50-State Food System Scorecard

www.ucsusa.org/FoodScorecard

Appendix: Methodology and Data Sources

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Motivation: The Need to Understand the Food System Across 50 States

As the findings of our 50-State Food System Scorecard suggest, there is no one single path to achieving the ideal food system, though signs of progressive policies and innovative solutions are present in every corner of the country. Yet, moving toward a healthier food system has proven to be difficult, perhaps partly because of the piecemeal approach that results when evaluating isolated components of what is an inherently complex, interlocking system. A more holistic understanding, one that embraces the intricate interactions of the food system, could help to demonstrate areas of strength and weakness, expose gaps in knowledge, and highlight areas for investment and opportunities for improvement.

In this analysis, we asked: what do we know about the overall health, sustainability, and equity of the food system across the United States? The primary objective of the study was to use publicly-available datasets to assess the US food system state by state, and to identify opportunities for improvement. A secondary goal was to identify gaps in knowledge that could be filled to advance the science and sustainability of food systems.

We approached this analysis by looking at a range of indicators in each of the states to gain an overall picture of the status of the food system nationwide. Although the selected indicators may seem disparate, taken together they all tell us something about this complex and wide-reaching system. We compared indicators among all 50 states because, while states differ in their natural resources, geographies, histories, cultures, populations, and more, they also share much in common. For instance, all states are subject to federal food and farm policy, have access to federal programs, and participate in national (and global) markets and supply chains. Thus, states that are leaders in areas of the food system may therefore serve as models for success, inspiring new goals and future standards. Similarly, looking at differences among states could reveal regions that may benefit most from new investments.

The following sections describe how we identified data and developed the indicators and rankings presented in our interactive 50-State Food System Scorecard at www.ucsusa.org/FoodScorecard. A spreadsheet containing our final data can be downloaded at www.ucsusa.org/FoodScoreData for further exploration.

Methods: Taking a Snapshot of the Food System

To begin, we developed a list of topics and questions of interest for food and farming systems based on expert knowledge and past work.[1] This list included indicators of agriculture and ecology, such as soil health, water quality, and biodiversity, as well as indicators of social conditions related to farms, nutrition, and communities. We defined terms and concepts as shown in the box below, and we located data by searching online for scientifically rigorous and credible sources that provided insight into the identified indicators at the state-level (see Tables 1 and 2).

We prioritized data from government agencies, but we included other datasets based on government sources in cases where rigorous methods were clearly described and where no comparable data was readily available directly from online government sources. We used only the most recent year of complete data in most cases. In select cases, where multiple years of recent data were available and more insightful (such as for recent cumulative grant funding), we integrated these to calculate cumulative values.

This analysis is intended to provide a snapshot of the conditions that influence our food and farming systems, as well as the outcomes these systems generate. Practical applications of this dataset may necessitate continued data collection, monitoring, and reporting to observe changes over time.

[1] In particular: http://foodsustainability.eiu.com/country-ranking/, http://map.feedingamerica.org/, https://www.iatp.org/state-climate-adaptation-plans, and https://www.usnews.com/news/best-states/rankings

BOX: DEFINITIONS OF KEY CONCEPTS AND METHODOLOGY TERMINOLOGY RELEVANT TO THIS STUDY

DEFINITIONS

Concepts

- **Food system:** The whole that encompasses growing, harvesting, transporting, processing, and distributing food, as well as the economic, environmental, health, and social dimensions of those activities. A healthy food system is one that is environmentally, economically, and socially sustainable, and that provides a nutritious food supply. This contrasts with today's dominant industrialized food system, which has in many regards not successfully met these standards.
- **Sustainability:** The ability of a system to endure economically, environmentally, and socially over the long term.
- **Agroecology:** The science that explores how farms affect and are affected by the ecosystems and communities that surround them. It can help farms develop ways to work with nature to improve profits and environmental and societal outcomes, as a foundation for healthier food systems. Agroecology is also defined as a movement and a practice.

Analysis

- **Variable:** A measurable factor affecting the food system that was considered for this analysis.
- **Indicator:** A variable or group of variables used to characterize some aspect of the food system.
- **Indicator categories:** Groups of indicators clustered based on common attributes.

Preparing the data for state-to-state comparison

Developing indicators: Given that states vary in many ways, we used the identified datasets along with reference data and established relationships to develop ***indicators*** that enabled state-to-state comparisons. Original data were standardized (converted to comparable measures, such as per capita, per land area, per total farm acre, etc.) to account for variability in underlying conditions from state to state**.** Ultimately, we developed 68 indicators (see Tables 1 and 2 for more details).

Given that included data were of different magnitudes and units, we normalized all data such that they could be represented as numbers between 0 and 1, where 0 and 1 represented relatively worse and better food system conditions, respectively, according to expert opinion. This calculation was performed by using the minimum and maximum values among the 50 states for each variable.[2] Therefore, a value of 1 in this scorecard does not suggest the best possible status, but rather indicates that the state is the leader, among all states, in the select aspect (e.g., indicator, category) of the food system.

Grouping indicators into categories and overall results: To simplify analysis and interpretation, we grouped indicators representing similar aspects of the food system into 10 ***indicator categories*** **(**ranging from 5 to 9 indicators per category, see Tables 1 and 2 for more details). These include:

- 6 categories focused on farms and ecosystems

[2] For these calculations we used the equations: 1) Normalized value = (Ni-Nmin)/(Nmax-Nmin) for variables where a higher value in the original dataset represented a relatively better food system condition, and 2) Normalized value = 1- (Ni-Nmin)/(Nmax-Nmin) for variables where a lower value in the original dataset was relatively better.

- 3 categories focused on food and health
- 1 category focused on social determinants and disparities

Category results were calculated as the unweighted average of all indicators within each category (assuming all indicators were of equal importance within each category).[3] Similarly, to estimate overall food system health, we calculated the unweighted average across all ten indicator categories (assuming all categories were of equal importance).[4]

Shortcomings and uncertainties

Our analysis represents an overview of the status of the US food system, but it has some shortcomings. For example, data gaps and the inherent complexity of the food system pose challenges to a comprehensive analysis. Even for indicators with state-level data available, the most recent dates and temporal resolution often varied significantly. Data sources ranged from static reports to real-time databases with variable update frequencies.

As a result, we were only able to provide a snapshot of the current system, rather than to explore changes over time. Also, although some indicators are more uncertain than others, such differences could not be well-quantified given the diversity of the data.

***Marcia DeLonge, Ph.D.**, is a senior scientist in the UCS Food and Environment Program. **Sarah Reinhardt, M.P.H., R.D.**, is a food systems and health analyst in the program.*

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[3] For the purposes of this scorecard, we focused on results from simple unweighted averages. However, given that indicators differed in terms of variability, distribution and certainty, we also explored the sensitivity of category results to weighting indicators based on data variability and skew. For example, we used the square root of the coefficient of variation (the ratio of the standard deviation to the mean) to test giving widely ranging indicators more weight. We also assessed the influence of skew on our results, by weighting highly skewed variables less in weighted averages.

[4] We also developed a version of the overall results where we first calculated the averages for the farm and ecosystem, food and health, and social determinants and disparities categories, and then took the average of these three subsets. In this case, we assumed that farm-, health-, and equity-related aspects of the food system were equally important, even though the numbers of indicators within these subsets were not evenly distributed for this study.

TABLE 1. OVERVIEW OF RESEARCH QUESTIONS GUIDING THE 10 INDICATOR CATEGORIES AND SUMMARIES OF IDENTIFIED INDICATORS

FARM & ECOSYSTEM

1. Is the farm sector positioned for innovation, adaptability, and long-term success*? (Farming Outlook)*

- Farmer age
- % farmers that are beginning farmers
- Farms per 100 residents
- % farms that are midsize
- % farmland owner-occupied
- % farms with women principal operators
- Ratio of minority farm operators to minority population
- Injuries from agricultural production per 100 workers
- Total factor productivity index (measure of efficiency)

2. Are farms positioned to contribute to a nutritious food supply? *(Food Produced)*

- Farmland per capita (acres per resident)
- % cropland in fruits & vegetables
- Crop specialization (% cropland used for top three crops)
- % principal crop acres in major animal feed and fuel crops
- Meat production and CAFOs per farm acres (index)

3. Have farms reduced reliance on non-renewable resources? *(Reduced Resource Reliance)*

- % farm acres treated with chemical fertilizers
- % farm acres treated with various chemical pesticides
- Water and irrigation resilience (index)
- Fuel costs (% of total operating expenses)
- Renewable energy operations per 100 farms

4. Are farms minimizing their impacts on ecosystems? *(Reduced Ecosystem Impacts)*

- % climate emissions from agricultural sector
- Agriculture climate emissions per million acres farmland
- Land-use change carbon sink per million acres farmland
- Erosion rates on farmland (water/wind, tons/acre/year)
- Nutrient loss (N, P) to watersheds per land area (index)
- % rivers, lakes, bays impaired (nutrient pollution, average)
- % area with low groundwater quality (nitrate)

5. How extensive are conservation agriculture practices? *(Conservation Practices)*

- Ratio of acres with no-till to other tillage
- % crop acres using cover crops
- % farms using rotational or MIG grazing
- % farms using alley cropping or silvopasture
- % farm acres under conservation easements
- % farm acres managed with organic practices
- % select animal products produced organically (average)

6. What investments advance sustainable agriculture*? (Farm Investments)*

- Conservation (EQIP, WHIP) $ per 100 farm acres
- Conservation Stewardship Program $ per 100 farm acres
- Conservation Reserve Program acres per 100 farm acres
- Conservation grant (CIG, RCPP) $ per 100 farm acres
- Organic R&D (OREI, ORG) $ per 100 farm acres
- Agroecology R&D (SARE, RENRE, BFRDP) $ per 100 farm acres
- Sustainable food system program & institutions **(**# per million residents)

FOOD & HEALTH

7. What is the status of food system infrastructure to support sustainable farms and dietary adequacy*? (Food Infrastructure)*

- # farmers markets per 100,000 residents
- # food hubs per 1 million residents
- # food policy councils/networks per 1 million residents
- Capacity for food waste composting (index)
- % census tracts w/healthy food retailer nearby

8. What are the dietary patterns and health outcomes associated with the food system? *(Diet & Health Outcomes)*

- % prevalence of household-level food insecurity
- % adults who consume fruit less than once/day
- % adults who consume vegetables less than once/day
- Age-adjusted % adults with fair or poor self-reported health
- % adults overweight or obese
- % children (age 10-17) overweight or obese
- Age-adjusted % adults with type 2 diabetes
- Age-adjusted % of adults with diagnosed hypertension
- Health care expenditures per capita

9. What investments support regional food systems and make nutritious foods more readily available? *(Food Investments)*

- Local Food & Farmers Market Promotion Programs (LFPP, FMPP) grant $ per 100 residents
- % farmers markets (FM) accepting SNAP benefits
- % FMs accepting WIC Nutrition Program coupons
- % FMs accepting Senior Farmers Market Nutrition Program (SFMNP) coupons
- FINI grant $ per 100 SNAP participants
- HFFI grant $ per 100 SNAP participants
- Community food project grant (CFPCGP) $ per 100 SNAP participants
- Farm to School grant $ per 100 students

SOCIAL DETERMINANTS & DISPARITIES

10. Which states experience lesser social disparities that result from and reinforce an unjust, unsustainable food system? *(Social Determinants)*

- Education gap by race
- Income gap by race
- Overall income inequality (GINI index)
- Gender equality: state parity score
- Infant mortality rate disparity by race
- % union membership (all occupations)

TABLE 2. DETAILED DESCRIPTIONS OF INDICATORS WITHIN INDICATOR CATEGORIES

NOTE: THE MEAN VALUE ACROSS ALL STATES IS SHOWN, AS WELL AS WHETHER HIGHER (H) OR LOWER (L) VALUES WERE CONSIDERED BETTER FOR THE PURPOSES OF THIS ANALYSIS. [5]

FARM & ECOSYSTEM INDICATOR SET

1. Is the farm sector positioned for innovation, adaptability, and long-term success?

Indicator	Mean	H/L	Summary
Farmer age (2012)	58.34 years	L	The average age of US farmers has been steadily increasing, threatening the long-term future of the profession as well as the capacity for innovation in the sector. Areas with more younger farmers may have a stronger farming community in the future, as well as more capacity to innovate and adapt to new challenges.
% farmers that are beginning farmers (<10 y farming) (2012)	22.44 % farmers	H	The fraction of US farmers that are beginning farmers has been in decline in recent years, causing concern for the future of the agricultural sector. Areas with more beginning farmers, many but not all of whom are likely young farmers, may be more likely to maintain a strong farming sector in the future.
# farms per 100 residents (2012)	1.04 farms	H	The total number of US farms has remained relatively level in recent years, after dropping significantly from the 1930s to 1970s, yet loss of farms is still a concern due to competing demands for land and persistently low farm profits. States with more farms relative to population may be more likely to maintain a resilient farming sector.
% farms that are midsize (2012)	47.66 % farms	H	In recent years, farm size has trended toward the extremes—very large and very small—with many midsize farms lost. Given the importance of midsize farms to rural economies, a higher percentage of them would be a sign of a healthier food system. Midsize farms have been defined as having a gross cash farm income between $350,000 to $1 million, or as a farm size of 50-999 acres; we used the latter definition.
% farmland owner-operated (2012)	64.26 % farmland	H	A high portion of farmland is rented rather than operator-owned, which limits land access for new farmers. Low rates of owner-operated farms also limit opportunities for sustainable management, as tenant farmers often lack freedom or incentives to adopt beneficial practices that landowners may deem too risky in the short term. Areas where more farm operators own their land may be more resilient.
% farms with women principal farm operators (2012)	16.64 % farms	H	Historically, farms have been operated largely by males. The vision for a more equitable food system includes increasing the percentages of women in these roles.
Ratio of % minority principal farm operators (2012) to % minority state population (2016)	0.21 [-]	H	Farm operators have been primarily non-Hispanic whites, largely due to racial discrimination, systemic dispossession of land, and inequitable allocation of resources throughout American history. Today, African Americans comprise less than 2 percent of the nation's farmers and one percent of its rural landowners. The vision for a more equitable food system includes an increased representation of people of color—racial and ethnic minorities, as termed by the US Department of Agriculture (USDA)—in these roles, such that the proportions are reflective of the overall population.
Injury rates per 100 full-time equivalent workers, for agricultural production (2016)	5.79 injuries	L	Farm workers are vulnerable to various injuries due to occupational hazards and a lack of adequate policies enforcing workplace safety and protections for agricultural laborers. Reducing such job-related risks is an important goal of a healthy food system. In this indicator, we included data from the Bureau of Labor Statistics on nonfatal injuries and illnesses associated with crop production, support activities for crop and animal production, and animal production and aquaculture.
Total factor productivity index (measure of efficiency) (2004)[6]	1.15 [-]	H	Total Factor Productivity (TFP) is a measure of the ratio of all farm outputs (including yields) to all farm inputs (including labor, chemicals, machinery), and reveals the efficiency of the production process. Higher values imply greater overall productivity and related economic growth and resilience. This TFP index presents values for each state relative to the TFP of Alabama in 1996 (i.e., where Alabama in 1996 = 1).

[5] Key reference data used for calculations include: Number of residents per state (2016), Total land area (2010), Total state cropland and agricultural land (2012), Number of students enrolled in school (2015-2016).

[6] National level data for TFP is available through 2015, but state level data is only available from 1960-2004(in Table 19 from the Economic Research Service here, provided as a relative level index based on the TFP in Alabama in 1996).

2. Are farms positioned to contribute to a nutritious food supply?

Indicator	Mean	H/L	Summary
Farmland per capita (2012)	7.70 acres	H	The amount of farmland per resident is an indicator of the capacity for bioregional food production. Higher numbers indicate a potential to produce a larger proportion of needed food within the surrounding region.
% cropland in fruits and vegetables (2012)	4.48 % cropland	H	The percentage of cropland acreage dedicated to fruit and vegetable production indicates a state's current potential to meet its own produce needs and support healthy diets for its residents, and to contribute to a healthier national food system.
Crop specialization (% cropland used for top 3 crops) (2012)	40.56 % cropland	L	A lack of dietary diversity in the United States is paralleled by a lack of agricultural diversity (i.e., high degree of crop specialization). The diversity of production on US farms has been in decline for decades, with consequences for the food supply and farmers' resilience to shifting prices, emerging pests, and extreme weather. We use the share of cropland taken up by the top three crops as an indicator for crop specialization and lack of crop diversity, assuming a healthier food system would use more land for a wider variety of crops.
% principal crop acres for major animal feed and fuel crops (2017)	42.86 % cropland	L	A large percentage of land is planted in crops used in large part for animal feed (such as corn, oats, sorghum, barley, and soy) rather than for direct consumption by humans. Biofuels markets also increase demand for the same crops,[7] with corn starch used for ethanol production and soybean oil used to make biodiesel. Taken together, these account for a significant area of US farmland, hastening the loss of farm diversity without contributing to food security or dietary quality. The use of some land for feed and fuel could be part of a land-based solution for sustainable diets and renewable energy (e.g., cellulosic biofuels, from perennial plants that build soil health). However, based on current land use, our vision for a healthier food system involves devoting relatively less land to feed and fuel production.[8]
Meat production (index, 0 to 1) (2012, 2016)	0.12 [-]	L	Current high rates and prevailing methods of meat production in the United States place a burden on the environment and communities, particularly related to air and water pollution from CAFOs (concentrated animal feeding operations) and manure management. This index includes total production (pounds) of red meat, poultry (broiler chickens and turkeys), and milk per total farm acres (2016); egg production per total farm acres (2016); and density of large feeding operations (number of operations with sales of cattle on feed that are greater than 5,000 head per million farm acres, 2012). A healthier food system would be characterized by index values that are relatively lower than today's values.

3. Have farms reduced their reliance on non-renewable resources?

Indicator	Mean	H/L	Summary
% farm acres treated with commercial fertilizer, lime, and soil conditioner (2012)[9]	28.76 % farmland	L	Many farmers and ranchers rely heavily on purchased inputs such as fertilizers, increasing costs and limiting economic resilience. A healthier system would have lower proportions of acreage treated with commercial fertilizers and soil amendments, and soil health would be maintained more through best management practices (for example, planting crops and cover crops that protect soils and promote biological processes to "fix" atmospheric nitrogen, adopting crop management practices such as crop rotations that reduce nutrient loss, etc.).
Cumulative acres treated for various pests with chemical pesticides (treated acres relative to total farm acres) (2012)[10]	50.61 % farmland	L	Many farmers rely heavily on purchased inputs such as pesticides to control insects, weeds, and other pests, increasing costs and limiting economic resilience. Farms that adopt integrated pest management systems can reduce pesticide use by relying on practices such as crop rotations and habitat modification to break pest cycles, and by including natural pest predators in ecosystems. This indicator presents cumulative acres treated with chemical insecticides, nematicides, herbicides, and fungicides; when multiple pesticides were used, those acres are counted once per type.

[7] ERS provides data on millions of gallons of ethanol and biodiesel produced.
[8] For this indicator, we use the total area planted for principal crops as the denominator.
[9] Commercial fertilizer and soil conditioner amounts used here are based on farmer responses to the 2012 Census of Agriculture Section 26 and include fertilizers, rock phosphate, lime and gypsum.
[10] Acres treated with chemicals used here are based on farmer responses to the 2012 Census of Agriculture Section 26 and include all chemicals declared for use to control insects; weeds, grass, or brush; nematodes; and diseases in crops and orchards such as blight, smut, rust, etc.

Water and irrigation resilience (index, 0 to 1) (2010, 2013)	0.55 [-]	H	Intensive agriculture has contributed to the depletion of key groundwater sources (such as the Ogallala Aquifer and throughout California). Because continued reliance on diminishing resources puts farms at risk, more resilient food systems would be characterized by less water reliance. This indicator assesses water reliance by considering several factors, including percentage of fresh water withdrawals for agriculture (irrigation, livestock and aquaculture, 2010), percentage of irrigated acres affected by related yield loss (non-equipment related, 2013), percentage of cropland acres irrigated (2013), and percentage of acres irrigated with conserved water (2013) or conservation irrigation practices (2013). Employing practices that conserve or reuse water, or adopting more efficient irrigation practices, reduces stress on water supplies. Practices such as planting drought-resistant crops and building the water-holding capacity of soil also conserve water but are captured in other indicators in this scorecard.
Fuel costs (% total operating expenses) (2012)	5.61 % expenses	L	Most energy use in food systems represents a reliance on nonrenewable resources and is an important indicator of long-term farm resilience and food system sustainability. We use fuel costs as a percentage of total operating costs as an indicator for energy use on farms. Note: The fuels considered here include gasoline, diesel, natural gas, liquefied petroleum gas, motor oil, and grease product.
Renewable energy operations per 100 farms (2012)	3.71 operations	H	Many farms have installed renewable energy operations to reduce reliance on nonrenewable energy sources. Such efforts are an important step toward a healthier food system. Renewable energy producing systems as reported by the 2012 Census of Agriculture include solar panels, wind turbines, methane digesters, geoexchange systems, small hydro systems, biodiesel, and ethanol.

4. How are farms minimizing their impacts on ecosystems?

Indicator	Mean	H/L	Summary
% total climate emissions from agriculture sector (2014)	9.18 %	L	Agriculture contributes to climate change in various ways, including soil nitrogen emissions (from fertilizers), manure management, enteric fermentation from the digestive process of ruminants, and more. In states where agriculture contributes a greater proportion of total state climate emissions, focusing on climate emissions reductions on farms and ranches would be of particularly high value.
Agricultural climate emissions ($MtCO_2e$) per million acres farmland (2014)	0.66 $MtCO_2e$	L	States with higher climate emissions per acre of farmland are responsible for a relatively high level of agricultural climate emissions. Emissions are reported in units of CO_2-equivalents, which take into consideration the different potency of major greenhouse gases. This dataset excludes emissions from producing or utilizing farm machinery and other inputs, as well as other related fossil fuel combustion on farms.
Land-use change and forestry carbon sink ($MtCO_2e$) per million acres farmland (2014)	4.35 $MtCO_2e$	H	Agriculture affects climate change indirectly through land-use change and land management that alters carbon storage in plants and soils. While practices that cause deforestation and soil degradation lead to carbon losses, other farming and ranching practices can increase carbon storage. Carbon emissions and sinks are reported in units of CO2-equivalents. The dataset used here includes estimates related to forest carbon flux, carbon from liming of soils, carbon in urban trees, nitrous oxide from settlement soils, and carbon storage from yard trimmings and food scraps, and contains significant uncertainties.
Erosion rates on farmland (water/wind, tons/acre/year) (2012)	3.27 tons/acre/y	L	Soil erosion (rill, sheet, and wind) degrades soil quality and pollutes water. While intensive agricultural production practices tend to increase erosion, conservation practices such as no-till, cover crops, and crop rotations can reduce or even prevent erosion.
Nutrient loss from watersheds per land area (kg N and P exported per km^2 annually) (index, 0 to 1) (2002)	0.26 [-]	L	Nitrogen (N) and phosphorus (P) are valuable nutrients typically applied to farming systems as fertilizers. When these nutrients are lost (exported) to watersheds through farm runoff and leaching, they contribute to pollution that threatens drinking water; impairs rivers, bays and lakes; endangers fisheries; and leads to dead zones in coastal waters. Here we rely on modeling results from 2002 because state-level datasets are limited. We present the normalized average of N and P loss to consider the effect of both nutrients.

% waters impaired due to nutrient pollution (average of rivers, bays, lakes) (2002-2010)	0.23 % water bodies	L	Water quality is an issue of great concern for the sustainability of our food system. Farm runoff and leaching is a leading source of pollution of the nation's rivers, bays and lakes, which support recreation and tourism and supply drinking water to communities. We present results based on data from 2002 to 2010 because available state-level datasets are limited.
% area with low groundwater quality due to high groundwater nitrate (>5mg/L) (1991-2003)	6.50 % watershed area	L	Agriculture contributes to high levels of nitrate in groundwater, which many communities rely on for drinking water. In areas where a large proportion of the population—as much as 35 percent in some states—depends on self-supplied drinking water, which is not federally regulated, communities are at risk of health problems (especially blue-baby syndrome, a harmful blood condition in infants).

5. How extensive are conservation practices based on ecological principles?

Indicator	Mean	H/L	Summary
Ratio of total acres using no-till to acres using conservation or conventional tillage (2012)	0.62 [-]	H	Reduced tillage (plowing) has been shown to decrease soil erosion and water pollution and conserve natural resources. As defined by the USDA, no-till is a method of planting crops where there is usually no cultivation, whereas conservation tillage leaves at least 30 percent of the soil covered by crop residue following planting, and conventional tillage involves mixing or inverting the entire soil surface. Although some outcomes of no-till farming are debated (e.g., the effect of no-till on soil carbon) and the practice often relies on pesticides, adoption rates are an indicator of the expansion of conservation agriculture.
% crop acres planted to cover crops (2012)	5.70 % cropland	H	Cover crops protect soils and reduce soil erosion and water pollution. Although interest in cover crops has rapidly increased in recent years—and adoption rates have increased—their use remains relatively low due to logistical, cultural, and policy barriers. The percentage of cropland acres using cover crops is an indicator of the expansion of soil-building practices.
% all farms using rotational or management intensive grazing (on some area within their operation) (2012)	14.15 % farms	H	Many grasslands and rangelands are overgrazed, leading to soil degradation and loss of long-term resilience to extreme weather. However, well-managed grazing practices can eliminate degradation or even regenerate soil resources. In its 2012 Census of Agriculture, the USDA assessed adoption rates of rotational grazing, defined as the practice of subdividing pasture into smaller sections and grazing different sections at different times.
% farms using alley cropping or silvopasture (2012)	0.22 % farms	H	Alley cropping and silvopasture are agroforestry practices that can be used to diversify farms, particularly by incorporating perennial plants. Perennials include grasses and trees that have deep roots, relative to annual crops, and that can build soil health, sequester carbon, and tap into water and nutrients in deeper layers of the soil. Expanding adoption of these diversified farming practices is an indicator of a transition to a more sustainable food system.
% farmland under conservation easement (2012)	3.11 % farmland	H	Conservation easement arrangements—in which highly erodible, unproductive, or environmentally sensitive farm acres are taken out of production—help farmers keep farmland while improving water quality and wildlife habitat. The presence of conservation easements as part of agricultural ecosystems can mitigate unintended consequences associated with nearby farms and ranches.
% farm acres managed with organic practices (certified, exempt, or in transition) (2014)[11]	0.75 % farmland	H	Farmers who grow crops using certified organic practices or who are in transition to organic certification are required to comply with a set of organic standards and typically use a suite of conservation practices. Although not all organic farming is equally sustainable, the expansion of organic farming is an indicator of the extent of resource-preserving management styles.
% animal agriculture inventory (2012, 2016) produced using organic management (2016)	2.08 % animal agriculture	H	Farmers who produce organic meat products are required to comply with a set of organic standards and typically adopt practices that promote conservation practices and reduce ecosystem damage per acre. Although not all organic production is equal, the expansion of organic production in animal agriculture is an indicator of the extent of resource-preserving management styles. Data represents the average percentage organic production of chickens (layers and broilers), turkey, hogs, beef cows, and milk cows.

[11] The 2008, 2014 organic surveys published all organic data (certified, exempt, transitioning); 2011, 2015, and 2016 only included certified organic

6. What investments support scaling-up and advancing more sustainable agriculture practices?

Indicator	Mean	H/L	Summary
Conservation program $ per 100 farm acres, including EQIP (1997-2015) and WHIP (2004-2015)	$ 2936.36	H	The USDA's Environmental Quality Incentives Program (EQIP) provides financial incentives to help share costs of adopting specific conservation practices. The department's Wildlife Habitat Incentive Program (WHIP), the authority for which was moved to EQIP by the 2014 farm bill, made critical investments specifically for practices that improved fish and wildlife habitat. States that have recently received greater investments (per farm acre) through EQIP and WHIP may be better positioned to advance sustainable agriculture practices.
Conservation Stewardship Program $ per 100 farm acres (2011-2014)	$ 247.68	H	The USDA's Conservation Stewardship Program (CSP) includes more than 70 million acres on US working lands. This program provides financial incentives and technical assistance to farmers who are already using conservation practices and want to strengthen their efforts by adding practices such as resource-conserving crop rotations, cover crops, grazing management, and more. States that have recently received greater investment (per farm acre) through CSP may be better positioned to advance sustainable agriculture practices.
Conservation Reserve Program, acres per 100 farm acres (2014)	2.26 acres	H	The USDA's Conservation Reserve Program (CRP) compensates farmers (through rental payments, typically for 10-15 years) for removing environmentally sensitive land from production (or limiting production to well-managed grazing) and for planting species that build soil and environmental health. CRP has been celebrated for its success in improving water quality, soil health, and habitat protection on agricultural lands. Although benefits from CRP can be lost when contracts end, enrolled acres represent an investment in conservation agriculture.
Conservation grants (CIG, RCPP) $ per 100 farm acres (2017)	$ 111.17	H	The USDA's Conservation Innovation Grants (CIG) and Regional Conservation Partnership Program (RCPP) are key grant programs that invest in sustainable agriculture. CIG provides competitive grants, funded through EQIP, that support projects led by the public and private sectors to drive innovation encouraging conservation practices. The RCPP implements contracts to fund innovative projects that connect producers and landowners with eligible partners to accelerate adoption of conservation practices. Recent awards through CIG and RCPP represent investment in expanding conservation agriculture.
Organic agriculture R&D grants (OREI, ORG) $ per 100 farm acres (2002-2014)	$ 54.44	H	Competitive grant programs through the USDA's National Institute of Food and Agriculture (NIFA) enable investments in organic agriculture practices that also support broader agroecology and food systems research, education, and extension. Key programs include the Organic Research and Extension Initiative (OREI) and the Organic Transitions (ORG) program.
Agroecology R&D grants $ per 100 farm acres, including RENRE (2012, 2015-2017), SARE (1988-2016), and BFRDP (2012, 2015-2017)	$ 269.72	H	Competitive grant programs administered by NIFA enable investments in agroecology and food systems research, education, and extension programs that pave the way for improved practices and systems. While NIFA manages numerous grant programs, select programs have a history of funding efforts that more directly support agroecology. These include the Renewable Energy, Natural Resources, and Environment (RENRE) program within the Agriculture and Food Research Initiative (AFRI), the Sustainable Agriculture Research and Education (SARE) program, and the Beginning Farmer and Rancher Development Program (BFRDP).

Sustainable food system programs and institutions per million residents, including sustainable food systems education programs (2018), INFAS member institutions (2018), Climate Hubs (2017) and the LTAR Network (2017)	2.55 programs or institutions	H	Sustainable agriculture education programs and initiatives are evidence of an investment in and commitment to healthier food and farming systems. Degree programs, educational farms, federally-supported research stations, and other opportunities at educational and research institutions that are focused on sustainable agriculture can trigger local interest and address challenges. There are numerous such programs and institutions across the country, including those catalogued by the USDA's National Agriculture Library, the institutions engaged in the Inter-Institutional Network for Food, Agriculture and Sustainability (INFAS), the Climate Hubs, and the Long-term Agroecosystem Research (LTAR) stations. While many of these are intended to serve all 50 states, their location within specific states is likely to be benefit and invest in host states.

FOOD & HEALTH INDICATOR SET

7. What is the status of food system infrastructure to support sustainable farms and dietary adequacy?

Indicator	Mean	H/L	Summary
# farmers markets per 100,000 residents (2017)	3.91 markets	H	Farmers market density serves as a proxy for the extent to which small and midsize farms can directly market produce and goods to consumers, with the implied benefits of expanding sales opportunities for farmers and making fresh, nutritious foods more readily available to consumers.
# food hubs per 1 million residents (2017)	1.01 food hubs	H	Food hubs are defined by the USDA as centrally located facilities with business management structures facilitating the aggregation, storage, processing, distribution, and/or marketing of locally/regionally produced food products. They offer substantial and well-documented opportunities to help small and midsize farms and food producers sell to large buyers such as schools or hospital systems. Food hub density serves as a proxy for the extent to which a state possesses infrastructural capacity to sustain its own local and regional food systems.
# food policy councils, networks, or coalitions per 1 million residents (2017)	1.08 councils, networks, or coalitions	H	Food policy councils, networks, and coalitions support local and regional food systems by leveraging human capital to secure financial resources and policy solutions. Higher densities of such social networks are likely to accelerate progress toward healthier food systems.
Capacity for food waste management via composting (index, 0 to 1) (2010-2014)	0.09 [-]	H	Food waste is a major problem linked to both farm and food systems, and about 40 percent of food in the US is wasted. While limited data is available on food waste at the state level, data on existing food waste compost programs offer some insight into the capacity for better food waste management and closed loop approaches to the food system. Such programs can increase food waste awareness and reduce related emissions, while recycling nutrients and creating compost to build soil health. Index includes tons of food waste composted (2010-2014), curbside food waste collection (2014), and number of compost facilities (2013).
% census tracts with at least one healthier food retailer within 1/2 mi. of tract boundary (2012)	64.43 % census tracts	H	Maintaining a healthy diet is particularly challenging in areas where healthy food retailers are hard to find. State and local efforts to ensure nutritious foods are geographically accessible—particularly for low-income communities routinely denied equal access to food retailers and quality produce—can be captured in part by the percent of census tracts with at least one healthy food retailer.

8. What are the dietary patterns and health outcomes associated with the food system?

Indicator	Mean	H/L	Summary
% prevalence of household-level food insecurity (low or very low) (2014-2016)	13.05 % households	L	Despite the productivity of US agriculture, food insecurity remains a significant problem. While this is a complex issue with many causes, first among them poverty, the measure of household-level food insecurity also indicates that the food system is not successfully meeting the caloric needs of all households.
% adults who consume fruit less than once daily (2015)	40.87 % adults	L	Consumption of fruits more than once per day is a measure of a health behavior that is heavily influenced by both socioeconomic and cultural factors, as well as the adequacy of the prevailing food system. Fewer adults consuming fruit infrequently

			could be one indicator of success in a thriving, healthy food system.
% adults who consume vegetables less than once daily (2015)	22.48 % adults	L	Consumption of vegetables more than once per day is a measure of a health behavior that is heavily influenced by both socioeconomic and cultural factors, as well as the adequacy of the prevailing food system. Fewer adults consuming vegetables infrequently could be one indicator of success in a thriving, healthy food system.
Age-adjusted % adults with fair or poor self-reported health (2016)	16.57 % adults	L	Self-reported health status is a subjective indicator of overall health and wellbeing, and research has shown poor self-reported health to be strongly associated with mortality in the general population. Although a broad range of factors contribute to overall health, many of the most prevalent and fatal chronic diseases, such as heart disease, are diet-related. A healthier and more sustainable food system would be associated with fewer adults reporting fair or poor health.
% adults overweight or obese (2016)	65.35 % adults	L	About two-thirds of US adults are overweight or obese, increasing risk of health conditions such as heart disease, stroke, type 2 diabetes, and some types of cancer. Though the pathogenesis of overweight and obesity is complex, it is well-established that diet and physical activity play a prominent role. All other things equal, we would expect that a food system that makes nutritious foods affordable and readily available would be associated with fewer adults who are overweight and obese.
% children 10-17 y overweight (85th-94th percentile) or obese (95th percentile or above) (2016)	30.12 % children	L	About one-third of US children and adolescents are obese, and thus predisposed to higher risk of developing chronic diseases and having poorer health later in life. Though the pathogenesis of overweight and obesity is complex, it is well-established that diet and physical activity play a prominent role. All other things equal, we would expect that a food system that makes nutritious foods affordable and readily available would be associated with fewer children who are overweight and obese.
Age-adjusted % adults with type 2 diabetes (2015)	9.16 % adults	L	About half of all adults in the US currently live with one or more preventable chronic diseases, many of which are diet-related. Recent estimates suggest that nearly 10 percent of the US population has diabetes, the majority of which (90-95 percent) is classified as type 2 diabetes and is strongly linked to dietary patterns. All other things equal, we would expect that a food system that makes nutritious foods affordable and readily available would be associated with fewer adults affected by type 2 diabetes.
Age-adjusted % adults with diagnosed hypertension (2015)	29.86 % adults	L	One in three adults in the US has high blood pressure, and heart disease is the leading cause of death among both men and women nationwide. By and large, the US food supply is in misalignment with the types of foods recommended to promote heart health, including fruits, vegetables, whole grains, and foods lower in sodium. All other things equal, we would expect that a food system that makes such foods affordable and readily available would be associated with fewer adults who live with hypertension.
Health care expenditures per capita (2014)	$ 8259.92	L	Health care expenditures per capita are used to quantify the financial burden of managing and treating acute and chronic disease among state populations. High health care costs are driven by multiple factors, including health care coverage, technology, and market trends, but can be used to broadly assess the relative economic burden of illness and disease among given populations. We operate under the assumption that a healthy and sustainable food system that makes nutritious foods affordable and readily available would be associated with reduced rates of disease, as described above, and lower overall health care expenditures per capita.

9. What investments support regional food systems and make nutritious foods more readily available?

Indicator	Mean	H/L	Summary
Regional food system grant $ per 100 residents, including LFPP (2014-2017) and FMPP (2014-2017)	$ 50.26	H	The USDA's Local Food Promotion Program (LFPP) and the Farmers Market Promotion Program (FMPP) are grant programs intended to expand markets for locally and regionally produced agricultural products. These programs' investments support farmers markets, food hubs, and other local food marketing strategies to improve regional food systems and make nutritious foods more readily available to consumers.

% farmers markets that accept SNAP benefits (2017)	31.36 % markets	H	The percent of farmers markets authorized to accept benefits from food assistance programs, such as the USDA's Supplemental Nutrition Assistance Program (SNAP), reflects state and local efforts to make nutritious foods more readily available to vulnerable populations while supporting local and regional food producers.
% farmers markets that accept WIC Farmers' Market Nutrition Program coupons (2017)	26.31 % markets	H	The percent of farmers markets authorized to accept benefits from food assistance program, such as the USDA's Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), reflects state and local efforts to make nutritious foods more readily available to low-income and vulnerable populations while supporting local and regional food producers.
% farmers markets that accept SFMNP Farmers' Market Nutrition Program coupons (2017)	28.72 % markets	H	The percent of farmers markets authorized to accept benefits from food assistance program, such as benefits from the USDA's Senior Farmers' Market Nutrition Program (SFMNP), reflects state and local efforts to make nutritious foods more readily available to low-income and vulnerable populations while supporting local and regional food producers.
FINI grant $ per 100 SNAP participants (2015-2017)	$ 139.21	H	The Food Insecurity Nutrition Incentive (FINI) program is a competitive grant program through NIFA that invests in projects designed to create incentives to increase fruit and vegetable purchases through the SNAP program, with priority given to local and regional produce. Investments made through programs like FINI are an indicator of progress toward developing a healthier food system that make nutritious foods more affordable and available to low-income and vulnerable populations while supporting local and regional food producers. The indicator has been scaled using the number of statewide SNAP participants because this is the primary audience of the program.
HFFI grant $ per 100 SNAP participants (2011-2016, 2017)	$ 228.30	H	The Healthy Food Financing Initiative (HFFI) is a joint effort by the USDA, the US Treasury, and the Department of Health and Human Services (HHS) to make nutritious foods more readily available, particularly in underserved communities, while stimulating economic growth and supporting local ownership of retail food outlets. The indicator is scaled using the number of statewide SNAP participants; although SNAP participants are not explicitly stated as the target audience of the program, this population serves as a proxy for those facing some of the same challenges, including food insecurity and financial instability, that HFFI is designed to address.
CFPCGP grant $ per 100 SNAP participants (2002-2017)	$ 325.51	H	The USDA's Community Food Projects Competitive Grant Program (CFPCGP) addresses food insecurity in low-income populations by providing funding for community-based food systems solutions, and investments suggest progress toward a healthier, more equitable, and more sustainable food system. The indicator has been scaled using the number of statewide SNAP participants; although SNAP participants are not explicitly stated as the target audience of the program, this population serves as a proxy for those facing some of the same challenges, including food insecurity and financial instability, that CFPCGP is designed to address.
Farm to School grant $ per 100 students (2013-2017)	$ 89.50	H	NIFA's competitive Farm to School Grant Program provides financial support, technical assistance, training, and outreach to make nutritious, local foods more readily available in schools. Investments in this program can both support local farms and improve dietary quality among participating students, and suggest progress toward a healthier, more equitable, and more sustainable food system.

SOCIAL DETERMINANTS & DISPARITIES INDICATOR SET

10. Which states experience lesser social disparities that result from and reinforce an unjust, unsustainable food system?

Indicator	Mean	H/L	Summary
Education gap by race (2016)	1.51 [-]	L	Greater educational attainment is strongly associated with better health outcomes and longer life. We would expect that inequitable educational attainment by race would reinforce characteristics of an unjust food system, whereas a healthy and just food system would be associated with a smaller education gap by race. This indicator is the ratio of the percent of the non-Hispanic white population with a Bachelor's degree or higher to the weighted percent of other self-identified racial and ethnic populations (black, American Indian or Alaskan native, Asian, native Hawaiian or

			Pacific Islander, other singular race, other two races, and Hispanic whites) with a Bachelor's degree or higher.[12]
Income gap by race (2016)	1.75 [-]	L	Income is a fundamental social determinant of health, and inequitable income distribution by race reinforces persistent characteristics of an unjust food system. This indicator is calculated as the ratio of mean per capita income of non-Hispanic whites to the weighted mean per capita income of other self-identified racial and ethnic populations (includes black, American Indian or Alaskan native, Asian, native Hawaiian or Pacific Islander, other singular race, other two races, and Hispanic whites).[13] We would expect that a healthy, sustainable, and equitable food system would be associated with a smaller income gap by race.
Overall income inequality, GINI index (2015)	0.46 [-]	L	Inequitable income distribution across the US population, represented by high values of the GINI index, reinforces persistent characteristics of an unjust food system. We would expect that a healthy, sustainable, and equitable food system would be associated with lower values of the GINI index.
Gender equality: State Parity Score (2016)	0.64 [-]	H	The state parity score by gender is a complex metric developed by McKinsey & Company that estimates the overall status of gender equality in each state. Higher scores indicate greater equality. Gender inequalities may be both a result of and a reinforcer of many of the current challenges inherent in the US food system.
Infant mortality rate disparity by race (ratio of non-Hispanic whites to total population) (2013-2015)	0.84 [-]	H	Despite a gradual decline in US infant mortality rates, significant racial disparities in infant mortality persist. This metric conveys the depth of racial health disparities rooted in myriad social, economic, and cultural injustices, and likely also captures the physiological impact of systemic racism. A healthy, sustainable, and equitable US food system would work to eliminate such disparities.
% union membership (2017)	9.94 % labor force	H	Union membership along the food supply chain has been declining for three decades, and only six percent of food chain workers are estimated to be members of a labor union. As union-represented workers have been shown to have relatively higher wages as well as better health and pension benefits, low membership rates underscore the persistent exploitation of food chain workers that has been demonstrated by research. Although union membership rates were not available at the state-level by sector, we use overall union membership as an indicator of union strength.

[12] This indicator is based on rankings provided from the US News Best States for Equality rankings and methods
[13] This indicator is based on rankings provided from the US News Best States for Equality rankings and methods.