



Ecological indicators of fruit and vegetable consumption (EIFVCs): A case study



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ABSTRACT

Food and drink consumption was found to be responsible for around 20–30% of environmental impacts. Environmental impacts occur during all stages of the food production chain. However, households influence these impacts with through their choice of diet and habits, thus directly affecting the environment through food-related energy consumption and waste generation. With the multiplication of local policies for sustainable consumption, it has become increasingly useful to gather information on the evolution of the ecological impacts associated with household food consumption. Dealing with the indicators of household consumption of fruits and vegetables will enable changes in the population's lifestyles and the effectiveness of local policies to be monitored.

The aims of this article are twofold: to provide a conceptual framework on the purposes of ecological indicators of fruit and vegetable consumption (EIFVCs) and to provide a methodological approach for selecting and measuring the most relevant EIFVCs at a local scale. Considering the great diversity of ecological impacts, the large number of potential EIFVCs must be reduced to obtain fewer EIFVCs, but that are relevant at local scale. To be relevant, the EIFVCs must provide information on the three phases of consumption (acquisition, use, and disposal) and on the upstream and downstream phases of the consumption process; they should evaluate the more problematic ecological impacts at the local scale (level of concern); and they have to only point out the ecological impacts that households can significantly reduce through their consumption rates. To measure relevant EIFVCs, three approaches must be combined: monitoring the ecological impacts, measuring the material and energy fluxes associated with household consumption, and analysing the consumer behaviours that result in the observed ecological impacts.

As an illustration, the methodology is applied to the Bordeaux Metropolitan Area (France). In this area, eleven EIFVCs seem relevant. The use of surveys characterises all eleven of the EIFVCs, despite the difficulty of establishing quantified relationships between household behaviours and measured ecological impacts. The measuring of fluxes is possible for eight of them, whereas the monitoring of ecological impacts is only feasible for two of them.

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1. Introduction

Household consumption is the consumption of goods and services by households, including the selection, purchase, use, maintenance, repair, and disposal of any product of service. It is

a major driver of global resource use and associated environmental impacts. Private consumption in developed countries is dominated by housing and infrastructure, mobility and food and drink, which are responsible for a large portion of the pressures and impacts (Spangenberg and Lorek, 2002; ETC/SCP, 2009; EEA and ETC/SCP, 2010). For the last twenty years, major international institutions have stressed the need to encourage populations to become more involved in preserving the environment (Chap. 4 of the Rio Declaration 1992). Among all of the levels (on the worldwide, nationwide, and local scales) at which policies for sustainable consumption have been put into place, the local scale is easily the most dynamic and doubtlessly the most effective; numerous initiatives have emerged from local public authorities (e.g., Local Agenda 21, sustainable

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cities); educational institutions (e.g., eco-schools, green campuses); producers of goods and services, in partnership arrangements with consumers (e.g., local food systems); and even consumers themselves via community-based actions (Dubuisson-Quellier, 2010; Seyfang, 2007).

With the multiplication of these local policies for sustainable consumption, information on the evolution of the ecological impacts associated with household consumption has become increasingly useful. Whereas various methods for estimating global pressures caused by consumption are under development (input–output analyses, national inventory tables combined with lifecycle impact data, and resource accounting methods to estimate ecological, carbon, land and water footprints) (Minx et al., 2009; EEA, 2010; Bastianoni et al., 2014), few of them exist to estimate ecological impacts at a local scale. However, ecological indicators of household consumption could show numerous benefits at the local scale. They can be useful decision-making tools when defining and improving local policies for sustainable consumption; present some interesting prospects for increasing ecological responsibility at the local level; may inform citizens on behaviour in the population to which they belong (Oullier and Sauneron, 2011); might assist families with making sustainable consumption decisions (Comim et al., 2007); might allow for higher levels of citizen participation in local life (Fraser et al., 2006); and finally, can be considered as an interesting tool to develop local attractiveness (Musson, 2012).

Food and drink consumption was found to be responsible for around 20–30% of environmental impacts, like abiotic resource depletion, overexploitation of fish stocks, acidification, ecotoxicity, global warming eutrophication, human toxicity, ozone layer depletion, and photochemical oxidation (JRC/IPTS, 2006; EEA and ETC/SCP, 2010; Fuchs, 2013). Environmental impacts are caused during all stages along the food production chain, although the most significant impacts occur early in the production chain (agriculture, food processing) (EEA, 2005; Druckman and Jackson, 2010). However, households influence these impacts through their choice of diet and habits, thus directly affecting the environment through food-related energy consumption and waste generation (OECD, 2002). Current consumption patterns do not only impact the environment, but can also have negative impacts on health, such as concerns about obesity (IASO, 2008; WHO, 2008). For these reasons, reducing the ecological impacts related to food consumption was identified as one priority field for action (Duchin, 2005; Wallen et al., 2004; Faist et al., 2001; OECD, 2001). This major challenge requires efforts at all phases of the food value chain. The role of local actors is of major importance to promote more sustainable patterns of food consumption: Local policies and retailers are in unique position at the heart of the food chain by providing a link between producers (by encouraging more sustainable production practises) and consumers (by encouraging more sustainable ways of consuming). Among the key determinants of changing food consumption, they can promote: a shift towards diets with lower consumption of meat and dairy products; a shift towards the consumption of more products from organic farming; and higher consumption of fresh, seasonal, and locally grown fruits and vegetables (reducing energy use during production, distribution, and storage). In this context, the consumption of fresh fruits and vegetables was chosen as a part of food consumption as a whole in order to define ecological indicators of the most significant impacts.

The aims of this article are twofold: to provide a conceptual framework on the purposes of ecological indicators of fruits and vegetables consumption (EIFVCs) and to provide a methodological approach to select and measure the most relevant EIFVCs. As an illustration, the methodology is applied to the Bordeaux Metropolitan Area (BMA), located in the southwest of France.

2. Ecological indicators of fruit and vegetable consumption (EIFVCs)

2.1. Conceptual framework

According to Heink and Kowarik (2010), indicators are variables that provide aggregated information on relevant phenomena used to evaluate environmental conditions or changes. Our purpose here is to focus on the environmental impacts of one specific food consumption cluster (the household consumption of fresh fruits and vegetables) by proposing relevant EIFVCs. The selection of indicators must be carefully attuned to the purpose of the survey (Dale and Beyeler, 2001); in most cases, a set of wisely selected indicators is needed (Niemeijer and de Groot, 2008). Our purpose here, then, is to propose a set of EIFVCs that provide information on the phases of consumption at the origin of these impacts and on the main ecological impacts of household consumption, in order to ensure more sustainable consumption patterns.

2.1.1. Direct versus indirect impacts of the consumption process

Fruit and vegetable consumption leads to direct negative environmental impacts (from travelling to shops, storing, cooking, and generating waste). The direct impacts are related to what households do, in terms of acquisition, use, and disposal. It is thus useful to distinguish the ecological impacts of each of these three phases of the process of consumption: the selection and acquisition of goods and services (e.g., purchasing, own production, rental); the use of these goods and services (e.g., frequency of use, maintenance, storage); and the disposal phase (e.g., wasted, dirtied, and abandoned) (Campbell, 1998; Fischer et al., 2012). Each of these phases is associated with decision-making and specific ecological impacts. However, indirect impacts linked with the lifecycle of consumer goods must also be considered for a more holistic approach to the ecological impacts of consumption patterns (Moll et al., 2005; Carlsson et al., 2005), as indirect impacts can be higher than direct ones, notably in the case of food consumption (EEA, 2005, 2010). This global approach also has the advantage of identifying any transfer of impacts when consumption patterns change (Hertwich, 2005).

Indirect impacts refer to upstream phases of production and distribution before the consumption phase and downstream phases associated with the product's end of life, such as recycling, incineration, and sending to a landfill. Yet, to date, many studies dealing with the ecological impacts of household consumption focus solely on the direct impacts (see for example Baker et al., 2007), while omitting the indirect impacts. For the purpose of EIFVCs, the consideration of direct and indirect impacts is justified because households can influence some practises of production, distribution, and waste management through their consumption patterns (Fig. 1).

2.1.2. The ecological impacts of the consumption of fruits and vegetables

Ecological indicators of household consumption hardly take into account numerous ecological impacts simultaneously (Caeiro et al., 2012; Munksgaard et al., 2005): The impacts are usually specific and deal with climate change (Heinonen and Junnila, 2011; Wallen et al., 2004), fossil fuel depletion (Carlsson et al., 2005), water depletion (Hubacek and Sun, 2005), or land use (Liu et al., 2003). The assessment of the ecological impacts of household consumption has yet to consider numerous impact categories at the same time. This approach can provide an overview of numerous potential ecological impacts of consumption patterns, as well as allow the transfers of impacts to be assessed when changing these consumption patterns.

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