



Journal of Hunger & Environmental Nutrition >

Volume 4, 2009 - [Issue 3-4](#): Food Systems and Public Health: Linkages to Achieve Healthier Diets and Healthier Communities

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Identifying Innovative Interventions to Promote Healthy Eating Using Consumption-Oriented Food Supply Chain Analysis

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Pages 336-356 | Published online: 11 Dec 2009

Cite this article <https://doi.org/10.1080/19320240903321243>

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machines and identifies further potential applications. These include fruit and vegetable supply chains, local food chains, supply chains for health-promoting versions of food products, and identifying financial incentives in supply chains for healthier eating.

KEYWORDS:

- food system
- food supply chain
- diet
- obesity
- Coca-Cola
- globalization
- food industry
- food policy
- food history
- financial incentives
- interventions

INTRODUCTION

Today, more than two thirds of adults and more than one third of children in the United States are considered overweight or obese and rates are continuing to rise.[1,2](#) Obesity has become a global problem, rising throughout Western countries and the developing world.[3](#) Some real efforts are being made to address obesity, but examples of programs or policies that have successfully led to reductions of obesity remain few. In part this can be attributed to a food and beverage environment conducive to unhealthy eating.

The food industry has made numerous efforts made to improve the consumer end of the food system.

This article reviews interventions and (2) consideration of the food supply chain as an organizational structure saved and was, for



efficiency of their supply chain.[5](#) Value chain analysis is a part of supply chain management that focuses on identifying where products gain value in the supply chain.[6](#) The value chain approach has since been adapted by economic sociologists to study power relations in global food (and other) chains and the interactions between the actors in these chains. Their aim is to shed light on the socioeconomic and environmental consequences, such as working conditions, and identify leverage points for improved business practices.[7–9](#) Researchers concerned with agriculture and international development have also used this value chain approach to identify how export-oriented food chains in developing countries affect employment and other development issues.[10](#) And the development of local value chains is at the heart of movements in the United States and elsewhere to develop more sustainable, locally oriented food supply chains.[11](#)

Food supply chains are increasingly analyzed for their environmental impact and sustainability. Life cycle assessment is a technique for examining the environmental impact of foods (and other products) throughout their life cycles.[12](#) A related form of analysis is carbon footprinting, used by food companies and others to examine where greenhouse gas emissions are located along the food supply chain.[13](#) Product roadmapping is another form of supply chain analysis that aims to increase the sustainability of supply chains.[14](#) The practice of sustainable public procurement also

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counterintuitive. The methodology developed here accepts this view, but, taking on board the supply chain approach, stresses the concept of action throughout the chain—that though one point could be enough, leveraging a series of points may be needed to create coherent change along the chain, and it is this coherence which then creates a tipping point for change. The method also adopts the economic concept of incentives and disincentives as the best way to articulate a leverage point for change.

Another critical aspect of the methodology is that unlike other applications, it focuses on identifying how food supply chains could be leveraged to alter food consumption. Despite the increasing application of supply chain analysis to food systems issues, there has thus far been no serious effort to examine how such analyses could be used to leverage healthier diets (also see Gereffi et al., 2009⁹). There have been analyses in the other direction—examining how food consumption patterns affect the food supply—but not in the direction from supply to demand.^{18–20} This gap reflects one of the core problems of modern food supply chain management: that human health remains marginalized as a supply chain issue, falling into the gaps between the different processes and actors in the chain (in contrast to the environmental and labor issues now perceived as supply chain issues).²¹ How to alter supply chain dynamics to encourage healthier eating thus represents a gap that needs to be filled.

The article starts by describing the concept of food supply chains and then examines how they can be leveraged to alter food consumption. Using insights from the food supply chain approach, the article then explores why the environment. It then examines what is provided by the environment. It then discusses the elimination of the supply chain.



WHAT

A food supply chain is a network of food from farm to fork.

- Inputs such as

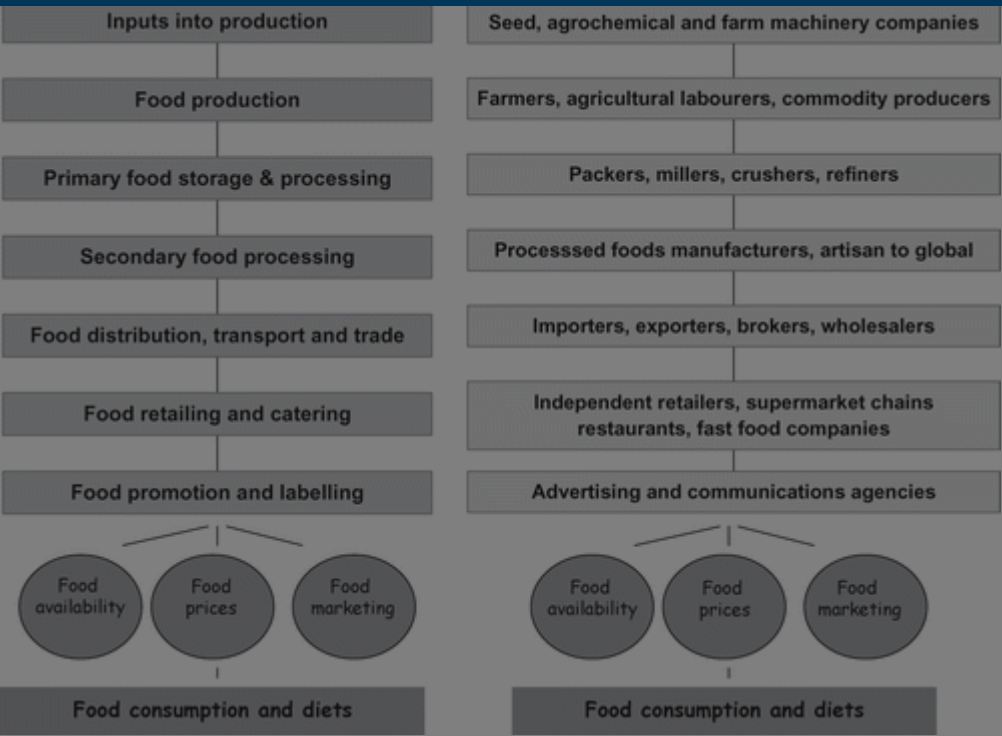
fertilizers, pesticides, and mechanized vehicles.

- Agricultural production: This includes the production of arable crops (grains, oilseeds), horticulture (fruits, vegetables), fish (farmed, wild), meat, and dairy.
- Inputs of nonfood aspects of the product and its distribution: A good example would be food packaging (aspect of the product) or vending machines (its distribution).
- Primary food storage and processing: This includes refrigeration and freezing (perishable foods), canning (e.g., vegetables), slaughtering (meat), milling (flour), and crushing (oilseeds).
- Secondary food processing: Notably the manufacturing of highly processed foods such as cookies, snacks, and prepared foods.
- Distribution, transport, and trade: Such as by truck from farm to a local market or from packing house to warehouse or by plane to another country.
- Food retailing: This includes local markets, small stores, supermarkets, as well as catering operations such as restaurants, hospitals, schools. It may also include wholesaling.
- Food promotion and labeling: Such as advertising, sales promotions, nutrition labeling

A simplified food supply chain can also be shown by Figure 1. The chain is also affected by various sources. What is the administrative arrangement of different chain affecting the chain?

FIGURE 1. Actor-based food supply chain





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Though most food supply chains comprise the same basic steps, they take many different forms. These differences arise from variations in the food product, scale, level of detail, etc., and, importantly, the reason for mapping and analyzing the chain in the first place. For example, the differing objectives of food supply chain analysis discussed in the introduction all lead to different-looking chains.

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Figure 2). This example also provides insights that support the development of the subsequently described method of consumption-oriented food supply chain analysis.

FIGURE 2 Broad historical shifts in the American food supply chain, from local to national to global.

| | Local | National | Global |
|----------------------|--|---|---|
| Food production | Minimal use of inputs; limited by environmental factors; producer-driven | Intensive use of inputs; farmers subsidized, so more state-driven | Intensive use of external inputs; more market-driven |
| Food transport/trade | Short distances; organized by producers; transport limits trade | Within nation; organized by state; high trade barriers | Global; organized by private actors; low trade barriers |
| Food processing | For storage e.g. pickling | More complex processing, & then traded | Global ingredients for highly-processed foods, manufactured locally |
| Food retailing | Own consumption or local markets | Small stores buying from wholesalers | Supermarkets buying from producers |
| Food marketing | Minimal, local information | Advertising | Highly sophisticated global marketing |
| Consumption | Shortages, hunger | Excess & shortages | Obesity and hunger |

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Historical Overview

Prior to the 1850s, Americans lived on their own land and food in the chain. The development of fresh meat available led to new breeds and new can appear. Into the 19th century, producing products

Americans markets or had and food in the chain. The development of fresh meat available led to new breeds and new can appear. Into the 19th century, producing products

place to stamp a brand, food branding and advertising became the way to compete for the consumer dollar. Billboards, newspaper and radio advertisements, premium giveaways, and enticing packaging could now be used to create demand for the wealth of new packaged products. By the 1930s, inexpensive diners, cafes, and hamburger joints had sprung up, and the 1950s saw the introduction of frozen TV dinners and McDonald's.[24,25](#)

This was also the era that saw the beginning of the big farm commodity programs that still characterize agricultural policy in the United States. The Agricultural Adjustment Act (AAA) of 1933 provided subsidies to incentivize farmers to expand production. Technological developments of agricultural inputs over next decades (e.g., fertilizers) further encouraged greater production. Farming became increasingly intensive and industrial, in turn affecting the availability and farmgate prices of the subsidized crops, such as wheat and soybeans.

The second half of the 20th century saw important changes in the way that the entire food chain was organized in the United States.[26–28](#) Most importantly, the power in the chain shifted away from the farm to the food-consuming industries—the primary processors, manufacturers, and retailers who “consume” the products produced by the earlier steps in the chain. Horizontal and vertical integration and consolidation led to increased levels of industry concentration. By 1997, four companies controlled 60% of all hog sales, and a few large retailers controlled a significant portion of the retail steps of the chain, moving from farm to retail.[28](#) The effect of this consolidation was to reduce the size of the family farms across the country, as the size of the farm became less important than the farm's access to capital and markets.

This consolidation moved the power of the food chain away from the farm, toward the processors, manufacturers, and retailers. Labor, farm costs, and the environment became less important. By 1999, 80% of the nation's farms were smaller than 100 acres. So despite the declining number of farms, the total production of food from the farm sector remained relatively stable.



From here, it was a short step to the globalization of America's food supply chain. US food companies began to buy up companies in other countries, thus increasing their global reach and power.[28,34](#) Exports increased as well, as agricultural policy, combined with high levels of technological and organizational efficiency, continued to promote the production of surplus relative to domestic need.[27,35](#) Successive governments pursued the policy of opening foreign markets for American products through the World Trade Organization and bilateral trade agreements (e.g., the North American Free Trade Agreement), which also opened up the country to imports. The development of cold chain technologies now allowed highly perishable products like seafood and fruits and vegetables to be flown in from all over the world. As a result, Americans began to consume more of the fruits—like grapes—now available beyond the US seasons and/or at lower prices than US products.[36](#) The process also allowed US food processors to rely more on ingredients sourced from overseas, cutting their costs of production.[35](#)

This shift to the global model involved more than just more imports and exports. It represented a political, economic, and ideological shift—essentially a paradigm shift—that favored the development of a market-oriented, economically efficient, and competitive food supply chain, a chain that lowers the costs of production and produces a consistent supply of a plethora of foods (many of them highly processed and based

on commodities). While the majority of the food consumed in this globalized system is produced in the United States, the system is characterized by a high degree of dependence on imports from other countries.

Characteristics

Between the 1970s and the 1990s, the United States shows that the country was a major player in the world where the technological and legal changes (the degree of integration) were instrumental in the organization of the food supply chain. The financial and organizational changes helped to overcome the challenges of the global market.



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Another important factor identified through the historical overview is that important shifts in outcomes of the food supply chain occur in response to mutually complementary changes throughout the chain. Take, for example, the rising production and consumption of packaged, processed foods and the decline of loose, unbranded primary processed foods. This pivotal shift was not just the result of the introduction of packaging technologies but of the rise of advertising, the introduction of supermarket retailing, the availability of low-cost ingredients—all operating in a consistent direction. These mutually reinforcing changes led to coherent incentives throughout the chain that provided a tipping point for change. The lesson here is that degree of coherence between the incentives in different steps in the chain is an important factor determining whether and what changes will take place and why chains behave and differ as they do. This in turn suggests that incentives in parts of the chain can be undermined by disincentives elsewhere, preventing change, and thus that the chain must be levered in a coherent manner to create long-term, sustainable changes to the food environment, consumer preferences, purchasing behaviors, and food consumption habits at the population level. There are two general approaches to do so. One is to intervene at several points along the chain to line up the incentives; the second is to implement just one or a small number of actions that introduce incentives or remove disincentives so significant that it has a ripple effect throughout the chain.



4. analyzing how these characteristics and incentives and disincentives affect the food environment: food availability, prices, and marketing;
5. identifying how these incentives could be leveraged to better align the food supply chain with healthy diets (what and who is needed to lever change).

The development of this analysis, and the concepts on which it is based, has been necessarily very general. To help identify specific levers to encourage healthy eating, the method needs to be applied to solve specific problems in the food environment. The supply of Coca-Cola beverages into school vending machines is used here to show how the method works. The availability of sweetened soft drinks in school vending machines has long been cause for concern among health advocates in the United States and elsewhere. Although there has been considerable activity in the United States and around the world to reduce this availability, efforts have focused on the consumer end of the chain rather than on reducing the incentives in supply chains.³⁹ A consumption-oriented supply chain analysis could contribute to understanding what these incentives are.

The presented analysis is not complete, because it is intended to simply illustrate the method. A fully comprehensive systems approach would require greater consideration of other soft drinks companies and other actors in the chain (such as soft drink distributors outside the United States). Other aspects, such as the role of advertising, are not addressed.

Testing

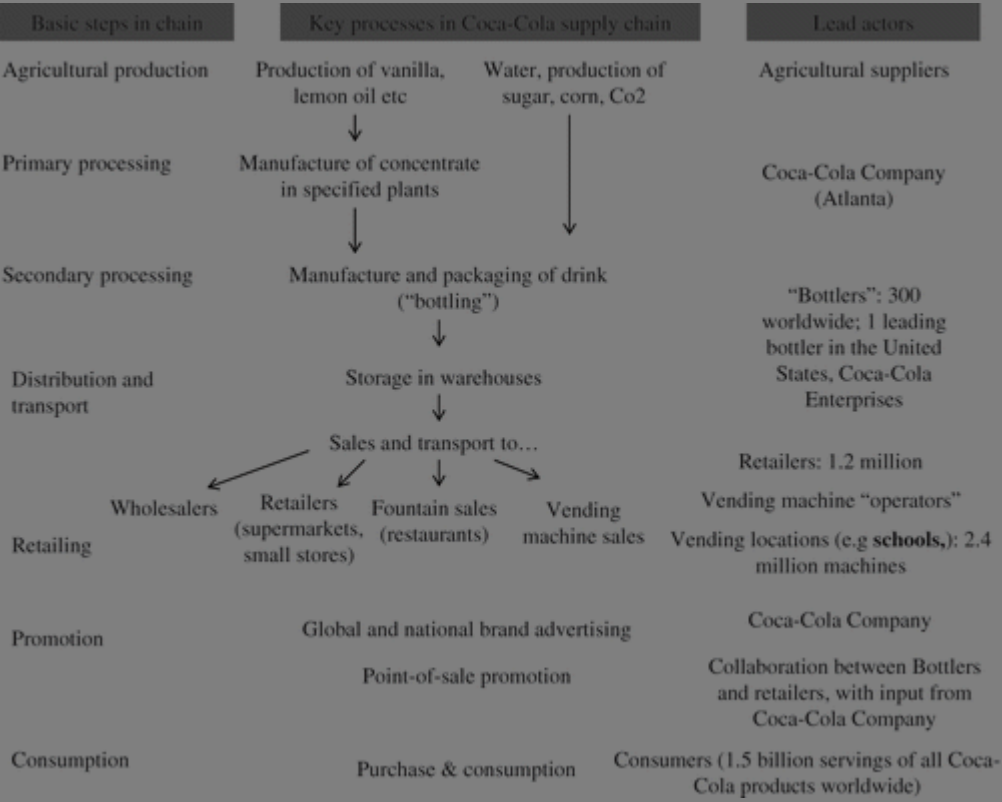
Step one

The first step is to identify the problem. In this case, the problem is the availability of sweetened soft drinks in school vending machines. The second step is to identify the actors in the chain. In this case, the actors are the Coca-Cola Company, the vending machine companies, and the schools. The third step is to identify the incentives and disincentives. In this case, the incentives are the profit from the sale of soft drinks and the disincentives are the cost of the vending machines and the cost of the soft drinks. The fourth step is to identify the levers for change. In this case, the levers are the availability of soft drinks in vending machines, the price of soft drinks, and the marketing of soft drinks. The fifth step is to identify the actors who can influence these levers. In this case, the actors are the Coca-Cola Company, the vending machine companies, and the schools. The sixth step is to identify the interventions. In this case, the interventions are to reduce the availability of soft drinks in vending machines, to increase the price of soft drinks, and to reduce the marketing of soft drinks. The seventh step is to identify the outcomes. In this case, the outcomes are to reduce the consumption of sweetened soft drinks and to improve the health of children.



their distributors, that distribute soft drinks into school vending machines, not the Company.

FIGURE 3 The Coca-Cola supply chain.



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Step two

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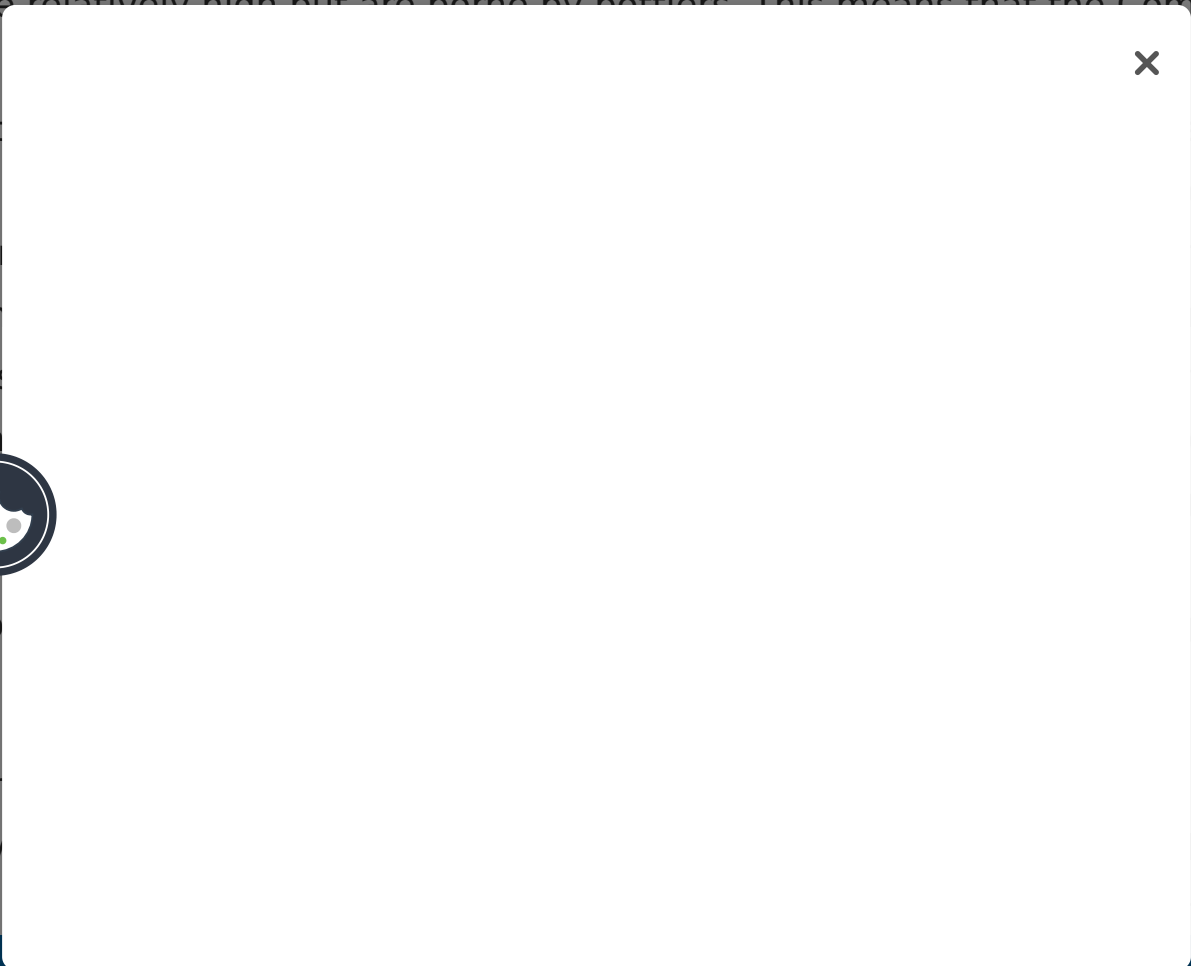
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with the right to establish concentrate prices, and require the bottlers to place a specified number of vending machines.

Both the Company and the bottlers are more powerful than the actors in the earlier part of the chain—the agricultural and product suppliers—and the later part of the chain—the retailers etc. At a basic level this is because there are many more suppliers and retailers than bottlers and so they have less bargaining power. It is notable, though, that the Company has expressed concern that the increasing consolidation among retailers and their increasing bargaining power—especially in the case of Wal-Mart—could affect their profitability.⁴⁰ Vending machines present an interesting case: they are different to standard retail customers in that they are vehicles through which beverages are sold directly to consumers housed in a third-party setting. As a third-party setting, schools are relatively small, unconsolidated operations with little expertise of contracting arrangements and often desperate for new funds. As such they are in a relatively weak position to bargain about the conditions of housing the machines. In most cases, the contracts between the bottler and the schools formalize this weaker power relation.

The financial costs in the chain reflect these organizational characteristics. The costs of ingredients and packaging are relatively low (albeit rising). Production and distribution costs are relatively high but are borne by bottlers. This means that the Company benefits from the low costs of ingredients and packaging (even though the Company does not own the bottling plants). The Company also spends up to 10% of its revenues on advertising, which is a significant cost. The Company also spends so much on advertising that it is measured on advertising revenues for its media in the United States. The Company's advertising activities are a significant part of its revenues for the Company. The Company's advertising revenues are with the bottlers. The Company's advertising revenues are relatively low compared with the bottlers' advertising revenues. The Company's advertising margin is relatively low compared with the bottlers' advertising margin.

There are a number of other factors that are relevant to the Company's advertising. There is a significant amount of advertising that has become



Policy characteristics of the chain also play a role. An important but often overlooked regulation is the Soft Drink Interbrand Competition Act (1980), which gives bottlers the legal right to exclusive territories within which to distribute their product as long as there is sufficient interbrand competition. This means that it is not permitted to have more than one bottler selling Coca-Cola Company products in one territory (e.g., a state).

In the 2000s, the availability of soft drinks in schools. The school board adopted guidelines for the portion sizes of soft drinks available.54



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into schools, driven by the ultimate incentive of wanting to reach young people. Organizationally, for example, Company-bottler contracts create an incentive for bottlers to place vending machines in schools, while the highly concentrated nature of the industry, combined with the lack of intrabrand competition and the weak power of schools, creates the incentive for exclusive contracts with schools. Financially the high margins from vending machines create an incentive for bottlers, and the cash benefits are an incentive for schools. Developments in the regulatory environment on school food removed disincentives to their availability, as did developments in vending technologies.

Step four

The fourth step is to examine the implications for availability, retail prices, and marketing. The increase of availability of sweetened soft drinks in schools has been well documented: in 2004–2005, 88% of high school students had soft drinks available to them through vending machines.[56](#) The effect of prices in vending machines is less clear, but for marketing, there is no question that vending machines provide a critical opportunity for branding young people at an impressionable age, in the hope that they remain loyal for life.

Step five

Step 5 is to examine the implications for availability, retail prices, and marketing. The increase of availability of sweetened soft drinks in schools has been well documented: in 2004–2005, 88% of high school students had soft drinks available to them through vending machines.[56](#) The effect of prices in vending machines is less clear, but for marketing, there is no question that vending machines provide a critical opportunity for branding young people at an impressionable age, in the hope that they remain loyal for life.

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already⁵⁸—at the nature of competition policy to see how it could be leveraged to create disincentives in the chain.


POTENTIAL APPLICATIONS OF CONSUMPTION-ORIENTED FOOD SUPPLY CHAIN ANALYSIS

This article has exemplified a potential application of consumer-oriented food supply chain analysis to a supply chain into a discrete setting—in the context of the availability of foods in those settings. There are many more potential applications of the analysis ([Box 1](#)). Supply chain analysis could be used to examine the supply of fatty, sugary, salty foods into other discrete settings like worksites and restaurants. It could be used to examine how consumer-oriented policies, such as regulations on food marketing to children, nutrition labeling, or food taxes, affect the earlier components of the food supply chain. This could help identify bottlenecks to successful implementation of the regulations (aspects that undermine their implementation), and the broader advantages and disadvantages throughout the chain of implementing such regulations. One example would be to examine the effect of voluntary initiatives—such as the school beverage guidelines—on the supply chain relative to legal approaches. In the other direction, the analysis could be used to examine how regulations in the food supply chain (such as those on cosmetic) standardizing the changing environment? Supply chain analysis could be used to examine how the barriers to promoting healthy eating. ⁵⁹



Box 1
Consumer-oriented food supply chain analysis

Download



Another example would be to examine the effect of voluntary initiatives—such as the school beverage guidelines—on the supply chain relative to legal approaches. Ultimately, the analysis could be used to examine how regulations in the food supply chain (such as those on cosmetic) standardizing the changing environment? Supply chain analysis could be used to examine how the barriers to promoting healthy eating. ⁵⁹

“healthy”

supply-side bottlenecks to achieving these goals and by providing insights into how to increase supply into underserved areas (or into discrete settings like schools). Experience of developing local food supply chains to encourage fruit and vegetable consumption while delivering value to producers shows that logistical supply chain management is often the key disincentive to such efforts. Supply chain analysis could be used at a local level to identify bottlenecks in the chain from, say, farm to school, or farm to low-income neighborhood. The analysis could also be used more broadly to examine whether different scales of chain (e.g., local versus national or global provision of fresh fruits and vegetables) are more conducive to healthy eating.

Another potential application is the influence of agriculture in healthy eating. The role of agricultural producers is explicit in local food supply chains, but there has been debate as to the role of agricultural policies in influencing the healthiness of the food supply in general.⁶⁰ Supply chain analysis could be used to examine more systematically the role of agricultural policies and programs in influencing the food environment in particular settings. For example, the consumption of pulses (legumes) is declining in many developing countries. Is this simply because of changes in consumer preferences, or are there explanations in the agricultural sector?

Comparison of chains for similar but different products could also be instructive in providing insights into how the supply of more health-promoting product could be encouraged. For example, comparing the supply chains for high-sugar products and high-sugar products that are also high in fiber could help identify what changes in the supply chain could lead to a healthier product, such as a high-sugar product that is also high in fiber. Another potential application is the influence of agriculture in healthy eating. The role of agricultural producers is explicit in local food supply chains, but there has been debate as to the role of agricultural policies in influencing the healthiness of the food supply in general.⁶⁰ Supply chain analysis could be used to examine more systematically the role of agricultural policies and programs in influencing the food environment in particular settings. For example, the consumption of pulses (legumes) is declining in many developing countries. Is this simply because of changes in consumer preferences, or are there explanations in the agricultural sector?



little studied problems in the food environment; to illustrate, it is possible that taking a supply chain approach to the problem of soft drinks in schools at an earlier stage would have led to solutions being identified earlier.

CONCLUDING REMARKS

It was noted in the introduction to this article that the supply chain approaches taken to food issues thus far have typically focused on business management, the environment, labor, and safety. As a counter balance, the method developed in this article has deliberately focused on consumption. This stress that leveraging the food supply chain is an underused policy response to the growing problem of unhealthy eating. Ideally, however, all aspects of the food supply chain that affect human health and well-being—whether it be economic concerns, working conditions, climate change, unsafe food, or healthy diets—should be considered as part of one system and thus in one analytical framework. Further discussion and debate are needed to merge the different approaches to create a new paradigm for the modern food system.

This article is based on a paper commissioned by the Healthy Eating Research Program of the RBC Foundation. The authors thank the RBC Foundation, for their support. The authors also thank the following colleagues for their contributions: Dr. David Lang and Dr. Catherine Dubé for inviting the authors to participate in the program and Dr. David Lang and Dr. Catherine Dubé for their support. The authors also thank the following colleagues for their contributions: Dr. David Lang and Dr. Catherine Dubé for inviting the authors to participate in the program and Dr. David Lang and Dr. Catherine Dubé for their support. The authors also thank the following colleagues for their contributions: Dr. David Lang and Dr. Catherine Dubé for inviting the authors to participate in the program and Dr. David Lang and Dr. Catherine Dubé for their support.

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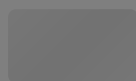
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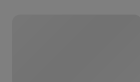
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