

'Foodprints' for sustainability and health: an Australian case study

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Background

Food consumption patterns and their significant global impacts on health and the environment are becoming a major point of concern [1-3]. Westernised diets, typically high in energy but low in nutrients, are replacing traditional diets, leading to increased incidences of obesity and chronic disease [1, 4, 5]. At the same time, food production is directly or indirectly responsible for up to 30% of anthropogenic greenhouse gas emissions (GHGE) [6], accounts for an estimated 70% of global water withdrawals [7] and occupies 38% of the earth's total land area [8]. Under current dietary trends, characterised by increased consumption of meat and processed foods, agriculture's impact on the environment is set to continue intensifying at an alarming rate in coming decades [1, 9-12]. Establishing and promoting synergies between healthy and sustainable diets has thus become one of the great global challenges for safeguarding future societal and environmental health [1-3, 13].

These global trends are particularly prevalent in Australia, where dietary patterns are already having an apparent negative impact on both human health and the environment [4, 14, 15]. Around 56% of adults are overweight or obese [16], and the health-related cost of poor nutrition is estimated to be well in excess of A\$5 billion per year and rising [17]. Agriculture also accounts for 18% of national GHGE [18] and uses more than half of the nation's water and land [19]. Food production and processing nonetheless contribute significantly to the Australian economy [20], meaning that any consideration of a healthy and sustainable diet must also account for potential adverse economic impacts.

Aims and motivation

Given present trends in food consumption patterns and agriculture's important role in the Australian economy, achieving a diet that is both healthy and sustainable for the whole Australian population represents a long-term interdisciplinary challenge. Based on recent findings highlighting the importance of factors such as affordability [21, 22], education [8] and demographic variables [23] as determinants of individual dietary behaviour, we argue

that a logical starting point for meeting this challenge is the development and application of 'foodprint' indicators (where 'foodprint' refers to a comprehensive combination of several environmental (GHGE, water, land use), economic (price, contribution to value added and employment) and health indicators (nutrient density, energy) better quantify and understand impacts associated with food consumption patterns of diverse socioeconomic groups.

In addition to its potential policy relevance, the development and application of 'foodprint' indicators constitutes an important contribution to the academic literature on food consumption and sustainability. Firstly, previous research on reducing food-related environmental impacts tends to rely on overly optimistic future diet scenarios (such as complete elimination of meat) and focuses on average global or national diets [7, 18, 20, 23-25]. However, studies from Australia and the UK emphasise the barriers to achieving such drastic changes in dietary behaviour [3, 26, 27] across the whole population as well as the need to pay particular attention to affordability and access (or lack of thereof) to healthy and sustainable foods [4, 15, 21, 22, 28, 29]. For this reason, we follow the lead of only a few recent studies by focusing on actual food consumption data from a diverse sample of individual consumers or households [30, 31], in an attempt to develop indicators and bespoke policy suggestions for different socioeconomic and geographic contexts.

Secondly, the majority of published studies rely solely on GHGE, which has become almost synonymous with total environmental impact [5]. Single indicator estimates such as GHGE or even food miles may be conducive to simplified recommendations, but result in a gross over-simplification of environmental impact [3, 4]. Our study concurrently employs several key indicators such as land use, water use and GHGE across the entire food supply chain in order to identify and quantify environmental impact trade-offs, whilst also taking into account how these impacts vary across different Australian regions.

Methodology

The study uses a framework based on the widely established method of environmentally extended input-output (EEIO) analysis, frequently employed in estimating environmental and other impacts of different diets [18, 23, 24, 32]. EEIO uses data on monetary transactions between economic sectors in order to ascertain the total use of resources (such as water, land and carbon) along whole product supply chains (which includes production, transport and processing). Economic data and environmental extensions are taken from the Industrial Ecology Virtual Laboratory (IELab), a highly innovative EEIO database which provides highly disaggregated economic and environmental data for agricultural and other food-related sectors in different regions of Australia [33].

The methodological framework consists of:

- a) establishing representative shopping baskets for 13 socioeconomic groups using the highly disaggregated, census-based *Mosaic* database [34], and quantifying their current environmental (carbon emissions, water use and land use) and economic impacts (contribution to GDP and employment) using EEIO analysis.
- b) comparing the diet of each socioeconomic group to the Australian Dietary Guidelines (ADGs) in order to ascertain where it is lacking or is in excess in terms of macronutrients (carbohydrate, protein and fat) and micronutrients (key vitamins and minerals) using a nutrient adequacy approach [3, 18, 35].
- c) developing indicators and realistic recommendations for policy interventions that may improve the health and environmental outcomes of future diets for different socioeconomic groups, taking into account their unique characteristics (e.g. purchasing power). This is based on spatially explicit food prices available to consumers living in different areas.

Preliminary results and significance

Our preliminary findings highlight the important role played by non-core/discretionary foods (defined as foods of 'little nutritional value which tend to be high in saturated fats, sugar and/or alcohol' [17]) and eating out as significant contributors of adverse environmental and health impacts (up to 25% of food-related CO₂ emissions). Non-core foods make up a significantly larger percentage of food expenditure for lower income segments, who also tend to spend a significantly higher percentage of their overall income on food. By employing 'foodprint' indicators we identify the worst-performing foods from an environmental and health perspective, such as processed meats and baked cereal products, and investigate their supply chain impacts. We consider how they can be replaced by healthier, more sustainable foods whilst considering price and affordability constraints.

We conclude by emphasising the importance of considering bespoke recommendations which cater to the particularities (such as access to food, food prices and available choices, income and education) of each socioeconomic group, as opposed to 'broad-brush' arguments urging everybody to eat less meat or dairy. As the first attempt to account for socioeconomic diversity in such a comprehensive and objective manner, we envisage that our ongoing findings will be used to create realistic recommendations to achieve healthy and environmentally sustainable food consumption for all Australians. Our findings are likely to be highly relevant to other developed countries currently experiencing similar food-related health and environmental problems, especially the UK and the US.

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