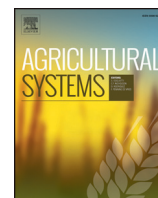




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## Agricultural Systems

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## Food Futures: Developing effective food systems interventions to improve public health nutrition

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### ABSTRACT

**Objective:** 842 million people worldwide are undernourished, while simultaneously the number of overweight and obese individuals increased to 2.1 billion in 2013. There is growing opinion that addressing the global burden of diet-related disease requires a much more comprehensive and multidisciplinary approach than stand-alone public health nutrition interventions such as nutrition education or food labelling. Instead, we need to develop whole of systems interventions to address the core problem and consider the way we grow, process, distribute and commercialize our food. However, there is little evidence or guidance on how to best achieve this goal. This research aims to develop a whole of food systems approach for public health nutrition research by building on systems methods from other fields of science. Specific objectives are to: 1) identify systems methods that are applicable to public health nutrition research; 2) identify how these systems methods and public health research can best be integrated.

**Methods/results:** We explored a range of systems methods which could potentially be applied to public health nutrition research. Based on these, we developed a framework for using and combining different systems methods in public health nutrition research. The framework consists of three main phases: A) availability and affordability of (un)healthy food; B) determinants of (un)healthy food availability and affordability; and C) food system intervention development. Phase A forms the platform of this research combining a series of smaller projects examining food availability, affordability and healthiness. Phase B uses global value chain analysis (GVCA) to identify different attributes of value, including both health and monetary values. Phase C aims to identify sustainable food system public health interventions using Group Model Building (GMB) and logistic modelling approaches.

**Conclusion:** This paper presents why and how systems methods can be used in public health nutrition research. The food system is highly complex and this complexity needs to be acknowledged to find solutions for the current nutrition challenges (obesity, under nutrition), which cannot be solved in isolation. We envision that the methods presented in this paper can form the basis for future research in this area where it can be applied to other public health nutrition research (for example other food products, in relation to specific diseases, different countries) as well as other domains of a sustainable food system not specifically focused on here e.g. economic, social and specific environmental outcomes.

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### 1. Introduction

Global nutrition is in a state of crisis; 842 million people worldwide suffer from under-nutrition (Food and Agriculture Organization of the United Nations (FAO), 2013a), while simultaneously the number of overweight and obese individuals increased to 2.1 billion in 2013 (Ng et al., 2014). Furthermore, the widespread burden of diet-related non-communicable diseases (NCDs) such as diabetes is becoming one of the world's largest societal problems (Amuna and Zotor, 2008; Lim et

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al., 2012; Ministry of Health, 2013; United Nations, 2011; World Health Organization, 2012) and forms a barrier to achieving development goals including poverty reduction and economic stability (Beaglehole et al., 2011). In New Zealand (NZ) about 40% of mortality is attributable to the effects of poor diets (Amuna and Zotor, 2008; Lim et al., 2012; Ministry of Health, 2013) and even modest improvements in diet could have a major impact on health if they are adopted by the majority of the population (Scarborough et al., 2010; Stefanogiannis et al., 2005).

Addressing the global burden of diet-related NCDs and improving population nutrition and health requires a multi-disciplinary approach. Public health interventions alone, including nutrition education, school programmes or food labelling, cannot solve nutrition problems on their own (Otero et al., 2015; Waterlander and Zenk, 2015). While such health interventions can be effective, programmes are costly and their scalability and long-term effectiveness is limited. More importantly, these interventions do not address the strong societal forces (food availability, costs, and commercialization) that work against individual behaviour change and do not reach the most vulnerable populations (Swinburn et al., 1999; Swinburn et al., 2011). Indeed, there is growing support for the position that “encouraging low-income families to consume healthier but more costly food to prevent future disease can be construed as an elitist approach to public health” (Otero et al., 2015).

To date, we lack consideration of how public health interventions must operate within the overall food system and global economy. Historically, industrialization, technical innovations and investments in our food supply have brought some major advancements; food became more available, varied, affordable, and famine has largely disappeared in developed countries (Tillotson, 2004). However, while being highly developed, our current food system not only delivers extremely costly food in terms of consequences to public health, but also in terms of capacity of the earth (biodiversity, ecosystem degradation and greenhouse gas emissions) and the unfair demand on developing countries (Swinburn et al., 2011; Lang et al., 2009; McMichael et al., 2007; O’Kane, 2012). In addition, it is unacceptable that surplus food production and widespread hunger currently co-exist at the global level (Pinstrup-Andersen, 2002), especially when about one-third of the global food supply gets wasted (Food and Agriculture Organization of the United Nations (FAO), 2013b).

High-level food system factors are often ignored when developing public health nutrition interventions. For example, studies to date have not taken into consideration how health policies would operate within the commercial market place where manufacturers can adopt strategies to circumvent the policy with a view to minimising impact on product sales. A retrospective example of such circumvention comes from the 1980s where United States farm policies made sugar more expensive expecting that this would result in higher soft drink prices and subsequent decreased consumption. However, the Coca-Cola Company substituted high-fructose corn syrup for sugar, saving them around \$25 million per year making Coca Cola both cheaper and more profitable (Hawkes et al., 2012). Currently, with net profit margins are around ¼ of the retail price, soft drink production is one of the most profitable industries in the world (Stuckler et al., 2012). Another example is the Danish saturated fat tax (introduced in 2011) which was abolished within one year of its introduction. While it was too early to be sure about the effects on population health, competing economic and political interests made the government decide to put it on hold (Stanford, 2012; Vallgarda et al., 2014) even though recent studies have indicated some promising effects on sales of targeted products (Jensen and Smed, 2012). Similar examples can be found in the field of tobacco prevention research where the tobacco industry has circumvented health policies by absorbing tax increases on some of their brands to reduce the financial impacts on consumers (Gilmore et al., 2013). There are also examples of health related food taxes that show promising results such as the recent soft drink tax in Mexico; however a much more comprehensive approach is needed to achieve long-term sustainable impacts.

It needs to be acknowledged that public health cannot operate in isolation and has to be able to achieve its goals within the existing economic, environmental and social systems. A key problem associated with the current food system is that food has become highly commercialized and prices do not incorporate externalities such as effects on public health or the environment (Pinstrup-Andersen, 2002; Caraher and Coveney, 2004). The system produces an oversupply of dietary energy and certain crops (e.g., sugar, corn) (Schafer Elinder et al., 2006) and provides us with more products in ultra-processed form (Tillotson, 2004; Nugent, 2011; Swinburn, 2008). Furthermore, the international food system has become highly complex making it difficult to understand drivers of the system. There is a clear need to look closely at the operation of the food system to find sustainable solutions improving population health, social welfare and environmental sustainability (Swinburn et al., 2011).<sup>1</sup> We should be looking at questions such as ‘*What makes our current food environment so unhealthy?*’ and ‘*Why do we overproduce and oversell unhealthy food?*’ (Hawkes and Ruel, 2011).

New inter-sector studies combining a systems approach and public health are needed to identify feasible and effective interventions and answer questions on how to achieve a healthy sustainable food environment (Acres, 2010; Burlingame and Dernini, 2011; McCorriston, 2013). An overview of the operation of our food system is key, because understanding the structure, strengths, and weaknesses of the system is required to find realistic alternatives (Hendrickson and Heffernan, 2002). In NZ, food production is the major contributor to the economy and there is a highly developed agricultural system (Campbell et al., 2009); however, similar to other countries, there is no policy at central government that outlines a long-term food and nutrition strategy (Acres, 2010). The system focuses merely on short-term economic profits without considering long-term consequences for public health, the environment and food security. Countries such as the United Kingdom, Australia and Canada intend to move from agro-production oriented food policies towards a comprehensive national food strategy and a recent scientific report to the Dutch government concluded that the Netherlands needs to take a whole food systems approach to ensure a sustainable, secure and healthy food production for the population in the future (WRR (Wetenschappelijke Raad voor Regeringsbeleid), 2014). The newly released Sustainable Development Goals list ‘End hunger, achieve food security and improved nutrition, and promote sustainable agriculture’ as the second of its seventeen goals revealing a globally recognized need to work on our food system (United Nations, 2015).

This research aims to develop a whole of food systems approach for public health nutrition research by building on systems methods from other fields of science. Specific objectives are to: 1) identify systems methods that are applicable to public health nutrition research; 2) identify how these systems methods and public health research can best be integrated.

## 2. Methods

We explored a range of systems methods which could potentially be applied to public health nutrition research (Waterlander et al., 2015). These methods are outlined in more detail below.

### 2.1. Analysis of the availability and affordability of (un)healthy food

A solid understanding of the food environment is essential in food systems research. Within public health nutrition, this research should focus on examining the availability, affordability and accessibility of healthy and unhealthy food. For example, evidence from the United States suggests that there is a large gap between dietary

<sup>1</sup> The importance of wider systems was already famously stated by Rose in 1985 quoting that to understand the reasons for sick populations, we must not just look at the individual but at the society.

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