the most important trends. Some of the issues identified in the food-consumption discussions were considered very problematic by the respondents, namely those who believed that the future is going in a probable, but not at all preferable, direction, or in an improbable, but preferable direction. These challenges included the use of convenience food, the expanded deployment of

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**Figure 1** The Scenario Process of “What’s for Dinner Tomorrow” (MIRHAMI 2030).
of technology in food production, and the origin of food in 2030. An example of this kind of discrepancy can be seen in Figure 2, which shows consumer attitudes toward the increasing presence of vegetarianism in the future. The issues were used as thematic starting points in the workshops. In these discussions, the participants considered possible ways of influencing the future of food and eating.

Methodologically, our project primarily combined qualitative methods used in futures and consumer studies. This approach enabled us to merge visions from both experts and laypersons and we invited both groups to answer the same questionnaire. Finally, to further discuss the scenarios and their implications, we organized five workshops for companies representing different parts of the Finnish food chain and a seminar for all actors in the food sector. We regarded the actors from corporations and other organizations as experts and partners and these individuals were invited to evaluate long-term futures rarely considered in the private sector (cf., Laasonen, 2012). Therefore, the project created interaction among the various stakeholders of the Finnish food chain and provided new insights, especially from the consumer’s point-of-view. We deemed this process of engagement to be especially valuable because of the importance of understanding the relationships and roles of the diverse actors comprising national and global food systems within the frame of food governance (cf. Marsden, 2002).

The consumer workshops enabled us to discern multiple ways of knowing about the future of everyday life. On several occasions, the discussions during our scenario exercises contained elements of backcasting processes, where people’s hopes and dreams of favorable futures were discussed (Vergragt & Quist, 2011). The project thus represented a common hybrid form of a scenario process containing features from both intuitive and explorative forecasting (“What could or would happen if...”) as well as normative backcasting processes (“What should happen”) (van Notten et al. 2003; Vergragt & Quist, 2011; see also EEA, 2009). In futures research, it is most common to concentrate on macro-level analysis and expert knowledge, but here we wanted to assess consumer-driven ideas on the future of food and eating and to emphasize the consumer’s point-of-view.

**Analyzing the Material and Designing the Scenarios**

Our analysis of the data and design of the scenarios drew theoretically and methodologically upon qualitative research practices where futures and consumer studies—as well as cultural anthropology (ethnography)—serve as starting points. Our own disciplinary backgrounds are in ethnology, sociology, religious studies, and research traditions oriented around cultural as well as socio-material practices that “consist of both doings and sayings” (Warde, 2005; see also Löfgren & Wilk, 2006; Feldman & Orlikowski, 2011). The triangulative methodology (using different methods and data, Janiesick, 2000) and our multidisciplinarity enabled us to look at the future of everyday life from a variety of perspectives.

The qualitative material that we analyzed consisted of transcribed interviews and discussions, images that the participants were invited to construct of future food consumption, and comments written in the open questions in the questionnaires. Possible futures are interpreted by pondering this empirical data, making observations of technologically mediated social interaction, and integrating personal experiences. Even in the workshop discussions, we encouraged the participants to use their own historical awareness and personal experiences of different phenomena to think about the facts they had previously read or heard, to make extrapolations, and to reverse and activate their thoughts as in brainstorming. This series of procedures led to discussions where consumers used their own insights and abilities to formulate explanations, interpretations, and imaginings. In other words, the workshops produced narratives based on the creativity of the participants.

In our analysis, we focus on the different contents and meanings given by the respondents to various constructions of different futures. These are possible alternatives in people’s forethought, analytical and semantic constructions created by directing the mind toward the future through imaging or by extrapolating observed changes. Bernard de Jouvenel (1967) called these constructions “futuribles.” These can be created and further simulated by comprising
The whole envisioning process was designed to be inventive: these scenarios serve as tools for making complex phenomena understandable and open for discussions and innovations. We visualized the scenarios as star maps (Figure 2). In these constellations, the size of the star captures the effect of driving forces, often felt to be beyond the capacity of ordinary people to influence. The stars in the middle describe the consumption trends, mostly made by consumers’ own choices. This approach enabled us to explore the different factors and their relationships affecting everyday life and eating practices, counter-trends, and reactions within the alternative ways of acting in the different scenarios (Kirveennummi et al. 2008a).

In existing future scenarios, people’s daily lives are not usually described in all their multiplicity (EEA, 2000). From our previous experiences, we knew that this process tended to simplify many of the temporal, cultural, socioeconomic, or geographic variations in how people produce coherent scenarios. The scenarios work as models, and consequently, the process of summarizing the texts and narrations often reduces their ethnographically thick descriptions (Geertz, 1977). The scenarios can thus be seen as constructions and generalizations of knowledge.

**Alternative Roles of (Un)Sustainability Within Four Scenarios in 2030**

In this section, we summarize some of the main features of the scenario outcomes (Kirveennummi et al. 2008a) and show how they illustrate different aspects of sustainable eating practices in the future.

**Scenario 1: The Cornucopian Future of Food Consumption**

In the cornucopian scenario, neither climate change nor population growth has had a sufficiently strong local impact to cause political pressure to develop ecofriendly legislation or sustainable food-production systems. Main cultural models and eating habits still derive from a world assumed to have unlimited resources. There is unrestricted competition among companies and an overload of food products that try to satisfy difficult-to-predict individual consumer needs, as the market is very fragmented and in a state of constant change. Large amounts of edible food end up as waste, producing some of the most severe environmental impacts associated with the food sector. Food waste is recycled for the production of bioenergy, but the production of “unnecessary food” squanders energy and other resources.

The promotion of healthy eating is an important driver in people’s food choices, although taste and pleasure dominate desires in relation to food. Consumers are even busier in the future than they are today. Thus, industrially produced convenience food plays a major role in daily eating habits.

Due to general indifference toward environmental issues, food scandals and sudden shortages of animal products still exist. These negative occurrences, combined with individualistic food choices, make the food system both complex and chaotic. Demand for efficiently produced organic food is growing rapidly and people are willing to pay for well-known multinational or multilocal ecological brands (the globally owned local brands). To get truly organic products and satisfactory experiences, people have begun to grow their own vegetables. This activity springs from a demand for naturalness and nostalgia as imaginative and comforting elements.

Warren Belasco (2006) describes cornucopian utopias as a recurring feature in visions of the future. The common conceptions presented in this scenario follow old, optimistic ideas about the future, namely limitless modernization and economic growth. The city of the future is like a farm and a wonderland. For consumption-oriented people, ecological sustainability means increasing the amount of green products, which may contribute to the greening of consumption practices, but is just as likely to affirm a hedonistic consumer culture (Fuentes, 2011).

**Scenario 2: Ecological Food Consumption**

In the ecological food consumption scenario, the influences of global driving forces are taken more seriously. Climate consciousness has caused the most radical changes in food cultures (see Anderson, 2005; Lemke, 2011). In the expert interviews and in the consumer workshops, respondents often described a world in which ecological practices, along with institutional support, guide food consumption. In this scenario, the whole food system is integrated into flexible production, distribution, consumption, and recycling networks. Sustainability in the form of ecological thinking is a fully acknowledged social driver, and thus the scenario describes an ideal active and motivational situation for solving problems.

There are many multi-level ways of governance among different actors, ecological and nutritional guidelines, and restrictions in every part of the food system. Food-production models and methods are planned carefully—how food plants should be grown and cultivated, where cattle should be bred, and so
forth. New production methods and logistics are constantly being sought out, not only for food production, but also for the protection of the environment and its natural resources. Products and packages are required to fulfill several ecological criteria and new norms regulating societal behavior are adjusted to everyday lives and practices.

In most households, food is prepared at home, but there is also demand for services provided by centralized kitchens or restaurants. The industry produces food more ecologically than the average household. Urban farming, as well as community supported agriculture, flourishes and many new kinds of collective systems come into existence to make household logistics more ecologically and economically sustainable.

The consequences of these more comprehensive sustainability systems also create new challenges. First and foremost, the variety of consumer choices is limited, sometimes extremely so. The means to democratically change the cultural atmosphere by affecting the awareness of the population increases intolerance and anxiety within society. Climate-friendly diets in their ultimate form can lead to “climate anorexia” that especially threatens the well-being of young people. Meat is no longer used for daily meals, and the majority of consumers do not eat meat at all. Due to sustainability in food production and demands for animal welfare, meat is more expensive and difficult to obtain. It may still be consumed on special occasions such as celebrations, where it has great symbolic value. One consumer described the likely disappearance of meat as occurring, “Well, maybe not in 2030, but I’d say that at some point people will think that it’s awfully brutal and primitive that we’ve been eating meat and all these other animal-based foods. And there’s going to be some other system providing protein for people” (Consumer workshop, Helsinki, September 25, 2007). There is constant debate among different schools of thought and traditions about values in promoting ecological or other forms of sustainability. This development has led to a culturally sustainable continuation of the multicultural and more tolerant ways of living, yet with a new culture of actions, norms, and restrictions for everyday life.

Scenario 3: Scarcity and Shortage of Food

In this scenario, altering circumstances, environmental constraints, and the growing population have driven food production into a deep global crisis. Due to climate change, large areas of the world are unsuitable for food production. Energy, water, and food shortages have become more severe and food prices have increased. Authorities regulate food consumption, which leads to conflicts, even wars. Military action is needed to ensure food safety in more peaceful areas. Life in major industrialized and urbanized areas is, at times, unbearable. The number of hunger refugees and migrants has grown continuously for years, and this has affected both global and national stability. Regional logistics management has become crucial for survival: food diets are simple and food consumption-production chains are as short as possible.

At the local level, food shortages spread mistrust and create conflicts between landowners and those without land. Land ownership is the main guarantee for better resources, security, and reproduction. This also means strong regulations for the public right of access to private land (in the Nordic context). In this shortage scenario, various close and global networking models and a new sense of strong communality are emerging. The value of food, land, and countryside living is increasing. Everyday diets are often based on grains, potatoes, beans, and cabbage. Considerable time is spent on gathering food for families and other networks of relatives or friends. It is difficult to make long-term plans for a more sustainable future. In the world of scarcity and crisis, there may be no option other than trying to produce food as efficiently as possible.

Scenario 4: Techno-Life and Food

This scenario is built around the dynamic technological modernization of society (c.f., Spaargaren, 1997). The worst future perspectives related to this scenario are scarcity and lack of resources, caused by global driving forces such as climate change and population growth. Technology is developed to solve scarcity problems. Innovative and effective technological solutions and premium food substitutes have reduced the suffering of the undernourished. On the other hand, people buy functional food, developed to promote health and prevent illnesses. The major technological and social innovations with an impact on food culture include the new forms of industrial production and products such as pills and other food substitutes for consumers. Other solutions include genetically modified food and newly developed food-preservation techniques.

A majority of consumers that attended the workshops in 2007, discussing the fourth scenario, believed that, in 2030, society will be more dependent on industrially produced convenience foods than ever before. Authentic raw materials are a luxury. Food products are designed in factories to meet individual tastes and preferences, as well as health and nutritional needs. Competition is fierce, the markets are saturated with substitutes and copies, and it is a demanding task to trace the origin of food. Numerous
certificates guarantee the authenticity of products and verify the taste and genuineness of raw materials.

The consumption of meat from “living animals” is regarded as abnormal and barbaric, since, in this scenario, there is enough in-vitro meat, produced painlessly in laboratories. Such products are considered safe and standardized—proper home food. The old vision of food pills has become reality; people are finally completely alienated from food production (Belasco, 2006). They use the time saved from cooking and eating for other activities. As a result, the preparation of food from scratch is considered a luxury for the privileged. Homemade food is produced under laboratory conditions. The art of home cooking is challenged when technological production, consumption methods, and equipment become too complex for most people. In many of the discussions with consumers, we noted a slightly utopian optimism regarding radical technological innovations: “I think that [running out of energy] doesn’t have to be a threat. What if we come up with energy, new energy, then we’ll have as much energy as we need. So, suddenly we wouldn’t have any problems, for example. It could turn out like that—you can never know for sure” (Consumer workshop, Helsinki, September 25, 2007).

Beating Unsustainability

In all of these scenarios, questions of sustainability appeared in different settings, in different cultural contexts, and with different patterns of consumption. The scenarios highlighted familiar problems such as the possibilities of food choices and individuality, the origin of food, and technological solutions regarding energy, food waste, or food processing. Other major features subject to change that both the experts and the consumers imagined having some future role were demographic sustainability and the global scarcity of resources. These themes pointed to long-lasting and fundamental changes (see Belasco, 2006) that could be seen in the foundation of other scenarios as well (see also Godet, 2001; von Braun, 2007). The most intriguing practices are the solutions carried out in the context of imagined everyday life.

Scenario 1: The Cornucopian Future of Food Consumption can be described as a market- and consumer-driven “business-as-usual” scenario. Eating, as well as consumption in general, is driven by strong hedonism and individual health concerns. The field of consumption is full of paradoxes, and from an ecological sustainability perspective, the multiplicity and abundance of choices generate several problems. Eating is a problem that is compounded by the absence of political will or the ability to address problems of well-being. If consumers remain passive there will not be enough critical mass to make the necessary cultural changes toward more radical ecological sustainability, as companies and consumers mostly focus, respectively, on economic profit or individual pleasure. With no effective regulatory authority, the situation in the Cornucopia is likely to resemble a Pandora’s Box, with ill effects escaping into the world food system (cf. Godet, 2001, who also uses the Pandora’s Box metaphor but in connection with food-safety issues). This scenario highlights questions on how to manage the changing needs of consumers and the variety of rapid flows of food and materials, particularly how the management of multiplicity will be arranged in the future.

Scenario 2: Ecological Food Consumption enables the expression of strong demands for more radical ecological thinking in consumption as well as in production and distribution. The crucial difference (compared to Scenario 1) is that the responsibility for environmental choices is not left to consumers alone. When food-policy issues become politically central, less democratic ways of handling opportunism have to be applied. Important steps for regulation have been made in the public sector with, for example, new forms of tax regulation (see also Vinnari & Tapio, 2012.) The best solutions show the impact of new multi-level governance models, where authorities make the regulations in collaboration with companies as well as active consumers.

This situation leaves us with two questions. First, what kinds of solutions exist, and how could these be developed further? Second, how can ecological restrictions be made effectively but with democratic methods to increase social resilience?

Scenario 3: Scarcity and Shortage of Food envisions a future where social sustainability and trust are constantly challenged by difficult crises. With respect to governance, a major focus is placed on human survival. Major political conflicts concern landowners and those without land or access to it. Land ownership is seen as the main guarantee for better resources, security, and reproduction. This situation may lead to strong pressure or some regulation regarding the public right of access to private land that (at least in the Nordic countries) has been a traditional form of land use in the woodlands. New questions emphasize social sustainability in terms of several questions. How can we efficiently manage both equality and the sharing of resources? How can political decisions made in a resource-impoverished situation even include long-term planning? Where do the borders between “us” and “them” go and what kinds of politics are used to frame or legitimate these actions?
Scenario 4: Techno-Life and Food describes changes using a familiar perspective related to technological and ecological modernization without any radical ruptures within society (see e.g., York & Rosa, 2003). The concept of homemade food as we understand it today has changed, as preprocessed ingredients are readily available. Challenges of sustainability are characterized by the acceptance of radical innovations, as well as the ability of technology to perpetuate prevailing cultural values. Many of the major critical challenges here are concerned with the perspective of cultural sustainability, which pays special attention to continuation and change, as well as with the participatory aspects of sustainability. As a result, it is inevitable that the cultural changes include alterations in understanding what is regarded as natural, “real” food. Taking this scenario as a starting point, it would be interesting to discuss the mechanisms of these changes in the future.

Reading the scenarios from a sustainability perspective shows the many contradictory elements around the concept and phenomena. The different notions of the uncertainty and the contradictions of future food consumption should be innovatively elaborated using other futures tools. The positive and negative outcomes show how the different aspects of sustainability should be analyzed and used proactively to make new paths to favorable futures.

Conclusion

“[In 2030,] there will be vegetarians, vegans, and then there’s one crazy beef-person” (Consumer workshop, Helsinki, September 25, 2007). This quote crystallizes the multiplicity of images created by consumers in workshops on the futures of food consumption. Consumers recognized a large number of well-known and previously unknown issues that should be taken into account when pursuing sustainable food consumption. In their views of a sustainable future in 2030 the major challenges are greenhouse-gas emissions, the environmental impacts of consuming animal-based food products, food packaging and food waste, food preparation in households and institutions, and organic food.

It should be pointed out that present policy plans have considered all these issues. Sustainability has already been apparent in both political and research agendas. Efforts to tackle problems related to food production, consumption, and distribution have created new vocabularies and concepts, such as “food policy” and “food governance” (Lang et al. 2009). Quite often, food plays a vital role in both strategies and research projects. Notable examples include the Swedish Food 21 Research Program, the UK’s Food 2030 (DEFRA, 2010), and the future challenges faced in the Mediterranean countries (ICAMAS, 2008). On the European Union (EU) level, the Policies to Promote Sustainable Consumption Patterns (the EUPOPP project) focused on housing and food.

Common to many current strategies is a new focus on consumers. Current policy making often relies on the informed choices of individuals, with the emphasis now on “consumer choice” (Kjærnes, 2012), for better or worse. This is why the collaboration between experts and laypersons in the scenario process presented here is important. Scenarios have typically been based on expert views regarding possible futures. However, if we are to take the goals of these various strategies seriously, it is vital to understand and involve consumers as experts of their own everyday lives. For them, the pathways to sustainable and just food production and consumption are paved with multi-level processes engaging a variety of actors. Even though consumers often emphasize the role of right consumer choices, they profoundly acknowledge the need for regulation and legislation as well. One central result of the scenario process is the notion that consumers’ ideas on how to balance the different perspectives of the sustainable futures have not gained enough attention in political processes.

The four scenarios presented in this article include many challenges recognized in other sustainable food-consumption discussions (Berger et al. 2011; Lemke, 2011; Reisch et al. 2011). For further implementation, the scenario methods and actual scenarios can be evaluated and used more effectively as innovative tools addressing the different aspects of sustainability generally and the cultural norms and presumptions guiding our eating practices and food categorizations. Indeed, some of the most interesting alternatives and new ideas can be found at the intersection of all four scenarios. The future of sustainable eating is not only a question of either optimistic growth-oriented abundance or scarcity-focused thinking. It is in the interstitial area where we can find an option worth striving for, a space for dealing with different sustainability challenges simultaneously. This space, where ecological, economic, social, and cultural sustainability meet new innovations, could be a new culture of action (for example, a sort of LOHAS 2.0, Lifestyles of Health and Sustainability, could be developed). This could be described as a scenario where all the different “good things” bundle and various aspects and perspectives of sustainability are identified and developed to new practices or products. Could this be a dialogical meeting point where unsustainability can be beaten with eating? Or is it another utopia, a trap created by ex-

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experts? The critical question is how to examine the blank spaces on the maps of scenarios and search for alternative forms of sustainability.

As it is evident that food production and consumption are key issues for a more sustainable future, it should be noted that ecological challenges are often addressed with green products and green consumption. In current debates, green usually equals organic or local food. Yet the problem is that all this “greenness” still reinforces a hedonistic consumer culture without promoting new reflexive and critical forms of consumption (Fuentes, 2011). Is it more effective to create a more sustainable future through consumer choices or selected policy strategies and measures in food production and consumption? The conclusion is that a consensus of the most desirable future cannot be found simply in people’s various values and ideas but has to be put forth by dialogue among the different actors. Even in the workshops, the participants spent a considerable amount of time discussing the different criteria of eating properly and deliberating over who has the authority to define those standards. However, we cannot assess desirability without carefully experiencing and testing it in changing everyday-life contexts.

People do not question consumption, but rather see it as a way of life (Repo & Raijas, 2010; Lemke, 2011). It is clear that big processes like climate change tend to be so daunting and modes of production so abstract that people feel overwhelmed. Consequently, individuals focus on personal engagements, small steps, and concerns (see also Adam & Groves, 2007). The re-evaluative process gives us some hints about the multiplicity and complexity of sustainability: for consumers, there are no clear normative standards that could or should be followed. Instead, there are different aspects of sustainability, and the challenge is to look at the complex issues in bottom-up or multi-actor processes. It is true that to develop sustainable products and services, some clear expert-driven regulations are needed. Nevertheless, it is useful to see how different concerns can be perceived from multiple perspectives and within the broader change of social patterns, and how analyzing them provides a fruitful way of building policies.

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References


ARTICLE

Integrated scenarios of sustainable food production and consumption in Germany

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Making food production and consumption more sustainable is a highly complex venture, requiring varied policy instruments. While finding an integrated and coherent approach is difficult, the use of strategic foresight might help to fill the gap. This article presents the results of an extensive scenario-building process in which we searched for sustainable solutions regarding food production and consumption in various possible future contexts in Germany. First, so-called context scenarios were formulated to describe different developments beyond the control of the relevant players, but that might have a significant impact on food production and consumption. Second, strategic food scenarios were developed to examine a wide range of sustainable solutions. Finally, the context and strategic food scenarios were merged and assessed to provide policy makers with a helpful "reality check" on different strategy options and guidance in prioritization. We explain the underlying methodology and, after a brief discussion of the main advantages and limitations of our approach, we draw some conclusions for sustainable food-consumption policy, highlighting the important role of society.

KEYWORDS: food consumption, sustainability, strategy, public policy

Introduction

Making food production and consumption more sustainable is a highly complex venture. On a global scale, with 800 million people starving, food security is the key issue (Knickel, 2002; Wiegmann et al. 2005; Reisch et al. 2010; EEA, 2011; UNCSD, 2011). In Germany, where food is more abundant than ever before, and the variety is immense while prices are low, food security is not the problem. At the same time, consumers evince increasing unease about the ecological integrity of food. Pesticides in drinking water and wine, hormones and antibiotics in meat, salmonellae and nicotine in eggs, and preservatives and additives in food head the list of consumer concerns (Umweltbundesamt, 1998; 2010; Kessner, 2007; Du, 2012). It is the entire food-supply chain—from the field to the processor to the retailer to consumption to waste treatment and disposal—that creates huge environmental pressures and is far from being effectively addressed (Umweltbundesamt, 2002; Collins & Fairchild 2007; Virtanen et al. 2011). Wiegmann et al. (2005) show, for example, that in 2004 the stages and operations pertaining to food accounted for 16% of German greenhouse-gas (GHG) emissions, the same share as for mobility.

Food production and consumption have also been linked with negative health effects. Currently, no one can rule out a direct or indirect correlation between the increase in nutrition-related diseases (especially allergies and cardiovascular diseases) and pollutant residues in food, artificial food additives, and the high degree to which food is processed today (Kearney, 2010; Weiss, 2011; Zessner et al. 2011; Hermanussen et al. 2012; Lindeberg, 2012). Therefore, comprehensive action toward sustainable food production and consumption requires an understanding of the entire food-supply chain—and not only of agricultural structures and practices, but of trade and transportation systems (including global equity), the retailing and marketing of products, and finally, the complexities that motivate consumer demand, and the ways in which food is treated, processed, and disposed. In other words, in addition to the ecological, social, and economic aspects of food production and consumption, public health is an important part of enhancing the sustainability of the food sector (see Reisch et al. 2010).

As complex as the topic of sustainable food production and consumption is, just as varied are the available policy instruments to steer the food system toward more sustainable outcomes. Instruments typically applied are information-based, market-based, and regulatory (Lorek et al. 2008). Nevertheless, despite growing interest in sustainable food policies on the part of policy makers, an integrated and coherent approach has thus far been difficult to find. Many of the instruments are designed one-dimensionally for
specific policy domains and do not recognize environmental and health tradeoffs (Reisch et al. 2011). Additionally, measures might lose their effectiveness or be postponed, when unexpected developments such as the collapse of global trade or weather catastrophes due to the onset of climate change shift political priorities (WEF, 2012). Strategic foresight can help to address this problem by providing an integrated vision of what a sustainable food system could look like in the future when shaped by different measures (Reisch et al. 2011).

This article presents the results of an extensive scenario-building process in which we searched for integrated solutions for sustainable food production and consumption in various possible future contexts. We refer to “integrated” here as the act of considering the entire food-supply chain in the scenario process and providing an overview of the full range of relevant technical and social innovations and ideas as well as stakeholder effects. As a first step in this project, we generated so-called context scenarios to describe possible developments beyond the control of the relevant players, but which might have a significant impact on food production and consumption. Second, we developed strategic food scenarios, which are scenarios that are shaped by the different players. The aim of the strategic food scenarios is to examine a wide range of sustainable solutions for food production and consumption. Sustainable solutions are those that move current patterns of food production and consumption toward being environmentally friendly, healthy, accessible to all (also in a global perspective) and embedded in a stable economic system.

Obviously, not all possible options for sustainable food production and consumption would equally meet all criteria in the same way. This enables the representation of all potential sustainable solutions without a preselected and normative judgment about the optimal intervention, which can vary from player to player. And, finally, we evaluated the viability of “strategic food scenarios” under different context scenarios. As a result, we provide policy makers with an assessment regarding both the realization and robustness of each option. Reviewing strategic options against context scenarios has two objectives: to identify the robustness of each option (can a strategy option be realized in a particular context scenario?) and to evaluate its strategic significance (how important is a strategic option in a particular context scenario?). Hence, this method provides policy makers with a valuable “reality check” and supports them in prioritizing strategy options (van der Heijden 2003; Rhydderch & Alexander, 2009).

Methodology

Project Design

Various authors divide studies of the future into three scenario categories: explorative (what can happen in the future?), predictive (what will happen?) and normative (how can a specific target be reached?) (Amara, 1981; Dreborg, 2004; Börjeson et al. 2006). This national case study applied the scenario-management approach developed by Fink & Siebe (2011), which is a type of exploratory scenario category that holds promise as a tool for policy development.

We selected the exploratory scenario option because our aim was to find out how the external environment around “sustainable food production and consumption” (the “context”) might develop in the future. The same exploratory approach was applied to investigate possible alternative solutions that move toward sustainable food production and consumption. Börjeson et al. (2006) use the terms “external scenarios” and “strategy scenarios” for these two types of exploratory undertakings, which, in our project, correspond with notions of “context scenarios” and “strategic food scenarios.” We therefore divided the project into three phases: the development of context scenarios, the design of strategic food scenarios, and the implementation of an evaluation phase in which the strategic food scenarios were reviewed against the context scenarios.

Volkery et al. (2008) state that integrating multiple perspectives and different types of expertise in scenario processes helps to create well-founded, provocative scenarios that represent a wide range of possible futures. On the basis of this observation, the work in all three phases was done in a participatory way during a series of workshops. For both scenario types (context scenarios and strategic food scenarios), we assembled groups of experts who represented a broad range of expertise and viewpoints. The aim here was to increase the legitimacy of the scenario studies by extending the sources of information and knowledge and creating an environment conducive to organizational learning and change.

The context scenarios in the first instance were developed during two 1½-day workshops. Approximately thirty participants from politics, science, non-governmental organizations, and business attended. The strategic food scenarios were then separately elaborated during two additional 1½-day workshops involving approximately twenty experts. Participants were chosen with expertise in agriculture, food processing, and retailing, as well as backgrounds in environmental, social, and health issues. Care was taken to include a balanced mix of innovative and alternative lifestyle representatives of civil society in addi-
tion to experts from business, academia, and politics. For the third stage, all of the participants from both previous scenario phases were invited to jointly discuss the implications of the merged scenarios.

**Scenario Building**

Many attempts to classify and streamline scenario-building methodologies can be found in the literature and there are several comprehensive overviews by Alcamo (2001), Börjeson et al. (2006), and Kosow & Gassner (2008). This article does not attempt to categorize the different approaches or discuss their merits or limitations. Instead, we focus on highlighting some general principles of scenario building and outline the methodology that we applied, the STEEP process, as we explain in Figure 1. This is based on the four-step approach described in Fink & Siebe (2011).

**Step 1: System Analysis**

All scenario projects must begin by scoping the scenario field, which means defining what exactly the subject of the scenario process is and where the boundaries of the system lie. After that, all aspects that have a certain influence on the scenario field—called influencing factors—are collected in a brainstorming phase. To achieve sufficiently broad consideration of all relevant aspects, the scenario field is systematically structured into different search spheres. The search process typically handles spheres on different system levels—global, national, and subject specific—and refers to different content-related spheres in society, technology, ecology, economy, and policy (STEEP) (e.g., Maack, 2001). The various influencing factors are selected partly by desktop research and partly through a participatory process in a multidisciplinary workshop. Using all of the influencing factors that are identified for developing scenarios, however, would be too complex and dilute the scenario story. Therefore, for this project, the aim was to select close to twenty influencing factors that were deemed to have the highest impact on the subject. To select these major influencing factors, called key factors, we employed a cross-impact matrix (CIM) in which all influencing factors were checked against each other with regard to causal relation (on a scale between 0 and 3). In a simple algorithm, we classified active (row-wise sum), passive (column-wise sum), and interconnected (active sum and passive sum combined) (Figure 2). Between 15 and 22 of the active and interconnected factors were chosen to be key factors after discussions in a workshop (Gausemeier et al. 1998; Godet, 2000; Villacorta et al. 2011).

**Step 2: Development of Future Options**

For each of the key factors, possible developments into the future—so-called future options based on the uncertainty of the factors—were identified, using a procedure analogous to that in Ogilvy & Schwartz (2004). First, relevant aspects for each key factor were collected and discussed in a participatory
process with the aim of identifying the two most important ones. For both aspects, two different possible future developments were jointly defined; for example, “The importance of self-sufficiency could be either high or low in society and the share of individual contribution to the food supply could also be high or low.” The crossing of two aspects with two developments at each end resulted in a portfolio with four different fields (see Figure 3).

Each field is given an illustrative name and is called a future option. In cases where participants wanted to have a fifth future option in the portfolio, this was discussed and added. In the rare case that one of the portfolio fields was not plausible at all, only three future options were chosen. Finally, for each of the key factors, between three and five future options were available. Importantly, at that stage, the key factors were discussed individually and not in combination with other factors as occurs in scenario planning described by Ogilvy & Schwartz (2004). This procedure ensures that more imaginable or thinkable future options will be identified in a creative process (Fink & Siebe, 2011).

Step 3: Scenario Development

To build credible and coherent scenarios, a consistency analysis was applied: optional future states of each key factor were checked pairwise with all other optional future states, applying a scale from –2 (these two developments cannot occur at the same time), –1 (can occur, but do not really make sense), 0 (mutual coexistence), +1 (makes sense), to +2 (mutual support, synergy). All scenario-workshop participants carried out this pairwise check for consistency. Ideally, this judgment should be made by consensus after deliberations within the group. Such discussions are often very time consuming, so that, alternatively, participants filled in a consistency matrix at home and deviations were discussed afterward among members of the group.

Having 22 key factors with four options each...
would mean over one trillion possible scenarios (4^{22} combinations). A scenario is typically built on the basis of one option for each key factor and the aim is to identify those scenarios that are widely consistent. A software tool helps to identify all consistent combinations of options.\(^1\) Combinations classified as inconsistent (-2) are not further considered in the calculations, which substantially reduces the number of plausible scenarios, though a few thousand possible scenarios still remain. Some of them will only differ in one or two factors, while others will differ greatly. It is then possible to group these remaining scenarios in clusters according to their similarity (expressed as distances), which can be visualized by multidimensional scaling. With the help of this kind of automatic visualization, scenario clusters can be identified. The idea is to select the clusters most removed from each other so as to open up the scenario space as wide as possible. Every cluster (along with its characteristics) represents one scenario.

Step 4: Analysis, Mapping, and Interpretation of Scenarios

In the fourth step, the scenarios were supplemented with descriptions. To ensure that we analyzed each scenario in more detail, we first asked the following questions: What are the main characteristics of the scenario? How does the scenario differ from the others? Who are the winners and losers? In a second step, the workshop participants evaluated all scenarios and we posited the following questions: Which of the scenarios were the “most similar to today”? Which of the scenarios are the ones we would like to see? Which scenario do we expect to actually happen?

The Resulting Scenarios

Context Scenarios

Context scenarios explore possible external settings in which sustainable food production and consumption must take place and that players and performers of sustainability policy cannot influence directly. A set of 22 key factors was chosen in a workshop (see Appendix A). For each of these elements, participants identified up to five options and checked for consistency. After calculation of all possible combinations, four consistent clusters of all plausible scenarios were finally selected and graphically represented. In Figure 4, we have grouped these four clusters in a cross, spanned by the dimensions “social inclusion/exclusion” and “economic stagnation/growth” to reduce the complexity of the project results.

Very short descriptions based on the plausible and coherent option bundles of each cluster follow. The workshop participants considered all of these scenarios to be possible options for future developments through 2040. It is important to note that these kinds of scenarios are not meant to be a prognosis (Fink & Siebe, 2011).

Scenario 1: Sustainable Lifestyle

Health and sustainability are the predominant values in society. The economy is prospering and social cohesion is high, developments made possible by a culture of openness and responsibility. Materialistic values are no longer in the foreground. People are predominantly oriented around LOHAS (Lifestyles of Health and Sustainability) and consume with a notable sense of responsibility (the concept of LOHAS was developed by Ray & Anderson, 2001). These values are reflected in global network policies: there is intensive international cooperation. Climate change is occurring, but the national consequences are manageable.\(^2\)

Scenario 2: Regional Togetherness

People in Germany take responsibility for themselves. Groups and communities organize their lives on their own in a crisis-like environment. Globally, people are poor and face environmental threats. Economic growth as a goal has become irrelevant. People

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\(^1\) Scenario Manager™ developed and maintained by ScMI AG.

\(^2\) It must be acknowledged that this scenario is not really sustainable from a global perspective as climate change would have severe consequences globally and also the LOHAS strategy is disputable in terms of its effectiveness. The participants named the scenario.
act locally and regionally while materialistic values are of minor interest. Technological innovations operate in the background and environmental protection is mainly driven by sufficiency and partly by consistency strategies (for a definition of “sufficiency” and “consistency strategies,” see e.g., Huber (2000)). Efficiency plays a minor role in this scenario.

Scenario 3: Alone Against the World

All circumstances point to a serious crisis: environmental degradation is progressing and international cohesion is weak. This leads to a national and individual reorientation with a quest for maximum profit. The state takes care of its people at a very low level, adopting a dominant and authoritarian role. Profit maximization endangers global society. In such a setting, sustainability plays a minor role. People are acting as individuals in a setting of low social cohesion warding off a dominant state.

Scenario 4: Two-class Society

A materialistic and economic orientation dominates society. Solidarity plays no role—productivity and efficiency are the guiding principles. Society is divided into poor and affluent classes. The economy is widely based on manufacturing finished goods (second sector) and exports. Both the primary sector (production of raw material and basic foods) and the tertiary sector (service industry) play a minor role in Germany. Global policy is oriented toward access to necessary resources. The whole setting is dominated by strong economic and political forces. Environmental protection is not important at all.

Evaluation of the Context Scenarios

All workshop participants assessed which of the scenarios were the “most similar to today, which they would like to see, and which they expected to witness. The result is visualized in Figure 5. In the view of the participants, conditions in Germany today—in the light of the financial crisis—are most similar to Scenario 3 (Alone Against the World). Pessimists expected that we would dive deeper into this scenario, while optimists expected Germany to move toward a healthy and sustainable lifestyle (Scenario 1). Interestingly, none of the participants expected to see regional togetherness or a two-class society (Scenarios 2 and 4). The desired future, though, is mainly shown in Scenarios 1 (Sustainable Lifestyles) and Scenario 2 (Regional Togetherness)—so it stands in contrast to the current situation in terms of social cohesion. However, all of these scenarios were considered plausible futures in which sustainable food production and consumption “must” take place.

Strategic Food Scenarios

To build strategic food scenarios for sustainable food production and consumption, eighteen key factors (see Appendix B) were identified in a workshop with eighteen participants from universities, business, agriculture, nongovernmental organizations, and the state environmental agency. These participants had expertise in public health, food production and retailing, urban farming, permaculture, food waste, slow food, consumer advice, sociology, and ecology.

As was the case for the context scenarios, for each of these key factors, the participants worked out possible—but only sustainable—future developments. Each of the alternatives is thought to be more sustainable than the situation today, but of course the degree can differ from option to option. The results were also clustered and graphically represented after multidimensional scaling (Figure 6). Seven clusters of strategic food scenarios representing possible alternatives for future sustainable food production and consumption were chosen.

To better understand the differences, the seven strategic food scenarios are grouped as ranging from global orientation to local focus (vertical axes). We can also distinguish who the central players are in designing sustainability: in the upper half of the illustration, it is the customer who demands more sustainable food production, trading, and consumption (who is actively aware about health and sustainable food options). In the lower part of the illustration, the drivers of sustainable development are either the economy (agriculture, the food industry, and the retailers) or public authorities. In the following sec-
tions, we describe the seven strategic food scenarios in more detail.

Scenario 1: Public Sector Takes Care of You

A clear division of labor and responsibility is established in this scenario. Hardly anyone prepares food or eats at home. Public cafeterias, bistros, and cafes are widely available and public authorities ensure that food production is healthy and efficient with respect to the use of resources. Where possible, regional and seasonal food is prepared in a sustainable way (e.g., closed resource cycles, socially friendly). Agricultural production is mainly organic, and diets include only small proportions of meat. Trade plays a minor role and only takes place between regions, not internationally. Smaller-scale agriculture is therefore established, supervised, and managed by public authorities. Indeed, the main driver for sustainability is the public authority.

Scenario 2: Self-sufficiency or Back to the Roots—Only on a Higher Level

The food industry is marginalized. Food production and preparation is in the hands of the consumer. Agricultural production is organized in small units, even in houses and/or urban gardens, and depends on intensive social communication and networking. However, basic products like cereals are still produced on a larger scale outside of metropolitan areas. The entire production of food and agricultural goods is oriented toward regional and local consumption rather than global trade. The main driver for sustainability is the autonomous and self-sufficient society. Efficiency is not the dominant principle, but instead development is guided by sufficiency and ecological principles. Slower turnover and the closure of resource cycles reduce environmental pressures.

Scenario 3: Think Global, Act Local

The food industry has been required to adapt. The consumer is competent and aware, and demands healthy and sustainable (e.g., fair, regional, organic) products. Preparing meals at home is an important part of daily life; therefore, regional production and markets experience a renaissance. People accept regionally available food, while convenience and prepared food is less in demand than today. Agriculture has a regional focus, with innovations accepted and applied insofar as they support organic farming. Transboundary import/export, especially over long distances, does not take place on any major scale. The main driver for sustainability is the orientation and knowledge of consumers, whose informed purchasing decisions create regional markets.

Scenarios 4/5: Organic Products Made in Germany and It’s My Choice

The food industry, distributors, and consumers share responsibility for sustainability in these two scenarios. Consumers are conscious about nutrition...
and food quality and are highly ecologically sensitive. For this reason, higher prices are widely accepted. Self-sufficiency plays no role in food production—mainly because there is no time and no need for it. Food producers must comply with sustainability standards to succeed in the market. Organic fast food and organic convenience food are the choice in “Organic Products Made in Germany,” while in “It’s My Choice” people take time to cook and eat at home, which is the main difference between these two scenarios. Agriculture is innovative in both cases and organic farming is standard practice, even on a large scale. Technology and renewable energy help make organic food available all year round, with imports limited to the necessary minimum. The main drivers for sustainability are both the demand for and the supply of sustainable products. Economy and society are the main players.

**Scenario 6: Innovations**

The food industry implements radical innovations in food production and distribution so that energy consumption and GHG emissions are low. Public health and animal welfare issues are no longer concerns. Consumers are trustful of controls and of the self-commitment of the food-production chain. They enjoy inexpensive convenience food and having meals with family and friends is an important part of everyday life. Elements of self-sufficiency do not play a role in this scenario. Agriculture is very efficient in terms of energy consumption and operates with a high level of productivity. The main driver for sustainability is efficiency due to (technological) innovations and the main player is industry in general.

**Scenario 7: Global Economy Sets the Framework**

The food industry is booming. Consumers prefer convenience food and one of the main criteria is price. Products are imported from wherever they are inexpensive. Due to this particular priority, all kinds of food are available all year round. Time and cost are the key issues for both producers and consumers. Labeling and state control ensure that health and sustainability standards are fully met. Agricultural production in other countries is far more efficient than in Germany, so German farmers focus on energy and fiber crops and food is mainly imported. In economic terms, this is the most beneficial division of labor. The main driver for sustainability is efficiency due to the highly effective division of labor and optimization supported by incentivizing policies and strong economic interests.

**Evaluation of the Scenarios by the Scenario Development Group**

All of the participants in the scenario workshops were again asked to evaluate the scenarios’ probability, desirability, and similarity to today’s situation. Resemblance to contemporary conditions does not imply that the current system is already sustainable, but it illuminates which strategic food scenario already exists in rudimentary form. This evaluation was visualized on a map of the future (Figure 7).
The expected future and the current situation nearly align while the desired future is rather distant. The experts who were part of the consultation envision a current orientation toward a global economy and little consumer autonomy. They do not expect this to change, but they would like consumers to be more empowered and to desire a stronger regional and local orientation.

**Sustainable Solutions in Different Contexts**

After the expert participants developed context scenarios and strategic food scenarios, the two were reviewed against each other. The objective of this exercise was to learn how the strategic food scenarios might work in each context scenario. In practical terms, this meant first looking at the portfolio of the four context scenarios along their dimensions “social inclusion/exclusion” and “economic growth/stagnation” (see Figure 4).

As shown in Figure 8, we then allocated, in a discursive process, the strategic food scenarios into this portfolio. “Social exclusion” plays a major role in Scenarios 1, 5, 6, and 7 while “Social inclusion” is prominent in Scenarios 2, 3, and 4.

The allocation of strategic food scenarios to economic development (steady state vs. growth) opens up room for more discussion and insight. “Economic development” is not an explicit factor in the strategic food scenarios. Trade, retailing, source of resources, and innovations, however, are implicitly connected to the economic system. In that light, some of the strategic food scenarios “require” economic growth while others might also work under conditions of crisis, though the interpretation is different. In the following two subsections, we discuss how a given strategic food scenario could be interpreted in a particular economic setting. We also reflect on which players will be the main drivers for sustainability.

**Solutions in a Context of Economic Stagnation/Recession**

Strategic Food Scenarios 4 (It’s My Choice), 5 (Organic Products Made in Germany), 6 (Innovation), and 7 (Global Economy Sets the Framework) require a high level of economic activity and consumption. A sustainable food strategy mainly based on trade, innovation, and technology would not be a realistic option under uncertain economic conditions. Scenario 6 might fit when innovation is used as an engine for triggering economic development (by increasing debt, most probably).

Scenario 1 (Public Sector Takes Care of You) could be a solution that fits exactly to the negative conditions described in Context Scenario 3 (Social Inclusion/Economic Crisis). The public sector is the last anchor for civil society and national industry. This solution tries to maintain the structures needed in the food sector to guarantee the population a basic food supply. When the economy is down and people become destitute, the state takes care of them as a social measure, using what we know today as soup kitchens and food pantries. Environmental relief
comes mainly from the low production and consumption volumes. People have little interest in sustainability values, although the footprint of poorer people is significantly smaller (Borgstedt et al. 2011). It would be very expensive, though, if the public sector “took care.” This scenario does not therefore seem to be very stable because it means a vicious circle of debt both for the people and the state. Social order would be endangered and the reactions of the state could be authoritarian or the state could even collapse leading to anarchistic conditions. Both alternatives have a high potential for violence and are the basic ideas of sustainability. In light of the financial crisis, one can get a small sense of this scenario by looking at countries like Greece, where such conditions are already manifest.

If, in an extreme variant, the public sector is not able to guarantee social welfare anymore (due to a lack of public money, dissolving institutional structures, or the like), no other option seems available—except for people to start to work together and help themselves as described in Scenario 2 (Self-sufficiency). This scenario, however, would require a different context of social inclusion and economic stagnation. We would be moving from Context 3 (Alone Against the Rest of the World) and Context 4 (Two-class Society) to Context 2 (Regionally Together). Here, civil society takes a leading role, people are forming small groups and in general social cohesion is high. This is a natural process of human adaptive capabilities and will to survive as experienced, for example, after the Second World War when there was hardly any formal economic activity and people had to develop their capacity for self-sufficiency.

While this is an extreme example, it does map out a pathway. When the economy becomes unstable or is stagnant, people start fending for themselves, including producing their own food, a process than can create conditions for social solidarity, mechanisms of simple exchange trade, and closer cooperation. Such effects can often be seen in regions where industries break down completely. People start taking matters into their own hands by building gardens, forming communities, and reorienting themselves to regional and local markets, as has been visible in Detroit in recent years (see also Conner et al. 2008; Dubuisson-Quellier & Lamine, 2008; Hemphill & Leskowitz, 2012).

**Solutions in a Context of Economic Growth**

Strategic Food Scenarios 4 (It’s My Choice) and 5 (Organic Products Made in Germany) certainly require a positive economic setting, because industry and trade are very “active,” balanced by the power of the consumer. Economic growth is not explicitly needed, but then again economic stagnation or recession would make these scenarios impossible. Additionally, society is neither divided nor community-based.

Strategic Food Scenarios 6 (Innovation) and 7 (Global Economy Sets the Framework) have a strong focus on economic growth and global expansion. Interestingly, the German government seems to favor this strategy, most notably in the report *National Research Strategy Bioeconomy 2030* that has the aim of securing the global food supply (Federal Ministry of Education and Research, 2011). Additionally, workshop participants rated this scenario as being “similar to today” (see Figure 5). This setting requires stable global political conditions and no trade barriers or comparable obstacles. Comparable circumstances are described in Chambers et al. (2007), Brunner (2009), and Belz & Schmidt-Riediger (2010).

We already described Strategic Food Scenario 2 (Self-sufficiency) in a context of economic stagnation. But it can also be thought to take place in favorable economic conditions, under which this scenario reflects the free will to “do it yourself” and to “take care of yourself.” Evidence of such a development can be found in, for example, Hemphill & Leskowitz (2012) who interviewed ten “do it yourself activists.” Recent work by Van Timmeren et al. (2004), Hirsch et al. (2010), and Aiken (2012) supports this idea of developments toward self-sufficiency. In the long run, we will see how the food industry reacts. It is likely that such a huge sector will conduct very strong campaigns against self-sufficiency because of the potential loss of market share. In the best case—from the point of view of sustainability—a strong demand for sustainable products might stimulate a change of production methods and product portfolio. Currently, there is no clear picture or vision of how society might function if the majority of people tried to be independent of an efficient division of labor. The question remains if such a scenario could ever be mainstreamed.

Strategic Food Scenario 3 (Think Global, Act Local), described as a regional option, is based on strong communities. Therefore, we consider it to be relatively stable and resilient. We do not see in this case neoliberal economic growth or economic recession in extreme forms. This strategic food scenario will “work” in different economic settings and will stabilize society with a regional or local focus.

**Discussion/Conclusions**

The use of scenarios should be advantageous to stakeholders for two reasons: they open the mind (of a group) to possible future developments and enable thinking about topics in all their complexity in a sys-
tematic fashion. In the scenario-management approach, these two benefits are achieved as follows: options are built out of all key factors with no limitation or condition in mind, and consistencies are checked between two factors at once pairwise, which reduces complexity for the stakeholder (see also Halford et al. 2005). Computer software helps to develop scenarios with maximum consistency and plausibility. An expert panel analyzes the interdependencies of the factors and crystallizes them into a concise scenario story. Lively and, to a certain extent, controversial discussions in the workshop situations prepare the ground for creative solutions and outcomes.

Of course, the scenario-management approach also has some limitations. One lies in the need for software to help formulate the scenarios consistently. Moreover, filling in the relevant matrices is a very time-consuming and demanding process. The overall time commitment of scenario management is greater than in scenario planning or other normative methods, because one needs to fill in, calculate, evaluate, and interpret the consistencies. One major drawback is common to all scenario methodologies: the scenarios always belong to the group that worked them out. The quality of any scenario process is thus determined by the preparation of the content, the selection of participants, and the transparency and reproducibility of the outcomes (Maack, 2001).

Differentiation between context scenarios and strategic food scenarios enables parts of the work to be reused. In our project, the context scenarios will also be applied to different strategic scenarios in other topic areas, such as sustainable housing or sustainable leisure activities. In the future, additional themes might be evaluated and assessed against these contexts, which will give a rather consistent picture and will enable the context scenarios to serve as a more generic tool.

This process of differentiation also helps to identify and classify strategies as either relatively robust or focused. By definition, robust strategies are less sensitive to uncertainty about the future, while focused strategies might be more effective reaching the underlying goals but are sensitive to changes in the future. For risk-averse policy makers, robust strategies can be expected to perform reasonably well, at least compared to the alternatives, even if society and policy are confronted with surprises or catastrophes. Robust strategies may also offer a more solid basis for consensus on political action among stakeholders with different views of the future, because such strategies can provide reasonable outcomes no matter whose view proves correct (Rhydderch & Alexander, 2009). A conclusion of this study is that current political strategy is exclusively dependent on economic prosperity and that there is no robust strategy which performs well in all context scenarios. We discovered, however, that more solidarity and empowerment of consumers are the most robust elements in the strategic food scenarios, which might lead to more sustainability under both favorable and unfavorable economic conditions.

In recent work, Reisch et al. (2011) stated that a coherent framework bringing together policy instruments (e.g., information-based, market-based, regulatory, self-commitment) and environmental, economic, and societal contexts is still lacking. Our approach might contribute to filling exactly this gap. Scenarios exploring the relevant context and merging these with strategic options has proven to be a useful instrument supporting the development and evaluation of political strategies, especially in the highly complex field of sustainability.

Acknowledgement
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References


Appendix A: List of Key Factors–Context Scenarios

<table>
<thead>
<tr>
<th>Social</th>
<th>Technological</th>
<th>Environmental</th>
<th>Economic</th>
<th>Political</th>
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<tbody>
<tr>
<td>Social values and environmental awareness</td>
<td>Dynamics of innovation</td>
<td>Structure of national economy</td>
<td>Public budget</td>
<td>Global governance</td>
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<tr>
<td>Patterns of private consumption</td>
<td></td>
<td>Target systems in business and economy</td>
<td></td>
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<tr>
<td>Organization of daily life</td>
<td></td>
<td>Global availability of resources</td>
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<tr>
<td>Urban frameworks</td>
<td></td>
<td>Climate change</td>
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<tr>
<td>Wellbeing/welfare</td>
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<td>Global state of the environment</td>
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<tr>
<td>Social cohesion</td>
<td></td>
<td>International environmental protection</td>
<td></td>
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<tr>
<td>Education</td>
<td></td>
<td>Globalization and trade</td>
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<tr>
<td>Social innovation</td>
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<td>Global finance and capital markets</td>
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<td>Global values and religion</td>
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<td>Global wealth</td>
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Appendix B: List of Key Factors–Food Scenarios

<table>
<thead>
<tr>
<th>Social</th>
<th>Technological</th>
<th>Economic</th>
<th>Political</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to pay for food</td>
<td>Degree of technological innovations in food industry</td>
<td>Production of food industry</td>
<td>Role of consumer-protection policy</td>
</tr>
<tr>
<td>Food-preparation practices in households</td>
<td>Degree of innovation in agriculture</td>
<td>Sources of food (regional)</td>
<td>Use and supply of resources</td>
</tr>
<tr>
<td>Buying patterns</td>
<td></td>
<td>Degree of out-of-home consumption</td>
<td></td>
</tr>
<tr>
<td>Cultural importance/settings of food</td>
<td></td>
<td>Market share and position of national agricultural production</td>
<td></td>
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<tr>
<td>Awareness and responsibility about food</td>
<td></td>
<td>Food retailing</td>
<td></td>
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<tr>
<td>Degree of out-of-home consumption</td>
<td></td>
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<tr>
<td>Knowledge and competencies of consumers</td>
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<tr>
<td>Lifestyle habits with regard to nutrition</td>
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<tr>
<td>Knowledge and competencies of consumers</td>
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ARTICLE

Bridging the science-policy gap: development and reception of a joint research agenda on sustainable food consumption

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To increase the uptake of research findings by policy makers and to encourage European researchers to better reflect policy needs, we facilitated the development of a joint research agenda (JRA) on sustainable food consumption (SFC) involving scientists, policy makers, and other stakeholders. Pursuing interpretive action research and using a number of data sources, we tried to understand how the “fit” between the characteristics of policy makers’ organizational contexts and the attributes of the JRA development process affects the reception of the JRA and its outcomes. Our framework was based on three distinct formations of discursive and material practices related to the use of knowledge in public policy making: bureaucratic, managerial, and communicative. Two dominant patterns seem to be represented in SFC consumption in the European Union: a transition between the bureaucratic and the managerial formation and a highly developed managerial formation with occasional communicative practices. We found that reflecting national policy priorities would help overcome some of the structural barriers between science and policy, whereas other barriers could be addressed by designing the process to better fit with the logics of the three formations, such as the fragmentation of knowledge (bureaucratic formation) or breadth of participation (communicative formation).

KEYWORDS: policy research, workshops, food consumption, participatory planning, stakeholders

Introduction

Increasing the uptake of research findings by policy makers and aligning research priorities to better reflect policy needs are two mutually reinforcing objectives of the science-policy interface. Shortcomings in the use of available evidence and scientific expertise in sustainable development and environmental policy making have been well documented (e.g., Pouyat, 1999; EC, 2008; Holmes & Clark, 2008; Likens, 2010; see also EC, 2001). In response, the European Commission (EC) decided to fund, through the Seventh Framework Program for Research and Technological Development (FP7), a series of knowledge-brokerage projects addressing the science-policy interface in a number of areas of sustainable development and environmental governance. CORPUS (Enhancing the Connectivity Between Research and Policy-Making in Sustainable Consumption) was one of the funded projects, focusing on three sustainable consumption areas: food, mobility, and housing.

One of the means chosen by the CORPUS project consortium to bolster the uptake of scientific evidence by policy makers was development of a joint research agenda (JRA) for each of these areas. This article reflects the JRA experience on sustainable food consumption (SFC). A JRA typically identifies priority areas and specific topics (for example, in the form of research questions, as in Pretty et al. 2010), but also goals, methods and/or expected results of research (cf. Sutherland et al. 2011). Its development involves scientists and policy makers, as well as representatives from both industry and civil society organizations (CSOs), and others. Joint or collaborative research agendas are one means of aligning research priorities between science and policy to produce policy-usable knowledge. Other approaches include high-level scientific committees involving policy makers, purpose-bound budgets for state-research agencies, high-level scientific reports, and dedicated research programs that “attempt both to focus on short-term political agendas and develop long-term research capacities” (Nowotny et al. 2003). JRAs are becoming more widely used in various areas with recent examples focused on sustainable food including ETP (2007), Niggli et al. (2008), and Pretty et al. (2010). In the current case, development of the JRA consisted of several stages conducted before, during, and after two workshops held in January and May 2011. Two of the authors of this article were actively involved as facilitators and observers throughout the entire JRA development process.

This aspect of the project was supplemented with interpretive action research. We simultaneously facilitated the process and conducted research to im-
prove its usefulness to participants. Our research had an interpretive dimension, since we hypothesized that the ways participants make sense of the JRA development process are to a significant extent determined by their organizational contexts—the constitutive social settings of their everyday work—and the interpretive parts of our methodology enabled us to acquire a richer understanding of those contexts. We theorize that organizational contexts simultaneously enable and constrain the ways in which policy makers are able to (and learn to) use knowledge and thereby influence what outcomes can be achieved in terms of further use of a JRA or change of policy makers’ practices. Our research design is presented in the subsections entitled Research Before, During, and After JRA Development and Theoretical and Methodological Framework; the JRA development is discussed in Preparation and Design of JRA Development.

During preparatory research stages, we developed a heuristic classifying three distinct knowledge formations that describe patterns of discursive and material practices related to the understanding, creation, circulation, and use of knowledge in public-policy making. We termed these ideal-types the bureaucratic, the managerial, and the communicative formations. Their historical context is presented in the section entitled Key Historical Developments of Public Administration and the formations themselves are explained in Toward Praxis/Discourse Formations of Knowledge in Public Policy.

In a European Union (EU)-wide survey, we observed two dominant patterns that seem to be represented in SFC policy: a transition between the bureaucratic and the managerial formations and a highly developed managerial formation with occasional communicative practices. These findings are presented in the section Knowledge Formations in European SFC Policy Making: Organizational Contexts. In an attempt to increase reception and enhance potential outcomes of the JRA development, we designed the process so it would have characteristics of both the managerial and the communicative formations, as presented in the section Design of the JRA Development: Attributes of the Process. We encountered a number of challenges when striving to achieve structural similarities between the process and participants’ contexts and this situation is outlined in the section Fit Between Context and Process and Achieving Outcomes. A broader discussion critically reflecting on our conceptual framework is presented in the section Broadening the Picture. In the concluding section, we summarize the main findings and formulate avenues for future research.

**Research Design, Methodology, and Process Design**

The research objective was to accompany the development of a JRA on sustainable food. In other words, we sought to develop an interactive process of aligning research priorities on SFC and to better understand the factors of the JRA’s reception (in particular by policy organizations) and outcomes one year after the process. Figure 1 depicts both 1) the preparation, design, and oversight of the JRA development process (grey boxes) and 2) the research itself consisting of preparatory research and development of heuristic analytical tools, accompanying evaluation, and follow-up research one year after the JRA development process (white boxes).

**Research Before, During, and After JRA Development**

In our research, we tried to understand how a fit between important characteristics of participants’ organizational contexts and the attributes of the JRA development process influence the production of outcomes. The notion of “fit” refers to structural similarity between the process of research-agenda development and the participants’ everyday organizational contexts, and is tied to the assumption that a tighter fit would make the process of research-agenda development more understandable and its outcomes more useful to its participants. Our research encompassed several stages and different sources of data.

First, before the start and during the process, we conducted an extensive literature review on the role of knowledge in the political process and the everyday work of public administrators to produce a heu-

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*Figure 1 Structure of JRA development and accompanying research.*
ristic framework for understanding policy makers’ organizational contexts. Second, we conducted a preparatory survey on the interaction of EU national level policy makers with scientific information. Using purposive sampling, we identified a pool of national sustainable development coordinators and officials responsible for the sustainable consumption and production agenda in EU member states. We conducted 25 semi-structured telephone interviews, primarily in English. The findings helped us to better understand participants’ organizational contexts.

Third, during the whole JRA development process, we carried out unstructured participant observation, adopting the role of observer-as-participant and taking notes on working atmosphere, intensity of interactions, and anecdotal information on interactions between scientists and policy makers. The observation was accompanied by a group reflection on process-design choices. The resultant data sources were observation notes and reflections.

Fourth, an evaluation report was produced immediately following every event. The documents used, among others, the following additional data sources: participant observation, qualitative interviews with two participants per workshop (one policy maker and one researcher), feedback questionnaires (response rate 77% for the second workshop and 65% for the third workshop), and content analysis of participants’ journals (response rate 34% and 16%, respectively).

Fifth, to better understand the outcomes, ten months after the last workshop we conducted a series of semi-structured telephone interviews on the reception of the JRA development process and the uses of the resultant document. We conducted purposive sampling to cover the perspectives of both policy makers and researchers (with a stronger focus on policy makers), and applied the concentration principle (with prescreening of the potential interviewees) to arrive at interesting and promising cases. Four policy makers and two researchers participated. The interviews were conducted in English and the results were anonymized. Interviews were transcribed and analyzed using two different methods, “fine structure analysis” (Feinstrukturanalyse) (see Froschauer & Lueger, 2003) and content analysis. Fine structure analysis is an interpretive method based in objective hermeneutics, helping to uncover latent meaning structures and through them understanding of objective meanings in (especially spoken) text. Its key theoretical proposition is that behind subjective meanings expressed in text are objective meanings that reflect the attributes of the speakers’ social systems, in this case their organizational contexts. Among the attributes of social systems uncovered by this (quite time-consuming) method typically are boundaries, internal differentiation, rules, dynamics, and complexities; we used it to collect data on the organizational contexts of researchers and policy makers to be able to better judge the fit between these contexts and the development of the research agenda. Content analysis was used to identify individual outcomes.

Finally, we conducted a qualitative content analysis of documents produced during the project. Our corpus consisted primarily of the project-inception report, workshop agendas, lists of participants, and moderation notes.

**Theoretical and Methodological Framework**

Our methodological framework took into account three different categories of variables and their interaction: 1) process variables relating to the design decisions made for the JRA development process and its resulting features; 2) variables representing the organizational contexts of individual participants, i.e., characteristics of the existing patterns of knowledge and related practices in their work organizations; 3) the outcomes of the JRA process. We hypothesized relationships among these three categories of variables as depicted in Figure 2. The fit between the characteristics of the process and the characteristics of the participants’ organizational contexts is key in how the JRA is received and the outcomes it will produce over time. For each of these categories, we formulated individual variables and corresponding concepts. We collected data for each concept across several sources (see section entitled Research Before, During, and After JRA Development).

The literature stresses the relevance of research users’ organizational context (Landry et al. 2001, Nutley et al. 2007). Evidence from healthcare, in particular, highlights the importance of the intensity of personal or institutional interaction, collaboration, or contact with researchers (e.g., Lomas, 2000; Hanney et al. 2003; Landry et al. 2003). We hypothesized that the organizational contexts of participants would, to a significant extent, determine the JRA outcomes. We understood participants and their con-

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**Figure 2 Conceptual model.**
texts to be locked into a reflexive relationship (cf. Bourdieu & Wacquant, 2006). On one hand, contexts constitute social settings in which policy makers work, interact, and learn—thereby shaping their skills, dispositions, and values—and provide both resources for and constraints on policy actions and practices. On the other hand, contexts are continually reproduced through everyday practices conducted by policy makers (and to a smaller extent other actors). We identified the following independent variables as representing relevant characteristics of organizational contexts that we observed: 1) regularity and character of exchange with researchers; 2) criteria of political legitimacy and scientific credibility; 3) flows and distribution of knowledge; and 4) perspectives on stakeholder participation. Data sources for context variables were qualitative interviews conducted as part of the preparatory survey as well as after the JRA process.

Process variables to a large extent reflected our decisions when designing the JRA development process. We identified the following (independent) variables: 1) diversity and plurality of views and values; 2) plurality of knowledge forms; 3) political legitimacy and scientific credibility; and 4) ease of bringing in individual perspectives and influencing the result. Data sources for process variables included observation notes and reflections, evaluation reports using several evaluation methods (see above) and other documents, as well as qualitative interviews after the JRA process. Based on context and process variables, we were able to assess the measure of fit.

Outcomes represent the reception of the JRA. We expected several possible outcomes in the form of, for example, changes in policy makers’ practices, adjustments in the priorities of researchers, initiation of new research partnerships, increased uptake of evidence in policy making, and/or follow-up activities. It was quite clear that the listed context and process variables would not be the only factors affecting the reception of the JRA, but we nevertheless focused our research on these items. A broader discussion can be found in the section Findings and Discussion. Data sources for the outcomes were qualitative interviews after the JRA process as well as evaluation reports.

Preparation and Design of JRA Development

We designed a “joint development of policy-led research agenda on innovative policy/instrumental approaches” that sought to achieve three objectives. First, we aimed to help identify the most pressing and urgent issues in SFC. Second, we tried to assist EU researchers in increasing their awareness of policy challenges, needs, and agendas. Finally, we strived to support evidence-based policy learning, community building, and knowledge exchange and discussion. The process consisted of several stages conducted before, during, and after the second and third workshops on SFC held in January and May 2011.

Before the start of the series of workshops, we identified the most relevant potential participants. Because the whole project was designed to improve the science-policy interface, two primary stakeholder groups were policy makers and researchers. Representatives of CSOs formed a stakeholder group of a second degree of relevance, and businesses were almost entirely excluded (although their contribution to the JRA could have been beneficial). We invested a great deal of effort to identify and target policy makers directly responsible for SFC policies in all EU countries.

As a first stage of the actual JRA development process, we undertook ten stocktaking telephone interviews with researchers from eight EU member states and the United States to gather a number of research topics and needs to be used as input in Stage 2. Researchers were chosen for their track record in SFC. To ensure coherence and enable initial clustering into a smaller number of themes, we complemented the interviews with desktop research of academic literature and recent policy documents (primarily at the EU level).

For Stage 2, we held an interactive session at the second project workshop on SFC in January 2011. Participants included eighteen policy makers, fourteen researchers, and six other experts from a total of fourteen EU member states, complemented by nineteen consortium partners (representing primarily researchers). We loosely based the format on the world café method.1 The participants interacted in and exchanged views across four “knowledge islands,” each representing a cluster of related topics,2 where through discussion they refined initial research priorities or identified new ones, implicitly also prioritizing the topics. Although we planned a little over 90 minutes for the session, this proved somewhat insufficient.

In Stage 3, we compiled the first draft JRA document based on the results of Stage 2 complemented with the input of experts from the project consortium. We next conducted a round of written feedback using the project’s online platform and including participants of the first interactive session, interviewees from the first stage, and all registered platform users. This process lasted several weeks. We received only

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2 The clusters focused on 1) research needs related to consumers; 2) research needs related to production and distribution; 3) research needs related to policy instruments and processes; and 4) exchange between science and policy.
a few responses, so there were no significant modifications when we prepared the second draft JRA as input for Stage 4.3

Similarly to Stage 2, the fourth stage had the form of another 90-minute interactive session. It was held at the third food-related workshop (May 2011) and included thirteen policy makers, seventeen researchers, and seven other experts from fourteen EU member states and two other European countries, complemented by sixteen consortium partners (representing primarily researchers). Apart from the consortium partners, eighteen participants were the same as in Stage 2 and nineteen participants were new to the process. Each participant could choose between one of the four working groups, each corresponding to one of the four thematic clusters from the second draft.4 Participants rephrased, amended, and generally improved the already identified research needs and voted on their prioritization. This time, the duration of the session allowed for intensive exchange of experience and opinions.

Stage 5 was similar to Stage 3. We amended the document with input from the second interactive exercise (producing the third draft) and conducted a second feedback round. Afterward, we included the comments that we received and finalized the JRA document which, in addition to being uploaded to the platform with a notice sent to all registered users, will at the end of the project be communicated to the EC (for an abridged version see the Appendix).

**Formations of Knowledge in Policy Making**

During the literature review, we identified distinctive organizational patterns that included the creation, circulation, and use of knowledge, and primary forms and functions of knowledge within the policy system. We call these patterns “formations of knowledge in public policy” and the central principles of their organization correspond to models of hierarchy, market, and network. The section **Key Historical Developments of Public Administration** provides a brief historical context for our later depiction of knowledge formations in sustainable consumption policy making. With broad strokes we paint a genealogical overview of generalities (rather than national differences) of organization of public administration and administrative reforms in Europe over the few last decades.5 In the section **Knowledge Formations in European SFC Policy Making: Organizational Contexts**, we describe the specificities we observed for SFC policy.

**Key Historical Developments of Public Administration**

While bureaucracy as an ideal became famous due to the work of Max Weber, its principles and practices (public ownership, planning, centralized administration, hierarchy, task specialization, and so forth) were introduced in western Europe much earlier—typically in the early nineteenth century, although in Prussia these developments occurred in the seventeenth century. The bureaucratic model of public administration rested on a machine-like conception of efficiency and rationalism and searched for ways to overcome deficiencies of human decision making (such as limited cognitive capacity or pressure to produce outcomes quickly) as well as prior feudal relationships within the government.6 In terms of public accountability, bureaucracies tend toward being impenetrable silos—“in so far as it can, [bureaucracy] hides its knowledge and action from criticism” (Weber, 1946; see also the importance of the concept of the “official secret,” Weber, 1964). As a result, clear connection or direct contact between policy and science (or other societal actors) was not common for bureaucracy, although science (as formalized bodies of knowledge) has been linked to specific administrative mechanisms from the late nineteenth century (Rutherford, 1999), enabling policy to classify and manage the “body of the population” and its territory (de Certeau, 1984).

After World War II, it became clear that the ideal of completely rational decision making was unattainable. Scholars started to develop concepts and decision-making principles to better cope with the encountered deficiencies (e.g., incremental “muddling through,” Lindblom, 1959; bounded rationality, Simon, 1961; principles of tension, mutual adjustment, and routinization, Sharkansky, 1970). During the 1970s, a number of scholars became increasingly critical of bureaucracy’s failings such as duplications and overlaps (Weiss, 1979a), rigidity of procedural rules (Barton, 1979), and inability to solve increas-

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3 The online platform of the project had over 300 registered members at that time (although only about 10% of them were policy makers), and rich and continually updated content (“knowledge units” and information on published research and upcoming policy events). Nevertheless, there was little activity by the participants themselves, particularly by the policy makers (for example in the forums).

4 The clusters were related to 1) sustainable food-supply chains; 2) sustainable diets; 3) drivers of food consumption; and 4) policy issues and knowledge brokerage.

5 More details pertaining specifically to policies of the environment, food, and sustainable consumption are provided in this issue’s editorial by Reisch et al. (2013).

6 Bureaucracy was supposed to attain the ideal of a dehumanized, objective, and rational set of practices, devoid of elements that escape calculation. For Weber (1946), bureaucracy has “a ‘rational’ character: rules, means, ends, and matter-of-factness dominate its bearing.”
ingly complex problems (related to, for example, development, energy provision, new technologies, or security).

During the 1980s (and in central and eastern Europe during the 1990s), a range of reforms with similar neoliberal characteristics were taking place in public administration. Their leading image was, as Foucault (2004) noted, “how the overall exercise of political power can be modelled on the principles of market economy,” i.e., “taking the formal principles of a market economy and referring and relating them to, or projecting them on to a general art of government.” The reforms transformed not only how society was being governed, but also how the governing was organized internally. To increase efficiency through economic competition among government units, the reforms introduced a results orientation and explicit standards and measures of performance, while monolithic bureaucratic structures were disaggregated and decentralized into more autonomous “corporatized units around products,” characterized by low-trust decentralized into more autonomous “corporatized units around products,” characterized by low-trust

It was also becoming more common to address some problems of bureaucracy through securing information (i.e., “evidence”) that should be “more impartial, more independent of particular perspectives, and…generalizable” or “the product of disinterested social science research” (Cohen & Lindblom, 1979). The underlying image for this move was that of two separate communities, knowledge producers and knowledge users (Caplan, 1979; cf. Jasanoff 1990), and the knowledge gap between them, calling for explicit “knowledge management.” The translator as a third, boundary actor (“policy middle men” in Heclo, 1974; “policy entrepreneurs” in Kingdon, 1995; “knowledge brokers” in Lomas, 1997) was recognized. This was a role often carried out by think tanks and other new types of advisers, forming a “new invention in government” (Dror, 1979; cf. Page & Wright, 2007). The provision of knowledge (policy advice) by external experts was expected to improve policies; after the title of Wildavsky’s book (1979) this became known as the “speaking truth to power” model. Nevertheless, policy analysts soon recognized that the two-community model brought a range of new problems. Inputs from external experts “overload collective decision processes, undermine consensus and coalition maintenance, and disrupt incremental decision-making patterns,” contradicting “the experience-based legitimation of most bureaucracies” (Dror, 1979) and introduce a somewhat naïve and dangerous expectation of conclusiveness and impartiality (Cohen & Lindblom, 1979). Also, despite the aspirations of the two-community model, empirically there seems to be no clear separation in time or content between science (knowledge production) and policy (design of decisions) (Weingart, 2001).

Think tanks and other sources of external policy advice such as ministerial advisers, private consultants, and interest groups have been involved in policy making since the 1940s, but their role has been growing particularly since the 1970s. At the same time, “there is evidence that the civil service as a source of policy advice is declining” (Page & Wright, 2007). Also, due to the fiscal crisis of the 1980s and 1990s and other societal developments, public authorities “do not have the necessary capabilities to realize hierarchical interventions” (van Buuren & Eshuis, 2010). The ideal of more collaboration with stakeholders and of participation, where citizens become partners (rather than customers), is formulated as “governance.” The state acts as a “partner, animator and facilitator for a variety of independent agents and powers, and should exercise only limited powers of its own, steering and regulating rather than rowing and providing” (Rose, 2000). Governing is done “at a distance” (Rhodes, 1997) through regeneration and reactivation of the ethical values “that are now believed to regulate individual conduct and that help maintain order and obedience to law by binding individuals into shared moral norms and values” (Rose, 2000). Public administrators become less managers and more partners, who must be “responsive,” in the sense that they are “reactive, sympathetic, sensitive, and capable of feeling the public’s needs and opinions” (Vigoda, 2002), and stakeholder representatives are drawn into the sphere of state-policy processes as reflected, for example, by the concept of the “policy worker” (Colebatch, 2006).

Toward Praxis/Discourse Formations of Knowledge in Public Policy

Our understanding of formations of knowledge in public policy aligns with Reckwitz’s (2008) notion of “praxis/discourse formations” or Foucault’s (1995) power-knowledge formations. These formations consist of strategically interwoven discourses, institutions, actors, artefacts, and rules for the internal workings of public administration, or, from the per-

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7 Wildavsky (1979) does not rule out public participation in the “hybrid of social interaction and intellectual cogitation” that he calls policy advice, but expert knowledge plays a privileged role.

8 As a result of these forces, some commentators speak of a move of the organization of societies away from hierarchies toward “horizontal networks of connected, free and equal actors” (Turnhout, 2010; cf. O’Toole, 1997).
Table 1 Key differences among formations of knowledge in public policy.

<table>
<thead>
<tr>
<th>Knowledge Formations</th>
<th>Bureaucratic Formation</th>
<th>Managerial Formation</th>
<th>Communicative Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metaphor</td>
<td>Hierarchy</td>
<td>Market</td>
<td>Network</td>
</tr>
<tr>
<td>Important forms of knowledge</td>
<td>Tacit knowledge of trained professionals, rules, procedures, and organizational structures</td>
<td>Explicit knowledge (reports) that is standardized, transferable, storable, applicable</td>
<td>Local knowledge that is multiperspectival, plural, citizen-originating</td>
</tr>
<tr>
<td>Relation of knowledge to context</td>
<td>Context-bound</td>
<td>Context-independent</td>
<td>Situational or “sticky” knowledge</td>
</tr>
<tr>
<td>Legitimacy through paradigm</td>
<td>Experience</td>
<td>Usability</td>
<td>Authenticity</td>
</tr>
<tr>
<td>Knowledge carrier</td>
<td>Well-trained, experienced, professional public servant</td>
<td>The “expert” (scientist, consultant, advisor, knowledge broker)</td>
<td>Citizen, partner, member of the public, stakeholder</td>
</tr>
<tr>
<td>Structure and concentration</td>
<td>Silos: centralized formal vertical hierarchies insulated from outside interference with knowledge segmented across units and staff</td>
<td>Hub and spokes: matrix and project structures cutting across organizational units, value- and paradigm-sharing communities</td>
<td>Networks: decentralized discursive communities with knowledge distributed throughout the network</td>
</tr>
<tr>
<td>Circulation</td>
<td>Relatively slow monodirectional vertical flows, predefined channels with limited points of input and output, hidden from criticism</td>
<td>Fast monodirectional flows, knowledge explicitly managed (capture, transfer, storage, retrieval, dissemination, application), mobile (e.g., international)</td>
<td>Interactive, fluid, ephemeral, multidirectional flows</td>
</tr>
<tr>
<td>Accumulation</td>
<td>Internal: slow accumulation through personal experience and filing, aggregation and translation into rules and procedures</td>
<td>Conversion of tacit knowledge into explicit, storing, capacity building</td>
<td>Co-production within social relationships, limited accumulation</td>
</tr>
<tr>
<td>Science</td>
<td>“Doctors” with ideals of prevention and cure, internally driven taxonomy of scientific disciplines, traditional quality control (peer review)</td>
<td>Social system separate from policy, problem- and application-oriented, inter- and transdisciplinary, different systems of quality control</td>
<td>Post-normal, participative, citizen-oriented, transdisciplinary</td>
</tr>
</tbody>
</table>

Spective of policy, as the “doing” of material and discursive practices. The purpose of these formations is to regulate the types and forms of knowledge that are deployed as dominant in policy processes, the criteria for legitimacy and credibility, the patterns of knowledge circulation and accumulation, and the actors allowed to participate.

During our literature review, we identified three ideal-type formations of knowledge in public policy. Using central metaphors from the governance literature (e.g., Kooiman, 1993) we call them the bureaucratic, the managerial, and the communicative formations. They serve as heuristic tools for describing what we understand as crucial organizational context variables. Empirically speaking, nevertheless, these formations tend to overlap (our findings are presented in the section Knowledge Formations in European...)

In the following three sections, we highlight the specificities of each ideal-type formation from the perspective of knowledge characteristics such as purposes and patterns of circulation and use (see also Table 1).

The Bureaucratic Formation

The central metaphor of the bureaucratic formation is hierarchy. In a bureaucracy, knowledge is considered impartial and value free and is kept separated from politics (Scharpf, 1973). Two particular forms of knowledge dominate: On one hand, there is what Polanyi (1966) termed tacit knowledge, which referred to knowledge that is typically problem- and sector-specific, acquired by trained professionals through long-term experience in the service (the “professional bureaucracy,” see Lam, 2000). On the other hand, there is knowledge that is “encoded” and “embrained” in the (mostly explicit) rules, procedures, and institutional structures of a bureaucratic organization (the “machine bureaucracy,” see Bonora & Revang, 1993; Lam, 2000). Knowledge of these rules also represents “a special technical learning which the officials possess” (Weber, 1946). In both

SFC Policy Making: Organizational Contexts). In the...
of its aspects, knowledge is fragmented, distributed across functionally differentiated organizational units and staff in a “meticulous functional dissection and separation of tasks” (Bauman, 1989). The “practical and mental distance from the final product means…that most functionaries of the bureaucratic hierarchy may give commands without full knowledge of their effect” (Bauman, 1989). Of course, documents (“the files” of Weber, 1946 or “inscribed knowledge”) as artifacts containing explicit knowledge constitute a vital form of knowledge, but they also again bring into the foreground the required tacit knowledge of the professional in navigating, understanding, and interpreting.

In the bureaucratic formation, knowledge circulates primarily within the “policy silo” with few points of input and output, hidden from external actors, and vertically travelling upward where it becomes formalized and institutionalized. The focus of knowledge is the internal organization of the state rather than the social system the public policies are supposed to change (Pons & van Zanten, 2007). As we mentioned above, notwithstanding the slowly increasing role of think tanks and specialized research institutes since the 1940s and 1950s (particularly in decisions regarding security), direct contact between science and policy is not common and policy typically does not strongly influence research priorities.

The shortcomings of this formation relate to inconsistent knowledge production, duplication, and over-systematization (Kosa et al. 2008). Learning and transfer of experience across functional boundaries are difficult (Lam, 2000) and problems occur with respect to effectiveness and implementation, professional monopoly (i.e., technocracy), and innovation (Mintzberg, 1979).

**The Managerial Formation**

The central metaphor of the managerial formation is the market; this can be observed, for example, in the structural arrangements establishing competition among knowledge providers (Dunleavy & Hood, 1994; cf. the “neo-liberal pattern” in Halffman & Hoppe, 2005). In the managerial formation, converting tacit knowledge into explicit knowledge and making it independent of the context of its creation is the objective of a range of practices of evaluation and “knowledge management.” Knowledge is thus loosened from its constraints: it is made mobile, equipped with a functionality of its own, commodified as units that can be “stored,” “transferred,” “applied,” and subordinated to market principles. Under managerial principles, knowledge is understood as value free and objective, with preference for “numbers” (economic calculations, indicators). The key actor in this formation is the “expert,” who in practical terms is a scientist, advisor, or consultant. (This is not to imply that tacit knowledge shared by administrators is irrelevant in the managerial formation.)

The separation of knowledge production and knowledge use has led to interface problems: science produces knowledge that is not necessarily compatible with policy. Under the managerial formation, therefore, the sciences are restructured away from disciplinary boundaries toward a series of transdisciplinary narratives for the identification and explanation of new forms of “regulatory practice” (Rose, 2000). Also, to bridge the structural barriers between the social system of science and the social system of policy, a new economic function of “knowledge brokers” (also known as knowledge translators or knowledge circulators) is created.

Circulation of knowledge in the managerial formation follows project-like structures cutting across departmental boundaries. Knowledge flows, although still mostly one-way and linear, have more points of input and output to the outside than is the case for the bureaucratic formation. Actors, both within and outside of policy-making organizations, create communities that share values and paradigmatic orientations (epistemic communities, communities of practice, advocacy coalitions), thus the metaphor of “hub and spokes.”

Several potential shortcomings of this formation have been documented in the literature. The necessity of policy makers to possess skills related to knowledge transfer and analysis and interpretation of scientific findings (Ward et al. 2009) but also, more importantly, the increasing dependency of politicians on experts, resulting in displacement of politics, have been dubbed the “scientification” of policy (Weingart 1999). Values and interests are hidden behind what the policy process treats as objective and instrumental knowledge (where only what can be measured and assessed is counted), and enacting policy alternatives different to the ones proposed by “experts” is difficult (Dror, 1979; Nassehi et al. 2007). Other risks include access to the centers of power provided to science and creation of knowledge elites around expert knowledge (termed “ politicization” of science; Dror, 1979). When in this formation participatory practices are pursued, then scientific discourse has a privileged position in framing the problems or solutions and citizens often perceive the experts to hold views that stand in opposition to theirs own (Fischer, 2000; Cook & Pieri, 2004).

**The Communicative Formation**

The central metaphor of the communicative formation is the network. Knowledge is structured into decentralized and distributed networks, discursive
communities (Meppem & Bourke, 1999), and spaces where participants aspire to “engage in Habermas-inspired deliberations and achieve communicative rationality” (Turnhout, 2010; see also the deliberative patterns of organizing public expertise in Halfman & Hoppe, 2005). Thus, specific types of knowledge are deployed and recognized, such as citizen knowledge, indigenous knowledge, local knowledge, and community knowledge. The dominant form of knowledge in the communicative formation therefore embraces multiple perspectives that represent different histories, values, and norms. Such knowledge is, on one hand, hardly separable from the context of its co-creation and difficult to transfer to and apply in different contexts (these properties have been included in the term “stickiness of knowledge”), but, on the other hand, it is also situational, fluid, and ephemeral. It circulates in interactive and multi-directional flows. Its primary carrier is the citizen, partner, member of the public, or “stakeholder,” linked to policy through participatory and consultative practices. Media are also important, with significant effects on the discursive influence of individual actors and coalitions. For administrators, skills of “persuasion, incentivisation and other forms of mobilization” are relevant, and “senior officials become ‘network managers’ rather than the wielders of public authority” (Page & Wright, 2007).

In the communicative formation, science is understood as a “cultural, social activity permeated with values and preferences” and as such “not essentially different from other cultural practices—including policy—[having] no privileged, unmediated access to the truth” (Turnhout, 2010). To maintain public legitimacy and reflect the problem orientation of regulatory practice, science in the communicative formation adopts plurality, pursues democratization by involving the public in various steps of the production and use of scientific knowledge (i.e., achieving co-production of knowledge), and attends to the interface between science and society. To describe these developments, scholars increasingly use the terms “civic science” (Bäckstrand, 2003) and “democratic science.”

Complexity and steerability are among the key challenges in this formation, as is a range of participation-related issues such as integrating or reconciling competing knowledges. Of particular note are the participation barriers that potentially exclude large groups, so that “[a]ctors who do not fit the requirements or expectations, who lack the skills and competences to use information or participate in knowledge production, or who wish to refrain from involvement will become effectively marginalised” (Turnhout, 2010).

Findings and Discussion

This section is structured in the following manner: In the first subsection, we present our findings on organizational contexts of participating policy makers that focus on representation of the three ideal-type knowledge formations across EU SFC policy making. Then, in the second subsection, we present the attributes of the JRA development process that we sought to develop in our design choices. The third subsection discusses how the JRA development process related to the organizational contexts of its participants. It also describes two types of challenges that we encountered: 1) those related to the structural differences between science and policy, and 2) those related to our ability to achieve a tighter fit between the process and contexts. The fourth and final subsection briefly opens up discussion of other factors in the JRA reception.

Knowledge Formations in European SFC Policy Making: Organizational Contexts

An initial assessment of the European policy area of SFC suggests that the bureaucratic formation is the least represented, in particular because “widespread reliance by the state on extensive systems of scientific advisory structures [has] become an integral feature of environmental (and health) policy making in industrialized societies” (Rutherford, 1999). Several features indicate that the communicative formation is the most desirable formation in European SFC policy. Communicative formation entails “responsibilization” and commitment of nonstate actors, especially consumers (e.g., through building consumer awareness, teaching “food literacy,” development of competence to use product labels), a high level of cooperation and networking with all food-system actors where the government is expected to “stimulate and coordinate” (Reisch et al. 2011); and reliance on sustainability science, characterized by trans- and interdisciplinarity, public participation, and orientation on use and learning (Clark, 2007). Science is a significant driver of policy development in SFC, although the influence is often indirect. An example of such an indirect pathway is the “self-sufficiency” concept that first acquired recognition in the public before becoming the subject of policy debate (Reisch et al. 2011).
The preparatory survey (Gjoksi, 2010) and qualitative interviews suggest that two dominant context patterns are observable throughout the EU, but neither of them displays strong elements of the communicative formation. We describe the first pattern, seemingly prevalent in central, eastern, and southern European countries, as a continuing transition from a bureaucratic to a managerial formation. Knowledge seems primarily tacit and tied to professional public servants and organizational structures and procedures. Nevertheless, a number of managerial ideas and practices are already present. Interaction with the scientific community is rather occasional, unsystematic, ad hoc, and asymmetrical across organizational units. In other words, only some units have the appropriate mandate. When scientific input is sought, it is during policy or strategy development in particular.

The second pattern is characterized as the fully developed managerial formation with occasional communicative practices (cf. Hess & Adams, 2007) and is more typical for northern and western European countries. Systematic and close contractual interactions with special research entities within or outside of ministries (research institutes and agencies) are common. The intensity of coordination of research activities and priorities, frequency of interaction, and number of actors within ministries reached by distributed knowledge are also high. In the case where national ministries have their own research resources, contact with external academics is pursued less frequently. In addition, even though an increasing number of practices adopt features of the communicative formation (such as public consultation or platforms for representation of plural opinions), these tend to conflict with the functions and purposes of the managerial ideal, which maintain a hegemonic position.

### Design of the JRA Development: Attributes of the Process

Although the project’s objectives, in response to the expectations of the EC, were oriented toward the managerial formation, we decided to pursue a hybrid form that includes a number of features that also support the communicative formation. Various scholars have suggested that knowledge brokerage can also facilitate the communicative formation through the creation of platforms and spaces where multiple categories of knowledge and stakeholders can come together (see, e.g., the social-change framework by Oldham & McLean, 1997; Cash et al. 2003; Fisher & Vogel, 2008; Sheate & Partidário, 2010). Along with these scholars we suggest that criteria of a successful knowledge-brokerage process can thus reflect also the features relevant to the communicative formation: the range of stakeholders involved, use of different types of knowledge, and exchange of knowledge in a non-normative environment.

We pursued a range of design choices combining aspects of both the managerial and the communicative formations (see Table 2), striving primarily to achieve orientation on policy needs and an open and balanced interaction between policy makers and researchers. We chose to increase the representation of communicative features on three grounds: its precepts are close to the normative principles of sustainability; its capacity to involve policy makers in a process with communicative attributes could provide resources and experience that empower them when they initiate new practices in their organizations; it can provide a counterfactual source of data even when not successful, since the communicative formation is not dominant.

A number of design choices and process features indicate the ability to bridge the structural differences...
between the social systems of science and policy and achieve a sufficient fit for both the managerial and the communicative logics. Our process was conducted as part of an EC-funded knowledge brokerage project (run primarily by an international academic consortium) and policy makers perceived it to be part of a larger stream of European-level policy initiatives on sustainable consumption.

**Fit Between Context and Process and Achieving Outcomes**

The open and balanced interaction between policy makers and researchers seems to have been a unique experience for many participants, particularly policy makers. The evaluations immediately following the two workshops indicated a high level of satisfaction of the participants with the design of the sessions. A total of 85% of policy makers participating in the first workshop and 100% of those participating in the second event were “very satisfied” or “somewhat satisfied.” This compares with 75% and 100% of the researchers, respectively. The needs of other stakeholders were apparently least successfully addressed (50% in both workshops).

Nevertheless, the achieved outcomes of the JRA were relatively modest across both of the observed context patterns (i.e., transition from a bureaucratic to a managerial formation, and highly developed managerial formation with elements of the communicative formation). The process was useful for sharing national policy practices and collecting ideas, but its influence on patterns of interaction between policy makers and researchers was very limited. Even though we reached the community-building goals (for example, in the second workshop 81% of participants developed new contacts to representatives of different communities), we did not observe tangible outcomes such as new policy-related initiatives and partnerships or changes in knowledge practices one year later. Policy makers did report using the JRA document as one of many sources of background information, in particular during the “windows of opportunity” when ideas for new policies are sought.

We theorize that the reasons for the modest outcomes reside in two main areas: the difficulty of overcoming the structural differences between the social systems of science and policy and insufficient fit between how the process was designed and the organizational contexts of participants (primarily policy makers).

The structural differences between science and policy social systems are used as the main argument for knowledge brokerage. These differences have been examined from a number of perspectives in the literature, including incentive structures, working cultures, time horizons and languages, and discourses (see e.g., Caplan 1979; Choi et al. 2005; Clark & Kelly 2005; Mitton et al. 2007; EC, 2008), as well as perspectives on salience, credibility, and legitimacy of knowledge (Cash et al. 2003). For our research, the differences in working cultures is the starting point, as our interpretive analysis provides some additional insights on the organizational contexts of policy makers dealing with SFC. Our results suggest that the robust structural conditions—in the form of procedures and practices, discourses, and hierarchies—that shape and constrain the work of policy makers stem from the needs of national governments to address challenges and forces originating within the policy machinery as well as in the societal and natural contexts. Individuals are situated in positions where relaxation of these constraints is difficult to achieve. The social settings in which policy makers are situated are characterized by intolerance to failure and a resultant reluctance to experiment. As their work requires higher responsibility, is woven into the robust flows of political and policy processes, and is based on a political mandate from the public, they see it as more consequential than that of academics, who seem to face less restrictive conditions in their daily work.

A constantly reappearing motive, especially pronounced in managerial contexts, is “issue prioritization.” This is a practice of estimating the relevance of encountered problems, thus giving them “strategic” meaning—precondition for processing and formulation of an appropriate response by the policy system. The national political agenda has much greater weight than international processes not directly related to domestic priorities. Our project was linked to international processes and it dealt with the large geographic scope of the entire EU in a rather abstract way, which further increased the distance between the JRA and the hierarchies of national priorities relevant for participating national policy makers. As a result of these structural differences, the policy makers came to regard our process as an “academic exercise” and, thus, lacking gravitas. The main outcome was a successful “sharing of national experience” through interaction with other policy makers and the researchers, rather than more tangible and use-oriented outcomes.

The second reason for the modest outcome is that achieving a fit between the process and the context also proved difficult. On one hand, for policy makers from contexts characterized by transition from a bureaucratic to a managerial formation, interaction with researchers tended to be novel and stimulating. In their organizations, contact with research tends to be the responsibility of specific constituent units and the research findings they encounter often have not been formulated with policy use in mind.
They tend to see sharing policy experience as beneficial (since the professional plays a large role as a carrier of knowledge). On the other hand, to achieve significant learning outcomes our process did not sufficiently match the complexity required by the bureaucratic fragmentation of knowledge. Such a match can be achieved outside of the organization by, for example, ensuring participation of “the right” people in the process, but adjustment can take place within the organization as well through development of procedures for the involvement of several departments, coordination, and assignment.

More frequent interaction with researchers has a certain influence on how policy makers from contexts that are primarily managerial, but with communicative elements, relate to scientists. The asymmetry created through separation of knowledge production and knowledge use results in policy makers feeling incompetent to judge the quality of scientists’ work while also expressing the need to defend the quality of their own work. Nevertheless, in this respect, there is a difference in how policy makers treat “their” researchers (typically working in subordinated units, institutions with framework contracts, or other public agencies) and “external academics.” The burden for achieving alignment of research priorities resides with researchers, who are expected to identify the needs of policy makers from action plans and other outputs of the policy process. In addition, we found that scientists are treated differently according to whether a given interactive practice is an expression of predominantly the managerial or the communicative logics. In the managerial formation, knowledge exchange practices are designed to be goal and function oriented, to be slim (efficient), to have strong relationship to political agendas, and to fulfill scientific criteria on credibility of knowledge. Parameters important for participatory practices in the communicative formation include clear responsibility for process decisions, breadth of participation, and transparency of the association between stakeholder representatives and the groups on whose behalf they are meant to speak. In this logic, scientists are treated as regular stakeholders without a privileged position.

Attempting to combine both managerial and communicative parameters in the same exercise carries a number of internal contradictions—not only does the position of scientists become inherently contradictory, but from the perspective of the managerial formation, broadly participatory processes are taken to be inefficient and even risky. Our process was deficient from the perspective of both formations—on one hand, it was not sufficiently goal-oriented and “scientific” and, on the other hand, scoring, prioritizing, and processing outcomes were insufficiently transparent.

Broadening the Picture

Our understanding of organizational contexts and the science-policy interface is somewhat related to “decision regimes” (Lindquist, 1988), the differentiation between “science push” and “demand pull” (Landry et al. 2001), and the classifications of the interaction of science and policy by Weingart (1999) and Halffman & Hoppe (2005). Our research focused on variables representing the organizational contexts of the participants and the JRA development process (see the section Theoretical and Methodological Framework) and tried to explain the observed outcomes on the basis of the fit between the context and the process. It is nevertheless clear that these are not the only factors affecting outcomes. At this stage, we can only speculate on the relative weight of other factors in the reception of the JRA, but nonetheless we can revisit our conceptual model (Figure 2) and open up space for other factors. Figure 3 shows that factors not included in our understanding of organizational contexts and the process of research-agenda development could be included in the model.

Were we to describe our endeavor with respect to the mentioned literature on the reception of scientific knowledge, the JRA process would be closest to the “interactive model” (Weiss, 1979b), since a more complex interaction and mutual influence between science and policy typically includes pooling of skills and understandings without scientists dominating the process. Therefore, the categories of “science push” (a linear model in which science generates evidence leading to policy change) and “demand pull” (another linear model in which knowledge demand by policy leads to new scientific knowledge) do not generally apply (Landry et al. 2001). Rhythms and stages of national policy processes, as well as policy priorities

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10 Literature on the reception of scientific knowledge and the role of evidence in policy making takes on a number of other perspectives, including “streams of activity” (Kingdon, 1995), the type of politics associated with a particular policy-making stage or policy issue (Wilson, 1980), different uses of knowledge (Weiss, 1979b), leadership, and discursive legitimacy of knowledge claims based on values and metaphors embedded in arguments or storylines.
or discourse coalitions, would be among the “other context variables” in Figure 3.

Conclusion

In the context of a knowledge-brokerage project on SFC, we facilitated the development of a joint-research agenda with the aim of better aligning research priorities with policy needs and of supporting evidence-based policy making. We expected that designing the process to more effectively accord with the organizational contexts of participating policy makers would lead to stronger outcomes in the uses of the JRA document and with respect to change in practices and engagement on new initiatives. We identified two sets of challenges. The first set, most prominently evident in the managerial formation, was related to the structural differences between the social systems of science and policy. The scientific character of the project consortium and the international context were particularly difficult to address and increased the distance of the process from national priorities. Another challenge was related to the limited independence of individual policy makers within their contexts and their resultant reluctance to experiment. A single exercise does not appear to have the potential to induce significant change under these conditions. To enhance the success of knowledge-brokerage processes in general and alignment of research priorities in particular we recommend linking up with the rhythms of national policy processes and reflecting on the framings of national issues and their prioritization. Nevertheless, SFC as a policy area is not yet fully institutionalized in most EU member states, and also lacks an integrated strategic approach. Knowledge brokerage thus has an additional challenge of establishing a link to framings and issues that are yet to be built on an established SFC policy base, and of promoting an integrated approach and facilitating policy coordination.

A second set of challenges relates to the characteristics of the formations of knowledge and their fit with the knowledge-brokerage process. We recommend that, when dealing with a bureaucratic context, the process should strive to match the complexity imposed by the functional fragmentation of knowledge. When dealing with a managerial context, there are three primary challenges: an orientation on direct functionality of the process for policy, a need for the immediate usability of scientifically credible knowledge for regulatory practice, and a recognition of the efficiency of the process. Breadth of participation, process transparency, and stakeholder accountability are the main areas of concern for a knowledge-brokerage process linking to a communicative context.

We have shown above that the communicative formation seems to be desirable for the policy area of sustainable consumption. The outstanding questions are how change among formations happens, how knowledge-brokerage processes can foster such a change, and what other factors need to be considered when designing such processes. This article looks at organizational contexts (knowledge practices, hierarchies, and discourses) as results of longer-term historical developments, but does not explore the role of knowledge brokers in these transitions. We suggest that organizational contexts influence the potential success of knowledge-brokerage practices, but perhaps their relationship can be reversed as well. Through learning and empowerment of policy makers, knowledge brokers might have the capacity to influence the character of knowledge practices in the policy machinery.

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References


Appendix: CORPUS Joint-Research Agenda on Sustainable Food Consumption (abridged)

Strategic Objectives of the Research Agenda

While there is no broadly accepted definition to date, several attempts to clarify and sharpen the concept of sustainable food consumption (SFC) have been made. Depending on the thematic focus—environment and climate, public health and life expectancy, malnutrition and critical access to food—definitions differ. As a result, current strategies focus on single issues independently (e.g., childhood obesity)—but there is a need for an overarching policy review that tackling the full range of unsustainable food production and consumption drivers. Developing such integrative strategies and identifying the most sustainable way to ensure the nutrition of the world’s current and future populations, however, requires further research.

The research agenda aims to develop and suggest a path of present and future research needs to help achieve SFC in Europe. Our objective is therefore to show the most pressing and urgent issues in the SFC domain, and to draw the attention of EU-based research for supporting, consequently, evidence-based policy making.

The scope of the research agenda regards the domain of SFC. Our project is on SFC, and although many topics from the production side have been covered, the focus of the research agenda remains on consumption. The geographical scope of our effort is Europe and, more precisely, the EU27 and beyond.

Themes of Research in Sustainable Food Consumption

Four areas of research have been identified to define the major fields where SFC research should converge to meet the major challenges of SFC.

1. Sustainable food-supply chains
2. Sustainable diets
3. Drivers of food consumption
4. Policy issues and knowledge brokerage

Each of these themes has received special attention and extensive reflections during the different rounds that constituted our work. For each of these themes a number of “hot topics” have been identified for research. Therefore, a deeper level has been defined selecting “knowledge needs” as urgent issues for future research in the coming years.

Sustainable Food-Supply Chains

<table>
<thead>
<tr>
<th>Hot Topics</th>
<th>Knowledge Needs</th>
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</table>
| Local food and sustainability     | • Social and economic benefits of local food initiatives to the local economy  
• Environmental impacts of local food in a life-cycle perspective: trade-offs and synergies  
• Potential of local food initiatives in ensuring food security and influencing consumer attitudes toward sustainable food  
• Comparative analysis of conventional agricultural systems at European/global level and best practices  
• Importance of cultural and identity aspects in setting up local and national food initiatives  
• Convergences and divergences between “local food systems” and “geographical indications”  
• Spillover effects of local food systems (e.g., urban gardening)  
• Ways to develop the local economy on the basis of ecosystem services  
• Collection of definitions on national, regional, and local food transparency                                                                 |
| Transparency of the food-supply chain | • Integrated food sustainability label: is it possible and what are the limitations?  
• Different tools in use to provide information about the environmental impact of food consumption and their effectiveness in promoting healthy, sustainable behaviors  
• Development of methods and tools for sharing information about the environmental impacts of food throughout the supply chain  
• Environmental and social impacts of food imports into the EU  
• How to overcome fear of transparency of the supply chain                                                                 |
| Food waste                        | • Mental, structural, age-related, and cultural reasons for food waste  
• Innovative technology to support development of novel, healthy sustainable foods and processes, including quality of raw materials  
• Quantities and types of food waste generated at all stages of the life cycle  
• Potential of food-waste prevention in terms of avoided pollution, use of natural resources, and recycling  |

Sedlacko et al.: Bridging the Science-Policy Gap
avoided costs
- Evaluation of initiatives on food-waste prevention (e.g., awareness campaigns)
- Innovative technologies and innovative social organizations to reduce waste and increase recycling
- Food waste vs. health and safety regulations
- Using ethology for preventing food waste
- Food waste and byproducts as raw material for other manufacturing chains or as high-value molecules
- Identification of successful practical measures that people of the EU have undertaken and reasons for changing behaviors

Retailers and sustainable food
- Environmental and social consequences of the spatial location of large retail stores
- Effects of organization of the food-supply chain on its environmental impacts—a comparison between member states
- Supply-chain synergies and overall coordination issues
- Transition processes: development of niches
- Retail concentration and its influence on food-consumption patterns across the EU
- The power of retailers to influence the environmental qualities of production and related success stories

Holistic approach to the food chain
- Research on cooperation in the supply chain to improve sustainability: good examples; preconditions; and ways of improvement
- Encompassing reflection of the supply chain (e.g., including transport, packaging, manufacturing, waste management)
- Food-system governance (social networks, role of civil-society actors, bottom-up approaches, relationships among actors along the chain)
- Analysis of the impact of EU multinational food companies in the South (e.g. imports, decentralization of production)
- Analysis of the configuration of actors and power in the food chain (e.g. concentration of companies, uptake of emerging models by major players, role of contestation and protest by civil-society organizations)
- Resilience of the food chain

Sustainable Diets

<table>
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<tr>
<th>Hot Topics</th>
<th>Knowledge Needs</th>
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| Reduction of animal-based products’ consumption | Role and potential of vegetarian and vegan diets to reduce environmental, health, and social problems
- Impacts of meat consumption on climate, land use, biodiversity, water usage, and global hunger
- Ways to shift the incentives/subsidies from meat/animal-based products to vegetarian/plant-based products
- Investigation of drivers of animal-based product consumption (both in developed and developing countries)
- Ways to promote less animal-based diets
- Research into sustainable fish production (farm and wild) and instruments to support sustainable fish |
| Sustainable and healthy diets | Key components of environmentally responsible, climate-friendly, socially fair, and healthy diets in different national/geographical locations (and global) across Europe and for different age groups
- Linkages between nutrition science and sustainability
- Mechanisms and incentives for adopting new behaviors toward a more plant-based diet
- Provision of comprehensive and useful information on sustainable and healthy diets
- Attitudes of different consumer segments concerning diet change
- Understanding the trade-offs and synergies among all sustainability attributes
- Needs of different consumer groups (e.g., age, social status)
- Alternative diets: use of existing nutritional data for knowledge brokerage and ways to embed them in society (e.g., cafeterias, restaurants, schools)
- Organic food |
| Tackling obesity and overweight | Drivers of obesity and overweight and related national differences across the EU
- Economic, health, social, and environmental costs of obesity |
• Best practices/programs to tackle obesity, overweight, and malnutrition in EU member states
• Identification of the individual costs of obesity (e.g., medical, psychological)

Food inequality
• Effects of increasing food prices on the most vulnerable social groups at risk of food poverty
• Role of education: in particular food storage, preparation skills, and understanding of healthy diets by different socioeconomic groups
• Access to and affordability of sustainable food for different socioeconomic groups
• Role of social innovation (e.g. “grow your own” and “community-garden” initiatives) in tackling food poverty and reconnecting people with food and where it comes from
• Identification of successful policy instruments and potential of their transferability
• Ways to enable businesses to supply food for sustainable diets
• Influence of (EU) politics and multinational firms on world hunger

Drivers of Food Consumption

<table>
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<th>Hot Topics</th>
<th>Knowledge Needs</th>
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<tr>
<td>Consumer behavior</td>
<td>• Environmental, economic, and social impacts of different lifestyles and food consumption patterns</td>
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<td>• Main factors influencing the food choice of different socioeconomic groups</td>
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<td></td>
<td>• Role of education in shaping consumer behavior</td>
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<td>• Role of the media</td>
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<td>• Drivers and barriers to the uptake of pro-environmental behavior</td>
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<td>• Frameworks/tools for changing social norms and supporting bottom-up change</td>
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<td>• Basket research: different patterns of socioeconomic groups, needed shifts, and how a sustainable basket looks under budget constraints</td>
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<td>• Influence of food cultures on SFC</td>
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<td>• Research on media coverage of sustainable food</td>
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<td>• Description of sustainable food with best practices examples</td>
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<td>Availability and affordability of sustainable food</td>
<td>• Affordability of sustainable food for different socioeconomic groups</td>
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<td></td>
<td>• Role of business in “making sustainable food the easy choice” and related success stories</td>
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<td></td>
<td>• Availability of sustainable food and related information to consumers in different consumption situations</td>
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<td>• Information to define what sustainable food looks like</td>
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<td></td>
<td>• New business models and alternative food networks</td>
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<td></td>
<td>• Labeling research</td>
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<td>Sustainable public procurement (SPP) of food</td>
<td>• Scope for increasing the effectiveness of SPP to reduce negative impacts of the food chain</td>
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<td>• Different incentive schemes in use across the EU--and their effectiveness--to encourage SPP of food</td>
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<td></td>
<td>• The potential of SPP of food to meet EU greenhouse gas reduction targets</td>
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<td></td>
<td>• The effects of SPP of food on the availability and affordability of sustainable food for private consumers</td>
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<td></td>
<td>• Impact of EU procurement law on SPP</td>
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<tr>
<td>Contextual megatrends</td>
<td>• Impacts of new food technologies and process and product innovation on food consumption</td>
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<td></td>
<td>• Price volatility: future governance and response of governments and the EU</td>
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<td></td>
<td>• Nutrition transition and related health problems (e.g., obesity, malnutrition)</td>
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<td></td>
<td>• Role of an aging population in changing food-consumption patterns, food systems, and global food trends</td>
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<td></td>
<td>• Challenges of urbanization and ethnic mixes to food-consumption patterns</td>
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<td></td>
<td>• Use of information technology to increase transparency and availability of information and for personal choice</td>
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</table>

Policy Issues and Knowledge Brokerage

<table>
<thead>
<tr>
<th>Hot Topics</th>
<th>Knowledge Needs</th>
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<tbody>
<tr>
<td>Policy coordination and governance</td>
<td>• Effective models and mechanisms for the engagement of the business sector and civil society in the governance of sustainable food policies</td>
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<td></td>
<td>• Policy coherence on the topic of sustainable food at the EU, national, and regional levels (relationships and conflicts among different policy sectors/line ministries)</td>
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<td>• Stakeholder management (practices, routines): what are success factors and challenges and</td>
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<tr>
<td>Methods of policy research</td>
<td>Knowledge brokerage</td>
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<tr>
<td>Effective mechanisms and institutional models (e.g., examples, good practices, and inspiring examples) of horizontal and vertical policy integration pertaining to sustainable food: what kind of models are used, particularly taking into account reliability issues and cooperation with stakeholders</td>
<td>Information-transition management of available scientific knowledge for policy makers</td>
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<tr>
<td>Reevaluation of currently applied systems and policies: success factors, best practices, learning in the policy cycle</td>
<td>Differences of rationalities, needs, and objectives between research and policy making and how to deal with them; how best to translate research results for policy makers’ needs (e.g., information management inside the public administration)</td>
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<tr>
<td>Implementation of methods for policy-impact assessment and policy-effectiveness studies pertaining to sustainable food and how to make them attractive for policy makers</td>
<td>Best ways to communicate research results about conflicts and trade-offs among the environmental, social, and economic aspects of SFC</td>
</tr>
<tr>
<td>Success factors of interdisciplinary research toward sustainable food policies, including practices and experiences with actual cooperation among disciplines</td>
<td>Differences in cultural and organizational factors in policy-research interactions and how to overcome them</td>
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<tr>
<td>Standardized methods for the comparative analysis of national sustainable food policies within the EU</td>
<td>Evaluation of the reliability of scientific knowledge (in the exchange between policy makers and researchers): meta-analysis of scientific findings in the form of a systematic overview</td>
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<tr>
<td>Coordination of research programs to maximize impact</td>
<td>Role and influence of intermediary institutions (e.g., think tanks, consultants) in the policy-making process, particularly on the EU level</td>
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<tr>
<td>Knowledge management of policy makers: finding and applying the “right knowledge”; definition of quality criteria for knowledge brokerage</td>
<td>Knowledge management of policy makers: finding and applying the “right knowledge”; definition of quality criteria for knowledge brokerage</td>
</tr>
<tr>
<td>Innovative ways to link research to policy making and related success factors</td>
<td>Easy accessibility and usability of database(s) research findings for policy makers</td>
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<tr>
<td>Knowledge management about future developments—using scenarios and visioning processes</td>
<td>Knowledge management about future developments—using scenarios and visioning processes</td>
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