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Understanding household food metabolism: relating micro-level material flow analysis to consumption practices

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ABSTRACT

Public and private food consumption is responsible for significant environmental impacts, resulting in numerous studies that highlight the problem and reveal its magnitude at global and national scales. Drawing on a high level of data aggregation and focussing on individual choices and attitudes, current accounts stop short of grappling with the underlying complexity of the phenomenon. In this paper, we explore the conceptual value and methodological feasibility of linking Material Flow Analysis (MFA) and Social Practice Theory (SPT) to apprehend household food consumption dynamics. We develop and pilot a "Practice-extended MFA" framework among selected households in Bangalore, India. While MFA modelling serves to describe and quantify all food consumption processes and related flows at the micro-level, SPT is applied to investigate how individual, technological and sociological aspects of consumption practices converge towards household food "metabolic profiles". The results revealed a complex system of interactions between food provisioning, storage and management practices, as well as socio-cultural norms. The paper concludes by emphasizing the contribution of a reflective stance between household metabolisms and consumption practices revealing not only what and how much food is consumed and wasted, but why and in what way.

1. Introduction

The need to reduce energy and material throughput associated with human activities is widely recognized. Food consumption is critical in this respect: 20–30% of all private and public consumption life cycle impacts are related to food (Tukker et al., 2006). Globally, an estimated 30% of edible food was wasted in 2010 (Parfitt et al., 2010; Gustavsson et al., 2011), leading to unnecessary resource depletion and GHG emissions (Kummu et al., 2012). Although all actors in the food system should be involved in tackling this issue (Gustavsson et al., 2011; Papargyropoulou et al., 2014), households play a significant role by staging the majority of transformation processes of food into waste (Timmer et al., 2009). Developing an inter-disciplinary framework to understand household-level food consumption patterns and dynamics would be an important first step towards informing and designing effective policy intervention regarding food waste. Numerous studies have been conducted to quantify and qualify household food consumption and related waste. Some rely on secondary datasets such as EUROSTAT or national statistics adapted to a specific country. In EU-27, Monier et al. (2011) showed that 25% of food purchased by European households is discarded. The situation is similar in Switzerland with households responsible for 45% of losses within the whole food supply chain (Beretta et al., 2013). A second type of quantitative study draws on primary datasets collected at the national level using different tools and methods, such as waste composition analysis (Holding, 2010; Quested et al., 2013a) or food diaries and interviews (Lyndhurst et al., 2007) combined with statistical methods (Sibrián et al., 2006). These findings have been complemented by research focussing on the causes of this phenomenon, linking the amount of food waste to socio-demographic variables (Friedl et al., 2006; Koivupuro et al., 2012; Quested and Luzecka, 2014); evaluating or quantifying food waste in relation to individual beliefs, attitude and behaviours (Lyndhurst, 2011; Graham-Rowe et al., 2014; Parizeau et al., 2015); focussing on specific elements of food products such as packaging (Williams et al., 2012); or the question of food provisioning linked to mobility (Sonesson et al., 2005). While these results are of critical importance to highlight the problem and reveal its magnitude, they

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do not take into account the underlying complexity of the phenomenon (Evans, 2012, 2014; Quested et al., 2013b). On the one hand, the high level of data aggregation on which these studies draw does not provide specific insights on food consumption and wastage patterns; on the other hand, focussing on individual choices and attitudes fails to address the diversity of household food consumption practices formed by overlapping behavioural, technological and institutional interactions among Food Supply Chains (FSCs) stakeholders and consumers within specific cultural contexts (Evans et al., 2013). The aim of this paper is to contribute to addressing this gap by exploring the value of an explicit connection between Material Flow Analysis (MFA) and Social Practice Theory (SPT). While MFA can describe and quantify all food consumption processes and related flows at the household level, SPT can be applied to understanding how individual, technological and sociocultural aspects of food practices relate to household food metabolism. We propose to address a methodological question: How can a metabolism study be complemented through a qualitative study of social practices in everyday life? To illustrate this, we present the results of a micro-study that took place among households in the growing mega-city of Bangalore, India.

1.1. Socially "extended" material flow analysis

Material Flow Analysis (MFA) is a family of tools aimed at describing and quantifying the metabolism of human activities, or the underlying set of biophysical flows and stocks linking society and natural environment (Ayres, 1994; Fischer-Kowalski, 1998). Formally an MFA is a systematic assessment of flows and stock of material – energy or substance – within a system defined in space and time (Brunner and Rechberger, 2004). Although the family of tools called "MFA" includes a diversity of methods and specific standards (Finnveden and Moberg, 2005), the core objective is to track every stage of the material or substance flows (the sources, transfer, accumulation and fate) through and within a system, based on the mass balance principle (Huang et al., 2012). This implies that MFA can be applied to any organisational level (individuals, households, firms) as well as various spatial and temporal scales. Defining the MFA system and its components ultimately depends on the object of study, what Brunner and Rechberger (2004) refer to as an *activity*. An activity comprises all relevant flows, stocks and processes of the material and energy necessary to fulfil a particular human need. For example and in the context of this paper, "to nourish" constitutes the activity on which we focus.

In relation to existing MFAs focussing on this activity (Beretta et al., 2013), one limitation to apprehending a national food system is that households remain a "black box" of complexity: little is known about what happens to food from the moment it enters the households, to when it leaves it as "waste". Households are often represented as a single process, transforming food input into waste output. Getting into that black box to understand how food is consumed and eventually wasted at the household level requires increasing the system's level of resolution: to make an analogy with a screen, the more pixels, the sharper and more detailed the image. Towards defining MFA subprocesses and disaggregating household activities, a finer reading requires engaging with the following questions: what type and how much food is being purchased? Where does it come from? How is it stored and eaten? And more specifically, how does this vary among different households and how, in turn, does this relate to the amount and types of food being consumed and wasted? Answering these questions could help identify all steps necessary for fulfilling the activity of food consumption and define the MFA system. However, MFA remains a descriptive tool: MFA reveals *what* and *how much* material (and energy) is consumed, but stops short of providing insights on *why* and in *what way* food is consumed and wasted, leading to a better understanding of local patterns and environmental impacts (Burger Chakraborty et al., in press).

Researchers in the field of industrial ecology and ecological economics recognize that material and energy flows are embedded in a social context (Binder, 2007a,b; Boons and Howard-Grenville, 2009). When it comes to explaining what cause physical flows to "be and become" in particular ways (Green and Foster, 2005: 664), MFA can be usefully completed with sociological analysis (Hoffman, 2003; Lifset, 2008; Schiller, 2009). Studies have been conducted to "socially" extend the MFA framework. Elaborating on a *Structural Agent Analysis* (SAA), Binder (2007a,b) investigates how social institutions and actor's decisions affect wood flows in a Swiss region; Hobbes et al. (2007) used an *Action-in-Context* approach to identify actors' actions and motivations driving the unsustainable extraction of timber in a Vietnamese village. These approaches proved to be useful in understanding how actor's decision-making processes affect concrete material flows. However, they rely on behavioural and microeconomic models, built around the assumption of rational choice, an approach that has been criticized to understanding choices in sustainable consumption studies (Cohen and Murphy, 2001; Shove, 2009).

1.2. Overcoming individualistic perspectives in consumption studies

In recent years, and building on the seminal work of Bourdieu (1979) and Giddens (1984), researchers have engaged with social practices theories to understand consumption as part of everyday life (Schatzki, 1996; Reckwitz, 2002), and in relation to natural resources and environmental concerns (Randles and Warde, 2006; Shove, 2010; Halkier and Jensen, 2011; Spaargaren, 2011). Rather than relying on overly simplistic visions of consumers as driven by individual need or greed, social practices fix the analytical lens on people and their doings and sayings, in relation to activities that are often routinized and habitual. Indeed, much of our everyday life involves mundane actions, such as turning on lights or running a shower, which consume resources but are very much inconspicuous (Shove and Warde, 1998). Although social practice theories are subject to different interpretations, some authors (Wilhite, 2013; Sahakian and Wilhite, 2014) suggest that social practices are a "block" of routinized actions, (re)produced and ordered in space and time, through the distributed agency across three "elements": people (their competences, understanding and engagement); the physical world (objects, infrastructures and technologies); and social context (culture, norms and institutions). The concept of "practice" implies that consumption activities are not conceived as the result of isolated individual and rational decision-making processes, but as the emergence, persistence and disappearance of practices formed by interactions among the "elements" of which practices are composed (Shove, 2015). It is the performative dimension of social practices (Schatzki, 1996), enacted in specific moments and places (Shove, 2009), which shapes the quality and intensity of resources used to fulfil an activity. One interesting aspect of social practices is that they can change over time (Spurling and McMeekin, 2015), no doubt when one or more of the elements holding together a practice shift (Sahakian and Wilhite, 2014).

Given our focus on methodological considerations in this paper, the social practices approach enhances the ability to detect and inform the elements influencing the practical performances of food provisioning, storing, cooking and eating, rather than individual choices and characteristics regarding shopping, food and tastes (Halkier and Jensen, 2011). Consequently, we are primarily interested in piloting our method and testing its ability to uncover processes shaping food consumption patterns in the home. In the