

Sustainable Food Systems: Perspectives on Transportation Policy

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ABSTRACT >> *Global agri-food and transportation systems have dramatically expanded food production and distribution worldwide. This integration, however, also adversely affects human health. The negative effects arise from unequal access to healthy food, unequal access to transportation for agri-food workers, increasing geospatial and economic concentration in the agri-food industry, and an emerging competition between food and fuel. Because the health of individuals is inextricably tied to the health of communities, regions, and ecological systems, health and transportation professionals need to act to both mitigate current disparities and enhance the future viability and sustainability of these systems. This paper offers numerous, specific recommendations for improving health through transportation policy and programs as they relate to agri-food systems.*

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Agri-Food Systems, Health, and Transportation: An Overview

Agri-food systems include the production, processing, distribution, and consumption of food; the disposal of wastes; and the resources, actors, rules, and processes involved in the design, implementation, promotion, and regulation of these activities. These systems interact with communities to affect human health, both directly and indirectly. This paper explores these interactions to inform transportation policies that improve health, strengthen communities, and protect the environment.

As a result of linkages between the agri-foods industry and growing transportation networks, most U.S. households have ready access to large quantities of foods from all over the country and abroad; communities in crisis can quickly receive food aid transported from faraway countries; and exporters can efficiently reach grocery store shelves and markets around the world, positioning U.S. corporations at the helm of an international retail food enterprise pegged at four trillion dollars annually.¹

But the integrated system for food production and distribution has left behind millions of Americans in low-income communities in the inner cities and sprawling rural areas. Women, people of color, and immigrants have been left particularly vulnerable. To reduce disparities and attendant costs; to distribute benefits more equitably; and to build more sustainable transportation, food, and community systems, transportation policy must focus on health concerns resulting from:

- Lack of access to grocery stores offering affordable, healthy foods. This imbalance is associated with higher rates of obesity, disease, food insecurity,² and related stress;
- Lack of efficient, affordable transportation access for agri-food workers, such as farm workers and food service staff, whose wages are among the lowest in a region;
- A global agri-food industry that is fueled by cheap energy and transportation subsidies but, paradoxically, poses serious health risks to the community and exacerbates climate change; and
- Competitive market pressures to use crops for fuel, raising the price of food.

Transportation policy has not traditionally considered these issues, but it should, given the increasing rates of obesity and related health costs; climate change; threats to global food security; and inefficient, unsustainable food systems that rely on cheap energy to distribute food to faraway places.

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Disparities in Urban and Rural Communities' Access to Healthy Foods

Communities do not enjoy the same access to healthy foods, with inner-city neighborhoods and remote, rural areas faring the worst.³ This disparity occurs for several reasons, including a lack of grocery stores in low-income neighborhoods, a lack of affordable mass transportation, and lower rates of automobile ownership in low-income areas.

Lack of Grocery Stores In and Near Low-income Neighborhoods

Over the past five decades, the food retail industry has transformed itself in many ways, resulting in fewer corporate chains capturing a larger share of the retail market,⁴ more big-box stores opened in suburban locations and

fewer in urban and rural ones,⁵ and supermarket chains with consolidated food supply and distribution systems.⁶ These shifts, and increasing suburbanization, mean that fewer people now live within walking distance—or a short bus or subway ride—to the grocery store.⁷ This spatial dislocation has been made possible, in large part, by federal transportation policy that financed highway development, supported increased truck transportation of goods, and encouraged personal automobile use through subsidies that expanded roadways and parking. For example, one study puts the total “tax subsidy” to motor vehicle users in the range of \$19–\$64 billion per year.⁸

Today, inner-city⁹ and rural¹⁰ neighborhoods have fewer and smaller grocery supermarkets, with poorer selections of healthy foods and higher prices than their suburban counterparts. Urban neighborhoods, conversely, have an abundance of smaller convenience stores and fast-food outlets, which offer disproportionately higher amounts of foods of poor nutritional quality.¹¹ A decline in wholesale and retail farmers' markets¹² also paralleled the decline of grocery supermarkets in urban and rural locations, although farmers' markets have recently seen a dramatic rise.¹³ Nonetheless, farmland in metropolitan areas, where a majority of fruits and vegetables are grown, continues to be consumed by urban sprawl.¹⁴

For low-income and urban residents, for people of color, and for immigrants—all of whom tend to own fewer cars than affluent and middle-class whites,¹⁵ the paucity of nearby supermarkets leads to higher rates of diet-related morbidity and mortality,¹⁶ and even greater stress related to grocery shopping. Conversely, relatively easy access to supermarkets is associated with higher household consumption of fruits and other positive dietary behaviors.¹⁷ Disparities in the number and size of supermarkets have been documented by race even after controlling for income, with African American neighborhoods most adversely affected.¹⁸ Higher costs,



poorer selections, and lower quality of foods in low-income neighborhoods mean that taxpayer-funded nutrition programs such as the food stamp program (more recently known as SNAP, or the Supplemental Nutrition Assistance Program) don't go as far as in better-off neighborhoods. Lack of affordable, neighborhood-based food outlets also forces low-income households to rely more on emergency food programs such as food pantries that—dependent on private donations and government surpluses—stock little in the way of healthy foods. What's more, poor diets conspire with poor air quality, fewer parks and fitness facilities, poor quality housing, high levels of crime, noise, and other social and environmental stressors in low-income neighborhoods.

Increased Dependence on Use of an Automobile for Grocery Shopping

Grocery shoppers tend to prefer to travel to supermarkets by car, in part because of the one-stop design of supermarkets and their proximity to large-scale shopping districts with abundant, available parking, all of which discourage walking or biking. Vehicles save time and can help shoppers reach more stores, combine trips, and transport heavy packages easily, including in inclement weather.¹⁹ One Austin, TX, study found that few people substitute walking for driving to the grocery store, even if pedestrian or cycling access is good.²⁰ Even the poor who do not own cars often borrow them, ask for rides from friends, or take taxis to do grocery shopping²¹; however, transportation and walking remain critical in providing the mobility needed to access grocery outlets for these families.²²

Public bus routes and schedules, even in well-served communities, are typically planned in ways that disadvantage food-shopping trips needed during weekends and evenings. A typical bus system is also planned around a central hub, a design that often lengthens travel time to more peripherally located supermarkets. And high levels of required parking for supermarkets may make them less of a priority

in transportation system planning. Perversely, such land use policies may exacerbate the peripheral location of supermarkets. Research from the United Kingdom suggests that when land use policies discourage new supermarket development on the urban fringe, stores invest more in expanding and refurbishing the older stores based closer to the urban core.²³

People who live in low-income households are underserved by both the food²⁴ and transportation²⁵ systems. In 2007, food insecurity rates in the United States rose even before the sharp economic declines of 2007–08. Overall, 36.2 million persons—or 12.2 percent of Americans, mostly women, minorities, and children—struggled with hunger. In May 2008, more than 28 million persons participated in the food stamp program, a 32 percent increase in five years; yet the program reaches only two out of three eligible households.²⁶ Access to food stamp offices for these populations often is undermined by the distances needed to travel, lack of evening hours of operation, and limited public transportation within communities.²⁷ Food stamp recipients are also vulnerable to losing benefits due to lack of transportation to recertification appointments.²⁸ For a variety of reasons, farm worker households face a higher risk of food insecurity.²⁹ At the same time, the poorest Americans who have cars spend disproportionately more of their household budget than the national average on the purchase, operation, and maintenance of automobiles³⁰; are subject to higher interest rates when attempting to purchase a car; spend disproportionately more on commuting to work³¹; and are more likely to miss work due to car problems.³²

Low-income populations are comprised disproportionately of women, who also tend to make more trips related to childcare and household servicing—including 75 percent more grocery shopping than men do.³³ Shoppers tend to mix and match stores for food shopping based on criteria related to product mix, price, quality, and quantities desired and also the

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relative proximity of suitable outlets to their homes and workplaces.³⁴ Rural residents shop for groceries at more stores than do urban residents and travel farther to reach the stores.³⁵ Nonetheless, the scarcity of large supermarkets in poor neighborhoods and the economic pressures that force low-income residents to shop in smaller stores in their neighborhoods remain significant factors in why poor people pay more for food.³⁶ Federal nutrition programs such as food stamps and WIC (Women, Infants, and Children) do not pay for transportation costs incurred by households to procure food.³⁷ The Summer Food Service Program, which is under-enrolled in large part because of transportation barriers, provides small multiyear, competitive grants for innovative approaches to overcome such barriers.³⁸

Although transportation costs represent only a modest share of the cost of food consumed at home—an estimated six to 12 percent³⁹—energy disruptions can cause significant hikes in the price of food, as was experienced in the first half of 2008.⁴⁰ This is because both the food and transportation systems are highly energy intensive. Also, declining diesel oil prices through the 1990s tended to restrain food transportation cost increases; this trend is unlikely to continue for long. Rising energy costs hit low-income households especially hard as they struggle with maintaining an automobile, higher utility costs, and buying enough food for their families.

Disparities in Affordable Transportation Alternatives for Agri-food System Workers

Low-income rural households also experience problems with access to affordable transportation.⁴¹ Agri-food workers' burdens in this regard are especially heavy, and the least paid among them also tend to be predominantly members of groups that

are also vulnerable within communities: disproportionately younger (or older), female, immigrant (including those without legal residency status), and people of color. Most farm laborers and food service workers earn close to the minimum wage and get few additional benefits or perks. According to the U.S. Department of Labor, the national median wage in 2007 for waiters and waitresses was \$7.62 per hour, and that for farm workers and laborers was \$9.78 per hour. By comparison, the median for all occupations was \$15.10 per hour. Dependence on public transportation reduces employment access far more than any other factor⁴²; when people who work at or near the minimum wage must make longer journeys to work, their income does not rise.⁴³

Agri-food workers also experience greater transportation challenges because of the dispersal of jobs across the metropolitan and rural landscape. As a subset, farm workers have special difficulties accessing transportation.⁴⁴ In one study of farm workers in Mendocino County, CA, two out of five workers depended on rides from family members and other acquaintances; those who incurred transportation costs (i.e., were not living on farms) reported a mean cost of \$40 per week—or roughly 16 percent of the average weekly wage—with a median of \$30 per week.⁴⁵ As other papers in this collection show, strong evidence exists of a correlation between lack of access to adequate mobility and lack of access to opportunities, social networks, and health-supporting services such as clinics and pharmacies. At the same time, anecdotal evidence suggests that farm workers with transportation issues are at higher risk for injury as a result of their greater reliance on older “junkier” cars, traveling in the early hours of the morning, lower safety requirements (such as seatbelts) for farm-worker transport vehicles, and lax enforcement of safety regulations for such vehicles.⁴⁶

Table 1. *Energy Consumption and Emissions by Different Freight Modes*⁵⁴

	Rail	Water	Truck	Air
Fuel (kilojoules per ton-kilometer)	677	423	2,890	15,839
Emissions (grams per ton-kilometer)				
Carbon Dioxide	41	30	207	1,260
Hydrocarbons	0.06	0.04	0.3	2.0
Volatile Organic Compounds	0.08	0.1	1.1	3.0
Nitrogen Oxide	0.2	0.4	3.6	5.5
Carbon Monoxide	0.05	0.12	2.4	1.4

Table 2. *Average Distance by Truck to Chicago Terminal Market, 1998*⁵⁵

Average distance by truck to Chicago Terminal Market (continental U.S. only)*	# States supplying this item	% Total from Mexico	
Grapes	2,143 miles	1	7
Broccoli	2,095 miles	3	3
Asparagus	1,671 miles	5	37
Apples	1,555 miles	8	0
Sweet Corn	813 miles	16	7
Squash	781 miles	12	43
Pumpkins	233 miles	5	0

* Information for this chart is based on the weighted average source distance—a single distance figure that combines information on distances from production source to consumption or purchase endpoint. For more information on method, refer to Pirog and Van Pelt, 2002 (endnote 55).

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Table 3. *Estimated Fuel Consumption, CO₂ Emissions, and Distance Traveled for Conventional, Iowa-based Regional and Iowa-based Local Food Systems for Produce*⁵⁶

Food system type/type of truck	Fuel consumption (gal/year)	\$ value of fuel (2001 prices)	CO ₂ emissions (lb/year)	Distance traveled (miles)
Conventional/semitrailer	368,102	581,601	8,392,727	2,245,423
Iowa regional/semitrailer	22,005	35,208	501,714	134,230
Iowa regional/midsize truck	43,564	69,702	993,243	370,289
Iowa local—CSA farmers' market/ small truck (gas)	49,359	78,974	967,436	848,981
Iowa local—institutional/ small truck (gas)	88,265	141,224	1,729,994	1,518,155

Transportation, Agri-food System Sustainability, and Disparate Community and Regional Impacts

In global commerce, the agri-food sector presents special opportunities and challenges when it comes to transportation. Food, especially produce, is different from other commodities in that it is perishable and requires timely delivery and careful handling—including temperature control and cooling—to prevent spoilage. Globalized transportation of food enables surpluses from one region to efficiently make up for shortfalls in other regions, and one hemisphere to continue to supply familiar foods to the other following the latter's growing season; it also makes available new markets for local agriculture.

Because both modern agriculture and transportation today are more energy intensive than in the past, when energy costs go up, food costs rise dramatically, making the global food system especially susceptible to inflationary pressures and communities vulnerable to rising

energy prices.⁴⁷ Additionally, the greater reliance on faraway sources for food has resulted in a loss of access to markets for many local and smaller-scale farmers, which, when combined with the loss of metropolitan farmland to urban sprawl, only exacerbates the vulnerability of food systems in many parts of the country.⁴⁸ Increased truck-miles and air-miles in food transportation worsen air pollution and climate change; increased roadway congestion causes more accidents; the loss of nearby slaughter and packing facilities increases travel times and stress for animals. Together, these factors accumulate social, economic, and environmental costs that are greater than what food source communities get in return for their products.

Increased Road- and Air-miles in Food Transportation

Environmentalists are increasingly concerned about the distance food travels from field to plate—typically 1,500 road-miles—which creates unsustainable demands on transportation, air quality, climate, and energy systems. One study revealed that the average distance for fruits transported to the Jessup, MD, terminal market was 2,146 miles, while

the average for vegetables was 1,596 miles.⁴⁹ Transportation accounts for about 11 percent of the energy use in the food system.⁵⁰ About 93 percent of fresh produce transported between cities in this country was carried by trucks, according to a 1996 USDA study.⁵¹ In addition to general emissions that affect our climate, truck emissions create disparate air quality-related health impacts on low-income and minority neighborhoods because of their greater proximity to highways and truck terminals.⁵² Causing even more concern is the rapidly growing air transport of food, which creates the highest CO₂ emissions per ton.⁵³

Table 1 shows the energy consumption and tailpipe emissions for different modes of transportation. Of course, the actual mode of transportation and the distance traveled varies by specific food product and its origin. Distances traveled by different products shipped from within the continental United States are given in table 2 (which also shows how much averages derived from travel within the continental United States may understate actual distances if a larger share of a product comes from Mexico). Energy consumption and emissions for different kinds of truck transportation participating in distinct local, regional, and the conventional national food system considered by Pirog et al. (2001) are given in table 3. This last table underscores the point that the sustainability of local food systems is mediated by the specific mode and fuel used in transporting foods.

Finally, the transportation sector is responsible for more than one-quarter of all emissions causing climate change.⁵⁷ Many agri-food advocates are increasingly concerned about the implications of climate change for future agricultural productivity and food security in poorer regions of the world, given the greater likelihood of drought, soil erosion, extreme weather events, and higher pest prevalence.⁵⁸ More sustainable transportation, together with an agri-food system that reduces energy and transportation demand, would help reduce burdens on future agriculture globally.

Increased Consolidation of the Food Industry and Disparate Social and Spatial Impacts

Industrial agri-food's specialization in certain crops has concentrated food production in regions and uses large quantities of fossil fuels to ship food around the country and the world. For example, 95 percent of the nation's processed tomatoes and just under one-third of the fresh tomato crops come from California.⁵⁹ In 2007, nearly \$152 billion of agricultural products crossed U.S. borders as imports and exports, representing more than half the value of agricultural products sold by U.S. farms that year.⁶⁰ This specialization, however, has reduced many "receiving" regions' previous diversity of production and made them more vulnerable to shocks in the system. For example, agricultural modernization has favored large farm size, crop monocultures, mechanization, and increased chemical inputs. Moreover, research points to rising food insecurity among low-income farmers in some countries as subsistence production has been replaced by export-oriented mono-cropping.⁶¹ These challenges, of course, affect rural communities and predominantly smaller-scale and low-income farmers whose market reach is hurt by the loss of localized infrastructure and support for logistics (management of the movement of goods). Cheap energy and transportation subsidies have therefore enabled the consolidation and globalization of the agri-food sector.

The case of retail supermarkets and resulting disparities in healthy food access was presented in the first section of this paper.⁶² The increase in food miles traveled results from: (a) restructuring of logistical systems due to stricter requirements from retailers' management of inventories; (b) realignment of supply chains so that more of the product from farm to supermarket is owned by a single firm or a strategic partnership of firms (which has happened to reduce costs and risks and also increase responsiveness to consumers); (c) shifts in production and distribution scheduling

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decisions, with negotiated coordination replacing market coordination; and (d) changes in management of transport resources such as increasing the use of air instead of road transport for food.⁶³

The consolidation of processing, wholesaling, and distribution operations results in fewer, larger, and more efficient facilities and the closure of more local and regional processing plants, warehouses, and related facilities. As a result, the plant closures cause greater economic insecurity and health risks for nearby communities.

The transportation sector also has experienced consolidation, with somewhat similar results. Railroad consolidations, for example, have increased the number of captive customers and, while the monopolization helps railroads financially, it also tends to distort the location of economic activity, creating or exacerbating regional disparities⁶⁴—and therefore vulnerabilities—in the food system.

Food Versus Fuel and Related Health Impacts

The production of the most popular forms of biofuels—corn ethanol and palm oil—threatens to cause a major increase in greenhouse gas emissions.⁶⁵ In the United States, corn ethanol poses special concern because of its net negative energy balance (that is, more energy is required to produce a gallon of corn ethanol than can be gained from it) and because its production and use contribute to air, water, and soil pollution.⁶⁶ Some food security advocates worry that the continued expansion of biofuels is raising food prices in this country⁶⁷ and elsewhere and causing malnutrition in many developing countries.⁶⁸ Still others suggest that corn ethanol has a worse impact on the environment and human health than do conventional fuels such as gasoline and diesel.⁶⁹ There are direct transportation impacts as well: as corn use shifts from exports and animal-feed use to ethanol production, grain transportation

is affected because of changes in quantities transported to diverse destinations and modes of freight used for raw and finished products.⁷⁰

To summarize the paper's analysis, transportation policies and subsidies—when combined with cheap energy over the past six decades—have thus created patterns of spatial dispersion of people and food outlets over the metropolitan landscape in ways that pose special hardships for low-income food shoppers as well as agri-food workers in urban and rural communities. Transportation has also enabled structural change in the agri-food sector so that decisions made in the name of economic efficiency have generated many negative environmental, social, health, economic, and spatial consequences, along with increased costs and risks to society as a whole. These consequences call for a review of the basic goals and purposes of transportation policy so that environmental, social, and health needs and goals take priority over private gain.



Elements of a Sustainable Agri-food System

A primary contribution of the agri-food system is to deliver adequate nutrition to support the health of human communities now and into the future. However, contemporary industrial agri-food practices also create direct health problems (such as through the effects of pesticides on farm workers or widespread obesity among youth and adults) and indirect health problems (through diminished quality of air and ground water and the pervasive use of antibiotics in meat production, for example). These practices also endanger the very base upon which the food system depends, thereby threatening future food security and health. That is, they are unsustainable.

A sustainable food system promotes the health of individuals, communities, *and* the ecosystem. As this paper shows, transportation is implicated in many of the pathways linking the agri-food system and health. Sustainable food systems are typically organized around the following principles, on which consensus more or less exists:

- produce and distribute food so that all persons have adequate access to nutritious foods within neighborhoods;
- respect and operate within the biological limits of natural resources such as soil, water, and species;
- minimize energy inputs, recycle resources, and use renewable energy and other resources;
- support vital and diverse urban and rural economies;
- enable viable livelihoods and fair trade among producers, processors, distributors, retailers, and consumers;

- provide safe, fair, and satisfying working conditions for workers;
- treat animals humanely;
- sustain the amount and quality of land needed for food production; and
- promote democratic processes in decision making related to food and nutrition.⁷¹

Transportation Goals

The following goals are proposed for transportation policy and programs to help build sustainable food systems that promote human, community, and environmental health in the United States and globally.

1. Healthy food access for all, with special focus on the needs of low-income communities and communities of color, through appropriate land use policies and affordable transportation alternatives.
2. Affordable and reliable transportation alternatives for low-income agri-food workers so that they may have access to employment, food sources, and other basic needs.
3. Transportation policies and programs that prioritize regional linkages over national and global ones as they relate to food systems so that local producers are connected with local eaters; regional economic development is promoted through localized networks and infrastructure; small-scale farms are supported; air pollution and climate change impacts are reduced; and risks associated with agri-food concentration, dependence on distant sources, and energy price hikes are mitigated.

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Table 4. *Desired Policies and Programs to Address Transportation-Related Agri-food Problems: Opportunities for Success*

Goals	Desired Policies and Programs
<p>Reduce disparities in access to healthy foods</p>	<p>Support local and metropolitan land use policies and planning for increasing neighborhood-based access to food retail sites such as stores, farm stands, and urban agriculture sites⁷²:</p> <ul style="list-style-type: none"> • Promote smart growth development that supports multiple transport modes and contains grocery stores, urban agriculture sites, and farm stands. • Encourage transit oriented neighborhood design to include grocery outlets. • Retrofit older neighborhoods for pedestrian, bike, and transportation access to food outlets and urban agriculture sites. • Reduce required parking for grocery stores in exchange for public bus connectivity during peak grocery shopping times (weekends, especially). <p>Support policies and programs that promote transportation access for low-income residents to grocery outlets and other healthy food sites:</p> <ul style="list-style-type: none"> • Promote paratransit or public-private partnerships for shuttle programs sponsored by supermarkets,⁷³ congregate (subsidized) housing facilities and community-based nonprofits to provide affordable rides for grocery shopping. • Develop and promote “grocery bus” routes⁷⁴ with weekend service to connect low-income neighborhoods to full-service supermarkets, food pantries, and urban agriculture sites. • Support community-based programs to create mobile markets or grocery van-delivery in urban and rural communities.⁷⁵ <p>Require transportation support in federal nutrition programs:</p> <ul style="list-style-type: none"> • Include transportation support for WIC, food stamp (SNAP), Summer Food Service, and farmers’ market-related nutrition programs to access healthy foods.⁷⁶ • Provide transportation support for small-scale farmers to sell at farmers’ markets in or near low-income urban or rural areas.

Goals	Desired Policies and Programs
Promote safe and affordable transit for agri-food workers	<ul style="list-style-type: none"> • Increase funding for job access and reverse commutes for low-income employees, including agri-food workers. • Encourage metropolitan transportation system design to increase access for low-income agri-food workers in processing, wholesale, and retail jobs in metropolitan areas. • Encourage paratransit options (vanpools) for farm workers.⁷⁷ • Review rules related to vehicle conversion for farm-worker transportation and safety equipment/use to increase transportation safety and minimize accidents.
Promote agri-food sustainability	<ul style="list-style-type: none"> • Support within transportation law small-scale farmers' and processors' transportation of product to farmers' markets and other local outlets. • Encourage and support cleaner and more efficient vehicles, especially smaller trucks used for local food transportation. • Review and adjust tax structure as it relates to overall transportation subsidy so that social and environmental costs associated with emissions in agri-food transportation are reflected in prices, especially in the case of air transportation of foods. • Promote use of more sustainable modes of freight for long-distance food transportation, such as rail and water. • Increase competitive access to rail for food transport (via separation of ownership of rail infrastructure from that of rolling stock, e.g. rail cars), increase subsidy for rail relative to road and air, and break up geographic concentration of control over railway infrastructure (e.g. tracks) to increase competition. • Prioritize local and regional food transportation networks and infrastructure over long-distance ones. • Support the development of mobile kitchens and processing facilities in urban and rural communities. • Promote metropolitan planning to prevent sprawl, preserve farmland, and promote urban agriculture in transportation-related rights of way.⁷⁸
Prioritize agriculture for food and promote sustainable biofuels	<ul style="list-style-type: none"> • Minimize competition in agricultural production between food and fuel (since most biofuel is used for transportation) by giving food a clear priority. • Support the development and promotion of genuinely sustainable biofuels. • Support the widespread conversion of waste cooking oil into biodiesel. • Internalize social and environmental costs of corn-ethanol production and end subsidies for biofuels that are sourced from food grains.

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Goals	Desired Policies and Programs
General recommendations	<ul style="list-style-type: none"> • Promote greater coordination between transportation and agri-food policies and programs. • Provide greater support for intra-regional (versus inter-regional) transportation. • Encourage tighter links among transportation planning, policy, and programs and anti-sprawl and pro-urban planning. • Facilitate improved regional coordination to support multiple transportation modes and programs and diverse trip purposes and needs. • Develop transportation systems at the regional level to create positive economic impact, including through regional food systems. • Consider USDA's Community Food Projects Competitive Grants Program as a model to promote community- and region-based collaborative approaches to improve food access, market access to small-scale farmers, and affordable agri-food system transportation.⁷⁹

4. The agri-food system reconfigured as a resource to reduce energy and transportation demands and related problems through the development of more local food systems and truly renewable fuels.

approach to improve health, build localized food systems, reduce the energy intensity of the agri-food system, and help the agri-food system contribute to the creation of sustainable transportation systems.

Transportation Policies: Opportunities and Barriers

Many of the problems outlined in the first part of this paper are rapidly turning into emergencies—if they are not already emergencies. Their simultaneous occurrence presents something of a perfect storm for health and sustainability concerns. The upcoming authorization of the federal transportation bill offers a significant opportunity to make headway in addressing—and correcting—these problems. The crises related to rising incidence of obesity and diet-related diseases, climate change, and national energy and food security provide impetus to increase access to healthy foods as part of a preventive

Specific recommendations that link policies and programs to emerging problems are presented in table 4.

Notwithstanding the policy and programmatic opportunities outlined in table 4, those seeking to meet health goals within transportation legislation face many barriers to success. These are outlined below.

The most obvious barrier lies in the structure of transportation funding, legislation, and governance—especially at the federal level. The majority of transportation funds are allocated by formulas tied to modes and trip purposes; this makes it hard to achieve the goals outlined here within the existing structure of transportation policy and policymaking. The

problem is that, at the national level, we fund and manage transportation programs primarily by mode, rather than by urgent societal needs or compelling national goals. We also allocate funding by state, making achievement of national goals even more difficult. This is further complicated by competition between donor and donee states (that is, states that send more gas taxes to the federal transportation budget than they receive in transportation funding, or vice versa), a situation made worse in the current recession because many of the donee states are in the hard-hit, former manufacturing belt of the Midwest. Moreover, we fund transportation through a myriad of other (non-Department of Transportation) agencies, including the departments of Agriculture (USDA) and Health and Human Services (HHS), leading to further fragmentation by sector. Such fragmentation of the program is the cause of many transportation-related problems experienced by communities and within metropolitan regions.

The problems posed by programmatic fragmentation suggest that addressing food- and health-related transportation problems, as recommended in this paper, could increase overall transportation inefficiency, if they are not coordinated well, that is, more silos are not the solution. Instead, the programs and policies recommended here must be tied to land use policies that reduce transportation demand, improve access and regional connectivity (regardless of trip mode or purpose), and improve coordination between transportation providers and the system as a whole. In addition, policy must prioritize regional food system transportation connectivity over national or international ones, support more energy-efficient and less polluting modes and vehicles, and more effectively use spare capacity in existing programs to support food access for low-income consumers and regional market access for small-scale farmers. This will require coordination across federal agencies such as Department of Transportation (DOT), USDA, and the Environmental Protection Agency (EPA).

Lack of precedence within transportation

legislation for key asks: To date, there is little precedence for transportation legislation incorporating many of the policies recommended in this paper. Some policymakers may view the recommendation to increase transportation assistance to low-income households participating in federal nutrition programs as more appropriately falling within the agriculture law. USDA already funds transportation for rural providers of the Summer Food Service Program, which feeds low-income children.⁸⁰ Similarly, the recommendation to prioritize agriculture for food over fuel may be viewed as falling under agriculture or energy, rather than transportation, even if most of the corn ethanol is destined for transportation-related uses.

Highways and roads (rather than access) as the primary orientation of transportation policy:

Despite the progressive changes ushered in by *ISTEA* and its successors, transportation policy continues to be driven by a dominant orientation toward roads and highways, rather than toward multi-modality that provides access to goods, services, employment, healthy food, etc., thereby meeting community and regional needs and goals. Local land use decisions often follow, rather than drive, regional transportation planning by metropolitan planning organizations. Because land use decisions are local, more support is also needed than is available within the transportation legislation for *transportation planning* that effectively integrates land use and transportation to promote smart growth, that is, increase mixed-use, transit oriented development and neighborhood-based access to basic needs. Similarly, many advocates believe that transportation programs and funding tend to be designed to serve the interests of powerful groups—highway builders, auto manufacturers, and petroleum corporations—and that relationships of power and patronage, rather than systematically derived community needs, drive transportation policy.

Sustainable Food Systems

Impending revenue shortfalls from gas

taxes: The expected shortfalls in the Highway Trust Fund present a challenge to funding new programs in the transportation legislation. Policymakers will need to find additional sources of funding that are adequate, sustainable, and fair. To this end, policies that improve health can result in savings in other areas, such as healthcare cost savings⁸¹ and can present new funding alternatives to fuel taxes. Such solutions go beyond the oft-suggested road and congestion pricing, both of which may further disadvantage the communities already at risk from current policies. More research is needed related to the net benefits and costs of transportation programs, including those suggested in this paper.

Convergence Opportunities

Efforts to build sustainable food systems are inherently boundary spanning and require work across disciplines, sectors, professions, and geographic scales. The federal transportation law authorization process provides unique opportunities to build partnerships among interests in sustainable agri-food systems, smart growth, public health, community economic development, anti-poverty and social justice, labor, energy security, and climate change mitigation.

Coalitions that have emerged to advocate for transportation policy reform, such as the Transportation Equity Network, Transportation for America, Surface Transportation Policy Project, Complete Street Coalition, and Smart Growth America, are calling for proposals with broadly similar goals as those suggested herein, even if they are largely silent on agri-food issues addressed in this paper.⁸² Among the coalitions advocating for more sustainable agri-food systems or elements thereof are the Community Food Security Coalition, National Sustainable Agriculture Coalition, Food Research and Action Center, National Family Farm Coalition, and American Farmland Trust.⁸³ Past efforts by these

groups to bring attention to sustainable agri-food issues within the transportation law have borne little, if any, fruit. We hope that the broad health rubric under which these papers are assembled will help coalesce the many groups mentioned above and attract new groups into the fold to add power to related transportation advocacy.

Additionally, the specific proposals made by this paper call for greater collaboration and coordination among various departments at the federal and state levels. For example, the proposals in this paper could benefit from partnerships among:

- DOT and USDA (and Department of Health and Human Services or the Department of Education when applicable) to provide transportation assistance to nutrition program participants in order to procure food, to improve neighborhood-based access to healthy foods through the use of transportation resources, and to support small-scale farmers' efforts to bring products to local markets in underserved areas. This would increase participation in nutrition programs such as SNAP, WIC, Summer Food Service, and Farmers' Market Nutrition; it would also increase the benefits of participation, improve health, and reduce healthcare costs.



- DOT, USDA, and the Department of Labor to provide affordable transportation for urban and rural agri-food workers to access jobs, food, healthcare, and other vital services.
- DOT, USDA, the Department of Energy, and the EPA to support the development of more truly renewable energy sources in environmentally sensitive ways, including through the use of switchgrass and waste cooking oil; to support the development of fuel-efficient vehicle and transportation systems; and to discourage the use of food grains for producing fuel. Such cooperation is sorely needed to eliminate the competition between food and fuel.
- USDA, DOT, and the EPA to mitigate the problems caused by long-distance transportation of food in international trade.
- Does the regional transportation infrastructure support local food producers and processors to efficiently market to local consumers, in addition to national distribution channels?
- Do transportation policies support modes of freight, fuel choices, and vehicle designs such that air and water pollution, greenhouse gas emissions, and energy use are minimized?
- Are the currently externalized social, health, and environmental costs and increased risks posed by the global, industrial food system internalized in the price of food and transportation? Are associated costs and benefits fairly distributed across diverse income and racial groups in urban and rural areas?
- Does the agri-food system support transportation policies with renewable and efficient options for energy that reduce environmental impacts on air, water, and climate; minimize competition with food production; and reduce dependence on foreign sources for energy?

Conclusion

This paper presents four clear problems impacting the interaction between agri-food and transportation systems and suggests possible actions that could solve them. Some solutions can be addressed through transportation legislation, but clearly efforts need to extend to legislation that addresses energy, agriculture, child nutrition, labor, and health and human services.

Whatever the final mix of policies, successful efforts will result in affirmative responses to the following questions:

- Do neighborhoods provide convenient access for all residents to healthy foods and other basic goods and services? Do they allow food shopping without the need for a car?
- Beyond basic accessibility, do transportation policies and programs enhance local and regional quality of life through improved multi-modal access for all residents to the region's resources and destinations and through reduced congestion?

The transportation authorization process presents opportunities to break bad habits, extend positive developments from the past, and launch bold new initiatives that set us on a better course. Promising directions that build on positive aspects of *SAFETEA-LU* include, for example, correcting inequities in funding across states; providing dedicated funding to states to meet air quality requirements; and creating pilot programs to test alternative transportation funding schemes (which should be extended beyond tolling and road pricing schemes that may hurt the transportation-disadvantaged).

Clearly, other strategies are needed to eliminate disparities and problems caused by the current agri-food–transportation system linkage: extending transportation programs to increase access to healthy food and agri-food employment, reducing railroad concentration, ending competition between food and fuel, and more.

Notes

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- ¹ U.S. Department of Agriculture, Economic Research Service, "Global Food Markets: Global Industry Structure," 2008, <http://www.ers.usda.gov/Briefing/GlobalFoodMarkets/Industry.htm> (accessed January 31, 2009).
- ² Food insecurity is said to exist whenever "the availability of nutritionally adequate and safe food, or the ability to acquire acceptable foods in socially acceptable ways, is limited or uncertain." S. A. Anderson, ed., "Core Indicators of Nutritional Status for Difficult-to-sample Populations," *Journal of Nutrition* 120 (1990): 1559–1600, 1560. Food insecurity ranges from a painful sensation of hunger, at its most severe, to families being relegated to a few inexpensive staple foods—such as macaroni and cheese—that do not alone make up a nutritious and varied diet. Inconsistent availability of food, lack of transportation to grocery stores, and skipping meals to keep food costs down all are indicators of food insecurity. Conversely, food security refers to access by all people at all times to a sufficient quantity of safe, nutritious, affordable, and culturally appropriate food for an active, healthy life, obtained through conventional sources.
- ³ In this paper, "access" is used to signify spatial proximity or convenient and affordable transportation to destinations. Proximity is central because low-income urban households display lower rates of automobile ownership and may need to rely for grocery shopping on walking, taking the bus, or rides from acquaintances. Social, cultural, and economic categories of access of food are also key to this paper; they are defined, however, by the term "food security" (see endnote 2).
- ⁴ For example, the top five grocery retail chains captured 48 percent of the market in 2007, double that in 1997, <http://www.nfu.org/wp-content/2007-heffernanreport.pdf> (accessed January 19, 2009).
- ⁵ Brookings Institution, *From Poverty, Opportunity: Putting the Market to Work for Lower-income Families* (Washington, DC: Brookings Institution, 2006), http://www.brookings.edu/reports/2006/07poverty_fellowes.aspx (accessed January 19, 2009); K. Pothukuchi, "Attracting Supermarkets to Inner-city Neighborhoods: Economic Development Outside the Box," *Economic Development Quarterly* 19 (2005): 232–44; E. Eisenhauer, "In Poor Health: Supermarket Redlining and Urban Nutrition," *GeoJournal* 53 (2004): 125; and R. W. Cotterill and A. W. Franklin, "The Urban Grocery Store Gap," Food Marketing Policy Issue Paper 8 (Storrs, CT: Food Marketing Policy Center, University of Connecticut, April 1995).
- ⁶ Today, the top food retailers control their own supply chains and manage their own fleets of trucks, warehouses, and buying offices. For example, Kroger has roughly 30 distribution centers to serve its 2,500 supermarkets, and other leading chains do the same to fully integrate their supply chains as a key strategy for remaining profitable. See Oakland Institute Report, "Food Chain Consolidation in U.S., 2007," <http://www.foodpolicy.in/html/archive/2007/rep/oakland1.htm> (accessed January 19, 2009). See also M. Hendrickson et al., "The Global Food System and Nodes of Power," Report prepared for Oxfam America, August 2008 (accessed March 24, 2009), paper can be downloaded by clicking on SSRN at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1337273; and Competition Commission, Groceries Market Roundtable Meeting (Amended Notes) (London, UK: October 9, 2006).
- ⁷ See, for example, a Canadian study: K. Larsen and J. Gilliland, "Mapping the

Evolution of Food Deserts in a Canadian City: Supermarket Accessibility in London, Ontario, 1961–2005,” *International Journal of Health Geographics* 7 (2008), <http://www.ij-healthgeographics.com/content/pdf/1476-072X-7-16.pdf> (accessed January 31, 2009). The study showed that in 1961, more than 75 percent of London’s downtown population lived within convenient access to grocery stores (i.e., a 10-minute bus ride combined with a 500-meter walk at the beginning or end of a bus trip). Because Canadian cities saw similar patterns of urban sprawl but at a lower intensity or scale than did most U.S. cities, it is safe to apply this study to U.S. cities as a general pattern.

- ⁸ M. A. Delucchi and J. Murphy, “How Large Are Tax Subsidies to Motor-vehicle Users in the U.S.?,” *Journal of Transport Policy* 15 (2008): 196–208.
- ⁹ For elaborations on this theme, see Brookings Institution, *From Poverty, Opportunity: Putting the Market to Work for Lower-income Families* (see endnote 5); D. Hendrickson, C. Smith, and N. Eikenberry, “Fruit and Vegetable Access in 4 Low-income Food Desert Communities in Minnesota,” *Agriculture and Human Values* 23 (2006): 371–83; M. Gallagher, *Examining the Impact of Food Deserts on Public Health in Detroit* (Chicago: Mari Gallagher Research and Consulting Group, 2007); M. Gallagher, *Examining the Impact of Food Deserts on Public Health in Chicago* (Chicago: Mari Gallagher Research and Consulting Group, 2006); S. N. Zenk et al., “Neighborhood Racial Composition, Neighborhood Poverty, and Spatial Accessibility of Supermarkets in Metropolitan Detroit,” *American Journal of Public Health* 95 (2005): 660–67; E. Bolen and K. Hecht, *Neighborhood Groceries: New Access to Healthy Food in Low-income Communities* (San Francisco: California Food Policy Advocates, January 2003); and many others. The Brookings Institution study found, for example, that the average grocery

store in its sample of 2,384 low-income neighborhoods is 2.5 times smaller than the average grocery store in a high-income neighborhood. Also, there is about one mid- or large-sized grocer for every 69,055 residents in low-income neighborhoods, half the availability found in other neighborhoods. Access to only small grocery stores results in higher food prices for low-income shoppers. In particular, more than 67 percent of the same food products in its sample of 132 different products are more expensive in small grocery stores than in larger grocery stores.

- ¹⁰ T. C. Blanchard and T. A. Lyson, “Retail Concentration, Food Deserts, and Food Disadvantaged Communities in Rural America,” in *Remaking the North American Food System*, eds. C. C. Hinrichs and T. A. Lyson (Lincoln, NE: University of Nebraska Press, 2007); C. Wirth, R. Strohlic, and C. Getz, *Hunger in the Fields: Food Insecurity among Farmworkers in Fresno County* (CA: California Institute for Rural Studies, 2007); A. D. Liese et al., “Food Store Types, Availability, and Cost of Foods in a Rural Environment,” *Journal of the American Dietetic Association* 107 (November 2007): 1916–23; T. Blanchard and T. Lyson, “Food Availability & Food Deserts in the Nonmetropolitan South,” Southern Rural Development Center, 2006, http://srdc.msstate.edu/focusareas/health/fa/fa_12_blanchard.pdf (accessed January 19, 2009); L. W. Morton et al., “Solving the Problems of Iowa Food Deserts: Food Insecurity and Civic Structure,” *Rural Sociology* 70 (2005): 94–112; L. W. Morton and T. C. Blanchard, “Starved for Access: Life in Rural America’s Food Deserts,” *Rural Realities* 1 (2007): 10; E. A. Bitto et al., “Grocery Store Access Patterns in Rural Food Deserts,” *Journal for the Study of Food and Society* 6 (2003): 35–48; C. Getz, “Perceived High Cost Deters Farmworkers from Eating Produce, According to UC Study,” University of California, News and Information Outreach, 2006, <http://news.ucanr.org/>

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- ¹¹ K. Morland and S. Filomena, "Disparities in the Availability of Fruits and Vegetables between Racially Segregated Urban Neighbourhoods," *Cambridge Journals Online* 10 (2007): 1481–89; L. V. Moore, A. V. Diez-Roux, "Associations of Neighborhood Characteristics with the Location and Type of Food Stores," *American Journal of Public Health* 96 (2006): 325–31; D. Block and J. Kouba, "A Comparison of the Availability and Affordability of a Market Basket in Two Communities in the Chicago Area," *Public Health Nutrition* 9 (2007): 837–45; M. Gallagher, 2007 and 2006 (see endnote 9); J. Block, R. A. Scribner, and K. B. De Salvo, "Fast Food, Race/Ethnicity, and Income: A Geographic Analysis," *American Journal of Preventive Medicine* 27 (2004): 211–17; K. Morland et al., "Neighborhood Characteristics Associated with the Location of Food Stores and Food Service Places," *American Journal of Preventive Medicine* 22 (2002): 23–29, and many others.

- ¹² For a documentation of the decline and rise of farmers' markets over the 20th century, see H. Tangires, *Public Markets and Civic Culture in Nineteenth Century America* (Baltimore: Johns Hopkins University Press, 2003); A. Brown, "Farmers' Market Research 1940–2000: An Inventory and Review," *American Journal of Alternative Agriculture* 17 (2002): 167–76.

- ¹³ Since 1994, when the USDA started to track growth in farmers' markets, more than 3,000 farmers' markets have opened nationally, reaching a total of 4,685 markets in August 2008. USDA, Economic Research Service, "Global Food Markets: Global Industry Structure," 2008, <http://www.ers.usda.gov/Briefing/GlobalFoodMarkets/Industry.htm>

(accessed January 31, 2009).

- ¹⁴ American Farmland Trust, "Farming on the Edge Report," <http://www.farmland.org/resources/fote/default.asp> (accessed January 19, 2009).
- ¹⁵ Surface Transportation Policy Project, "Surface Transportation and Poverty Alleviation," n.d., <http://www.transact.org/library/factsheets/poverty.asp> (accessed January 19, 2009); R. D. Bullard and G. S. Johnson, eds., *Just Transportation: Dismantling Race and Class Barriers to Mobility* (Gabriola Island, BC: New Society Publishers, 1997); and A. D. Gardenshire, "Economic and Sociodemographic Influences on Autolessness: Are Missing Variables Skewing Results?," *Transportation Research Record* 1670 (1999): 13–16.
- ¹⁶ S. H. Babey et al., *Designed for Disease: The Link Between Local Food Environments and Obesity and Diabetes* (Los Angeles: California Center for Public Health Advocacy, PolicyLink, and UCLA Center for Health Policy Research, 2008), <http://www.healthpolicy.ucla.edu/pubs/publication.asp?pubID=250> (accessed January 19, 2009); L. Mikkelsen, S. Chehimi, and L. Cohen, *Healthy Eating & Physical Activity: Addressing Inequities in Urban Environments* (Oakland, CA: Prevention Institute, 2007); M. Gallagher, 2007 and 2006 (see endnote 9); M. C. Wang et al., "Changes in Neighbourhood Food Store Environment, Food Behaviour and Body Mass Index, 1981–1990," *Cambridge Journals Online* 11 (2007): 963–70; K. Morland, S. Wing, and A. V. Diez-Roux, "The Contextual Effect of the Local Environment on Residents' Diets: The Atherosclerosis Risk in Communities Study," *American Journal of Public Health* 11 (2002): 1761–67; and The Food Trust, "Food Geography: How Food Access Affects Diet and Health," http://www.thefoodtrust.org/catalog/download.php?product_id=120 (accessed January 19, 2009).

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- ¹⁸ See, for example, Zenk et al., "Neighborhood Racial Composition" (endnote 9).
- ¹⁹ S. L. Handy, "Understanding the Link between Urban Form and Nontravel Behavior," *Journal of Planning Education and Research* 15 (1996): 183–98; and J. Boivin and P. Matharu, "Bus Transit and Grocery Shopping in Detroit, Wayne State University Department of Geography and Urban Planning, unpublished paper, 2008.
- ²⁰ S. L. Handy and K. Clifton, "Local Shopping as a Strategy for Reducing Automobile Travel," *Transportation* 28 (2001): 317–46.
- ²¹ See, for example, K. Clifton, "Mobility Strategies and Food Shopping for Low-Income Families: A Case Study," *Journal of Planning Education and Research* 23 (2004): 402–13.
- ²² This is an especially significant problem for the rural elderly. *Food Security, Insecurity, and Hunger: Rural Food Access Patterns: Elderly Open-Country and In-Town Residents* (Ames, IA: Iowa State University Extension, 2004); and K. Clifton, "Mobility Strategies" (see endnote 21).
- ²³ N. Wrigley, "Understanding Store Development Programmes in Post-property-crisis UK Food Retailing," *Environment and Planning A* 30 (1998): 15–35.
- ²⁴ For recent statistics on national food insecurity, see, for example, M. Nord, M. Andrews, and S. Carlson, "Household Food Security in the United States, 2007," USDA, Economic Research Service, Report #66, 2008, <http://ers.usda.gov/Publications/ERR66/ERR66.pdf> (accessed January 19, 2009).
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- ²⁶ Food Research and Action Center, "Food Stamp Participation in May 2008 Sets Another Record High," http://www.frac.org/html/news/fsp/2008.05_FSP.htm (accessed January 19, 2009).
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- ²⁹ A Fresno County, CA, study found that nearly half of all farm worker households were food insecure compared to 36 percent of all county households. The same study also found that just over half and only about 36 percent of those eligible used food stamps in the winter and summer, respectively. C. Getz, "Perceived High Cost Deters Farmworkers from Eating Produce, According to UC Study," University of California, News and Information Outreach, 2006, <http://news.ucanr.org/newsstorymain.cfm?story=899> (accessed January 19, 2009).

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- ³⁴ S. L. Handy and K. Clifton, "Local Shopping as a Strategy," 331 (see endnote 20).
- ³⁵ E. A. Bitto et al., "Grocery Store Access Patterns in Rural Food Deserts," *Journal for the Study of Food and Society* 6 (2003): 35–48.
- ³⁶ L. F. Alwitt and T. D. Donley, "Retail Stores in Poor Urban Neighborhoods," *Journal of Consumer Affairs* 31 (1997): 139–64; C. Chung and S. L. Myers, "Do the Poor Pay More for Food? An Analysis of Grocery Store Availability and Price Disparities," *The Journal of Consumer Affairs* 33 (1999): 276–96; and P. Kaufman and S. M. Lutz, "Competing Forces Affect Food Prices" (see endnote 10).
- ³⁷ However, WIC rules do allow states leeway in deciding whether or how to address transportation issues in making healthcare appointments. USDA, Food and Nutrition Service, *Federal Register: "Special Supplemental Nutrition Program for Women, Infants, and Children (WIC): Miscellaneous Provisions," Proposed Rule*, 2002, <http://www.fns.usda.gov/cga/Federal-Register/2002/120202.pdf> (accessed January 19, 2009). For example, in Michigan, WIC participants are allowed to seek transportation assistance for both healthcare as well as nutrition counseling appointments, whereas in West Virginia, only healthcare appointments are funded for transportation assistance. Other programs such as the Summer Food Service Program and senior nutrition programs are more sensitive to the transportation needs of their younger and older clients, respectively, and provide community grants for transportation assistance, <http://www.summerfood.usda.gov/Community/transportation-grants.html> (accessed March 24, 2009). Additionally, a small pot of USDA funding exists for farmers to bring product to market. Few studies exist on who benefits from this funding and how it is used.
- ³⁸ Food Research and Action Center, "Rural Transportation Grants Successfully Increase Summer Food Participation," 2006, http://www.frac.org/afterschool/pdf/rural_transportation_grants_report_2006.pdf (accessed February 12, 2009).
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- ⁴⁰ In March 2008, for example, wholesale food prices, an indicator of retail prices, rose the previous month at the fastest rate since 2003, with egg prices jumping 60

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- ⁴⁴ R. Stochlic et al., "An Assessment of the Demand for Farm Worker Housing and Transportation in Mendicino County" (California Institute for Rural Studies, August 2008). See also Rural Assistance Center (RAC), http://www.raconline.org/info_guides/transportation/ (accessed January 30, 2009). According to the RAC, 40 percent of all rural residents live in areas with no public transportation, and another 28 percent live in areas with limited levels of service.
- ⁴⁵ R. Stochlic et al., "An Assessment of the Demand for Farm Worker Housing and Transportation in Mendicino County" (see endnote 44).
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- ⁴⁷ See, for example, M. C. Heller and G. A. Keoleian, *Life Cycle-Based Sustainability Indicators for Assessment of the U.S. Food System* (CSS00-04) (Ann Arbor, MI: University of Michigan, Center for Sustainable Systems, 2000). From a personal communication with Ken Dahlberg, Professor Emeritus at Western Michigan University (September 27, 2006), of the energy used in the U.S. food system, roughly 21 percent is used for agricultural production, 14 percent for transportation, 16 percent for processing, 7 percent for packaging, 7 percent for eating establishments, 4 percent for food retailing, and 31 percent for home food refrigeration and cooking.
- ⁴⁸ In Michigan, the nation's second most agriculturally diverse state (California is first), only about 10 percent of the \$25.7 billion spent on groceries at home and for eating out went to the state's producers. P. Cantrell, *The New Entrepreneurial Agriculture* (Benzie, MI: Michigan Land Use Institute, 2003), <http://mlui.org/downloads/newag.pdf> (accessed January 19, 2009). Similar trends exist in Iowa and other agricultural states. For example, see Pirog et al., *Food, Fuel, and Freeways* (see endnote 39).
- ⁴⁹ M. Hora and J. Tick, *From Farm to Table: Making the Connection in the Mid-Atlantic Food System* (Washington, DC: Capital Area Food Bank of Washington, DC, 2001) (citation derived from R. Pirog et al., 2001; see endnote 39).

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- ⁵⁰ This figure varies between 11 percent (Pirog et al., 2001) and 14 percent (Dahlberg, personal communication), suggesting that more new research is needed on this topic.
- ⁵¹ R. Pirog et al., *Food, Fuel, and Freeways* (see endnote 39).
- ⁵² For example, see D. Houston, J. Wu, and P. Ong, "Structural Disparities of Urban Traffic in Southern California: Implications for Vehicle-related Air Pollution Exposure in Minority and High-poverty Neighborhoods," *Journal of Urban Affairs* 26 (2008): 565–92, for research related to the traffic that is generated by the Los Angeles (CA) port and its impacts on low-income and minority communities that are located nearby. Container traffic at the Ports of Los Angeles and Long Beach, CA, has tripled in the past 15 years, resulting in massive port-related heavy-duty diesel truck (HDDT) traffic on surface streets in the low-income and minority communities of Wilmington and western Long Beach adjacent to the ports. The volumes of HDDTs often reached 400 to 600/hour for several hours immediately upwind of sensitive land uses, such as schools, open-field parks, and residences. The documented health and environmental consequences of HDDT emissions raise serious public health concerns for the inhabitants who reside, work, attend school, or recreate in close proximity to roadways with HDDT traffic.
- ⁵³ R. Pirog et al., *Food, Fuel, and Freeways* (see endnote 39).
- ⁵⁴ *Ibid.*
- ⁵⁵ R. Pirog and T. Van Pelt, "How Far Do Your Fruits and Vegetables Travel?," Iowa State University, Leopold Center for Sustainable Agriculture, 2002, http://www.leopold.iastate.edu/pubs/staff/ppp/food_chart0402.pdf (accessed January 19, 2009).
- ⁵⁶ R. Pirog et al., *Food, Fuel, and Freeways*, 33 (see endnote 39).
- ⁵⁷ Pew Center on Global Climate Change, 2004, http://www.pewclimate.org/global-warming-basics/facts_and_figures/us_emissions/usghgemsector.cfm (accessed March 24, 2009).
- ⁵⁸ Roy Darwin, USDA, Economic Research Service, "Climate Change and Food Security," 2001, <http://www.ers.usda.gov/publications/aib765/aib765-8.pdf> (accessed March 23, 2009); and Food and Agriculture Organization, "Climate Change and Food Security," 2007, <http://www.un.org/climatechange/pdfs/bali/fao-bali07-6.pdf> (accessed March 23, 2009).
- ⁵⁹ USDA, Economic Research Service, "Vegetables and Melons," 2008, <http://www.ers.usda.gov/Briefing/Vegetables/tomatoes.htm> (accessed March 23, 2009).
- ⁶⁰ USDA, "Foreign Agriculture Trade of the United States, Value of U.S. trade—Agricultural, Nonagricultural, and Total—and Trade Balance, by Fiscal Year," updated January 13, 2009, <http://www.ers.usda.gov/data/FATUS/index.htm#value> (accessed January 19, 2009). According to the Census of Agriculture, in 2007, U.S. farms sold \$297 billion in agricultural products while incurring \$241 billion in production expenses, http://www.agcensus.usda.gov/Publications/2007/Online_Highlights/Fact_Sheets/economics.pdf (accessed March 22, 2009).
- ⁶¹ For example, see B. Meertens, "Agricultural Performance in Tanzania under Structural Adjustment Programs: Is It Really So Positive?," *Agriculture and Human Values* 17 (2000): 333–46.
- ⁶² Indeed, both the history of supermarket development—seen, for example, in the rise of the first supermarkets of the Great Atlantic and Pacific Tea Company—and the

current dominance of Wal-mart underscore the preeminent contribution of logistics and transportation to their retail dominance.

- ⁶³ A. Smith et al., "Validity of Food Miles as an Indicator of Sustainable Development," AEA Technology Environment, commissioned by Defra, 2005, <https://statistics.defra.gov.uk/esg/reports/foodmiles/execsumm.pdf> (accessed January 19, 2009); A. C. McKinnon and A. Woodburn, "Logistical Restructuring and Road Freight Traffic Growth: An Empirical Assessment," *Transportation* 23 (1996): 141–61; M. D. Boehlje, S. L. Hofing, and R. C. Shroeder, "Value Chains in the Agricultural Industries," Staff Paper # 99-10, August 31, 1999, http://www.centrec.com/Articles/value_chain_ag_industry/value_chains_in_ag_industry.pdf (accessed March 24, 2009); and A. Potter and B. Gardner, "Management of Transport Resources: Investigating the External Cost Impact of Integrated Inbound Logistics," Logistics and Operations Management Section, Cardiff Business School, December 2006, http://www.cardiff.ac.uk/carbs/research/working_papers/logistics/Investigating%20the%20external%20cost%20impact%20of%20integrated%20inbound%20logistics.pdf (accessed March 24, 2009).
- ⁶⁴ M. H. Sonstegaard, "Competitive Access to North American Rail," *Transportation Quarterly* 57 (2003): 61–67.
- ⁶⁵ See, for example, D. Pimental, "The Ecological and Energy Integrity of Corn Ethanol Production," in *Reconciling Human Existence with Ecological Integrity* eds. L. Westra, K. Bosselmann, and R. Westra (London: Earthscan, 2008); and J. P. W. Scharlemann and W. F. Laurance, "How Green Are Biofuels?," *Science* 319 (2008): 43–44. Relative to petroleum, nearly all biofuels diminish greenhouse gas emissions, although crops such as switchgrass easily outperform soy and corn. Scharlemann and Laurance argue, however, that the process for selecting one biofuel over another needs to consider its full environmental effects. When deforestation by palm oil producers or nitrogen use by corn producers is considered and their energy and emissions taken into account, they conclude that corn or canola biofuels may be worse for global warming than simply burning fossil fuels.
- ⁶⁶ Pimental, "The Ecological and Energy Integrity of Corn Ethanol Production," 252–53 (see endnote 67).
- ⁶⁷ See, for example, C. F. Runge and B. Senauer, "How Biofuels Could Starve the Poor," *Foreign Affairs* (May/June 2007); and USDA, Agricultural Marketing Service, Ethanol Transportation Backgrounder: "Expansion of U.S. Corn-based Ethanol from the Agricultural Transportation Perspective," 2007, <http://www.ams.usda.gov/AMSV1.0/getfile?dDocName=STELPRDC5063605&acct=atpub> (accessed January 19, 2009). Increased demand for ethanol has raised prices, which has resulted in increased production but also the diversion of corn from food-related uses to fuel.
- ⁶⁸ D. Cronin, Inter Press Service, "Development: 'Food Miles' Hard to Digest," 2008, <http://ipsnews.net/news.asp?idnews=41183> (accessed January 19, 2009).
- ⁶⁹ Corn-based bioethanol has higher burden on environment and human health. A. Jha, "Biofuels More Harmful to Humans than Petrol and Diesel, Warn Scientists," *Guardian*, February 2, 2009, <http://www.guardian.co.uk/environment/2009/feb/02/biofuels-health> (accessed January 30, 2009). Researchers found the total environmental and health costs of gasoline are about 71 cents per gallon, while an equivalent amount of corn-ethanol fuel has associated costs of 72 cents to \$1.45, depending on the use of chemicals in its production. However, there are high hopes for the next generation of biofuels, which can be made from organic

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waste or plants grown on marginal land that is not used to grow foods. These have less than half the combined health and environmental costs of standard gasoline and one-third of current biofuels.

⁷⁰ USDA, Agricultural Marketing Service, Ethanol Transportation Backgrounder: “Expansion of U.S. Corn-based Ethanol” (see endnote 67).

⁷¹ Prevention Institute, “Setting the Record Straight: Nutritionists Define Healthful Food,” 2009, http://www.preventioninstitute.org/sa/documents/SettingtheRecordStraight_final_031309_000.pdf (accessed March 24, 2009). See also policy guides by American Planning Association, <http://www.planning.org/policy/guides/adopted/food.htm>; and American Public Health Association, <http://www.apha.org/advocacy/policy/policysearch/default.htm?id=1361> (both accessed March 23, 2009); and Catholic Healthcare West Food and Nutrition Vision Statement, n.d.

⁷² The recommendations also have other benefits, such as household savings and job creation. For example, see T. Litman, “Smart Transportation Economic Stimulation: Infrastructure Investments That Support Strategic Planning,” 2009, http://www.vtpi.org/econ_stim.pdf (accessed: February 6, 2009). Litman argues that a reasonable scenario of aggressive fuel economy targets, investments in alternative modes, and supportive land use policies can reduce U.S. fuel consumption 20 percent–40 percent, saving future consumers \$150–\$350 billion annually in fuel and vehicle expenses; providing economic benefits from reduced fuel import costs of similar magnitude; producing additional economic, social, and environmental benefits; and generating one to two million additional annual domestic jobs.

⁷³ For example, Numero Uno Market in Los Angeles, CA, capitalized on the population density and high transit-dependence in the inner city to establish a van shuttle

service that takes shoppers who spend at least \$30 to their door. Coordinated with two Metropolitan Transportation Authority bus routes as a means for people to get to the store, Numero Uno’s nine-van shuttle service made it one of the top-five grossing supermarkets in Los Angeles. M. Vallianatos, A. Shaffer, and R. Gottlieb, *Transportation and Food: The Importance of Access* (Los Angeles: Occidental College, Center for Food and Justice, Urban and Environmental Policy Institute, 2002). See also a feasibility study, for example, which makes a business case for such shuttles when provided by supermarkets. D. Cassady and V. Mohan, “Doing Well by Doing Good? A Supermarket Shuttle Feasibility Study,” *Journal of Nutrition Education Behavior* 36 (2004): 67–70.

⁷⁴ Dedicated or special bus routes to connect low-income consumers have been provided by Austin, TX, and Hartford, CT. See Vallianatos et al., *Transportation and Food* (see endnote 73).

⁷⁵ For example, Belo Horizonte’s (Brazil) municipal food programs include vans that act as mobile grocery stores. Together, these programs—along with special stores that sell foods in bulk, farm stands, and popular restaurants in low-income neighborhoods—cost less than one percent of the city’s budget. C. Rocha, “Urban Food Security Policy: The Case of Belo Horizonte, Brazil,” *Journal for the Study of Food and Society* 5 (2001): 36–47.

⁷⁶ Research on nonemergency medical transportation shows cost savings as well as increased welfare as a result of transportation subsidies. R. Wallace et al., “Access to Health Care and Non-emergency Medical Transportation: Two Missing Links,” *Transportation Research Record* 1924 (2005): 76–84; and P. Hughes-Cromwick and R. Wallace, Executive Summary: *Cost-benefit Analysis of Providing Nonemergency Medical Transportation* (Washington, DC:

Transit Cooperative Research Program, Transportation Research Board, January 2006). Such a preventive health approach should be adopted in integrating transportation into federal nutrition programs.

⁷⁷ An innovative example of farm worker transportation is demonstrated by Agricultural Industries Transportation Services, which provides vanpools to qualified farm workers in Kings, Tulare, and Fresno counties (CA), <http://www.kartaits.com/aitshome.htm> (accessed January 19, 2009).

⁷⁸ In addition to connecting rural food production with urban consumers, some cities are linking transportation and food production within the urban setting. In Tennessee, *ISTEA* funded a program that constructs community gardens along recreational corridors such as bike and walking trails. In Madison, WI, low-income gardeners working with the Community Action Coalition set up food gardens in highway rights of way, within cloverleaf intersections, and by the side of roads. See Vallianatos et al., *Transportation and Food* (endnote 73).

⁷⁹ USDA, Cooperative State Research, Education and Extension Services, <http://www.csrees.usda.gov/fo/communityfoodprojects.cfm> (accessed March 24, 2009).

⁸⁰ USDA, Summer Food Service Program, <http://www.summerfood.usda.gov/Community/transportation-grants.html> (accessed March 24, 2009).

⁸¹ R. Wallace et al., "Access to Health Care and Non-emergency Medical Transportation," and P. Hughes-Cromwick and R. Wallace, Executive Summary: *Cost-benefit Analysis* (see endnote 76 for both citations).

⁸² For more information about these coalitions and organizations see: <http://www>.

[transportationequity.org/](http://www.transportationequity.org/); <http://www.transportationforamerica.org/>; <http://www.transact.org/>; <http://www.completestreets.org/>; and <http://www.smartgrowthamerica.org/transportation.html>.

⁸³ For more information about these coalitions and organizations see: <http://www.foodsecurity.org/>; <http://sustainableagriculture.net/>; <http://www.frac.org/>; <http://www.nffc.net/>; and <http://www.farmland.org/>.