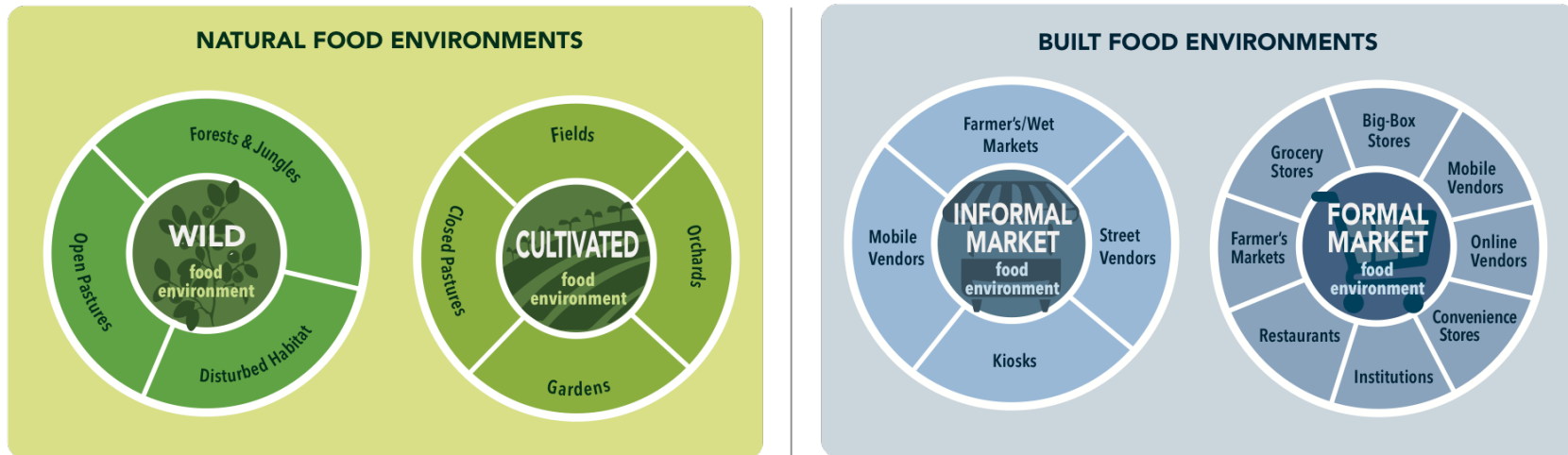


# The Food Environment Transition Towards Sustainable Diets

## FOOD ENVIRONMENT TYPOLOGIES



**Speaker: Selena Ahmed, Assistant Professor of Sustainable Food Systems**

Co-authors: Shauna Downs, Anna Herforth, Carmen Byker Shanks,  
Jessica Fanzo



# Key Challenge of the Anthropocene: Supporting Healthy Diets and Planetary Health

## Food + UN Sustainable Development Goals

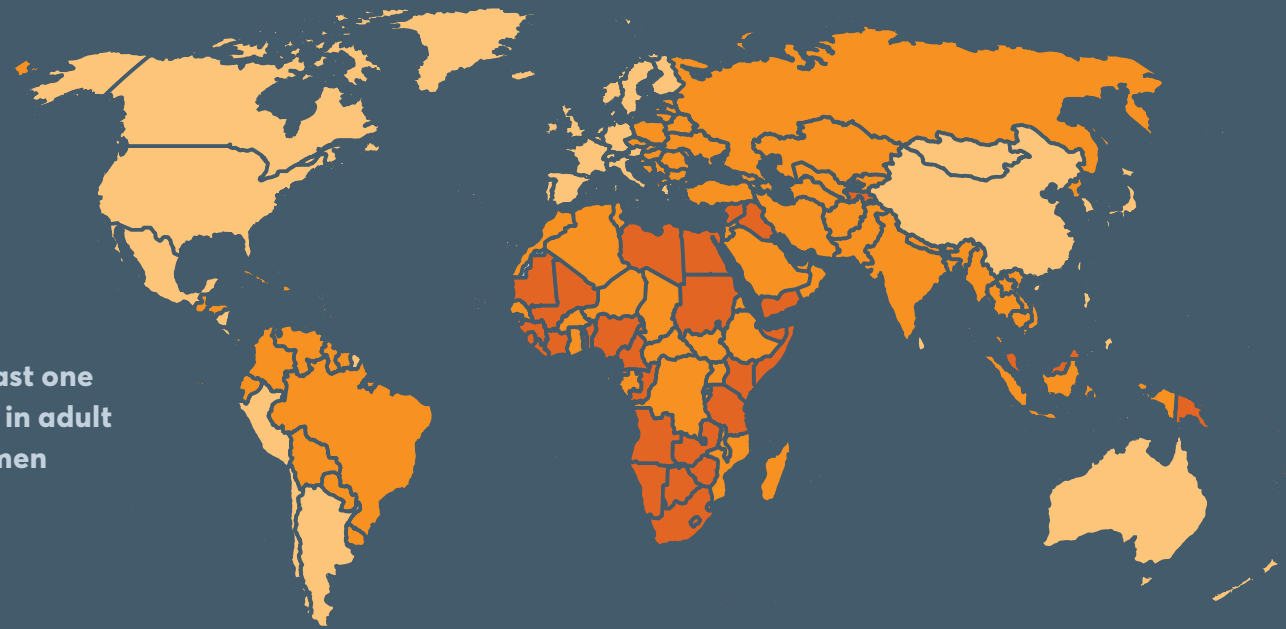


# Poor Diets are the Leading Risk Factor of the Global Burden of Disease

**Every country in the world is affected by malnutrition**

Countries with a burden of at least one of: childhood stunting, anaemia in adult women, overweight in adult women

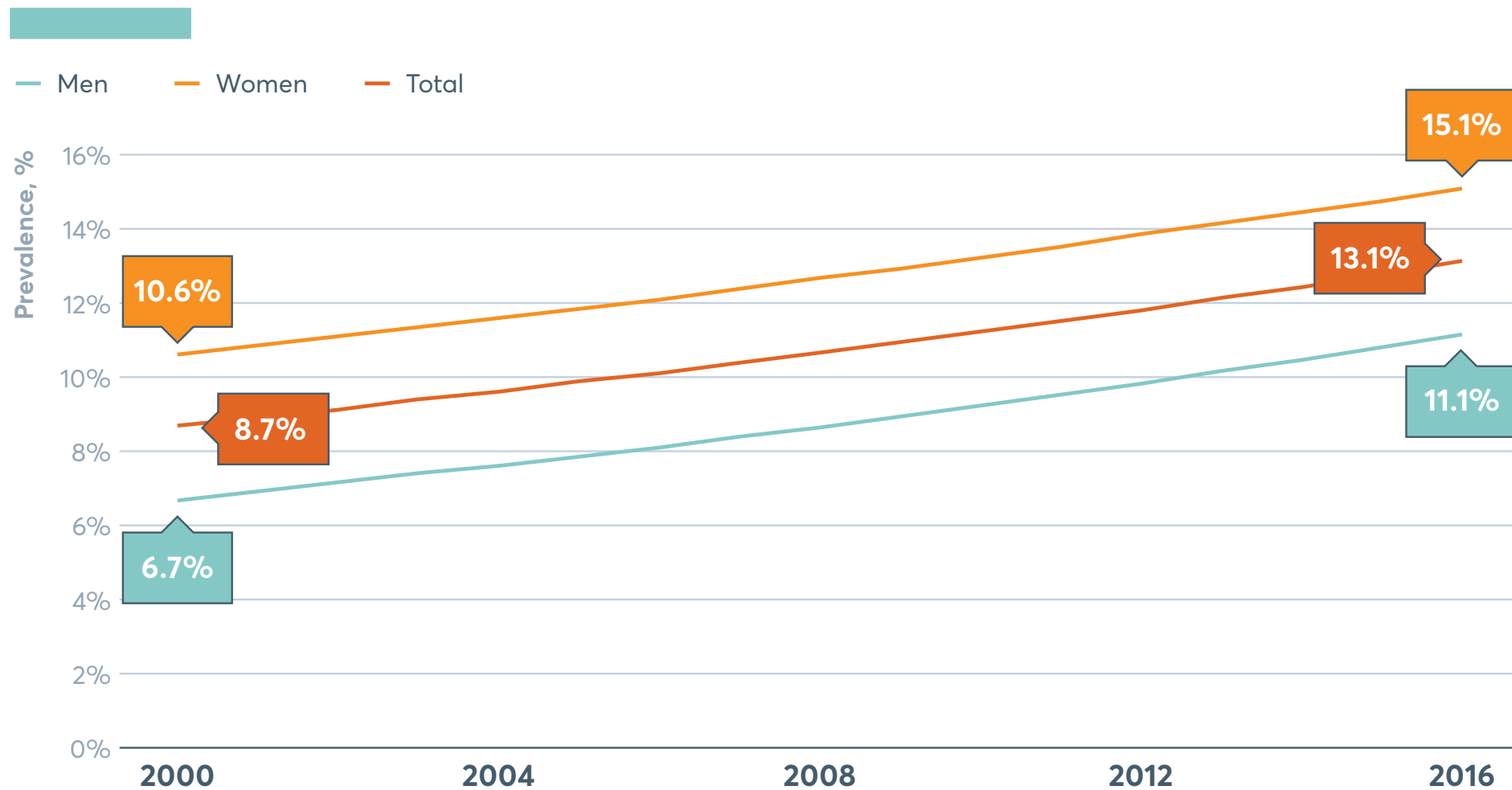
- At least a single burden
- At least a double burden
- A triple burden



Source: 2018 Global Nutrition Report



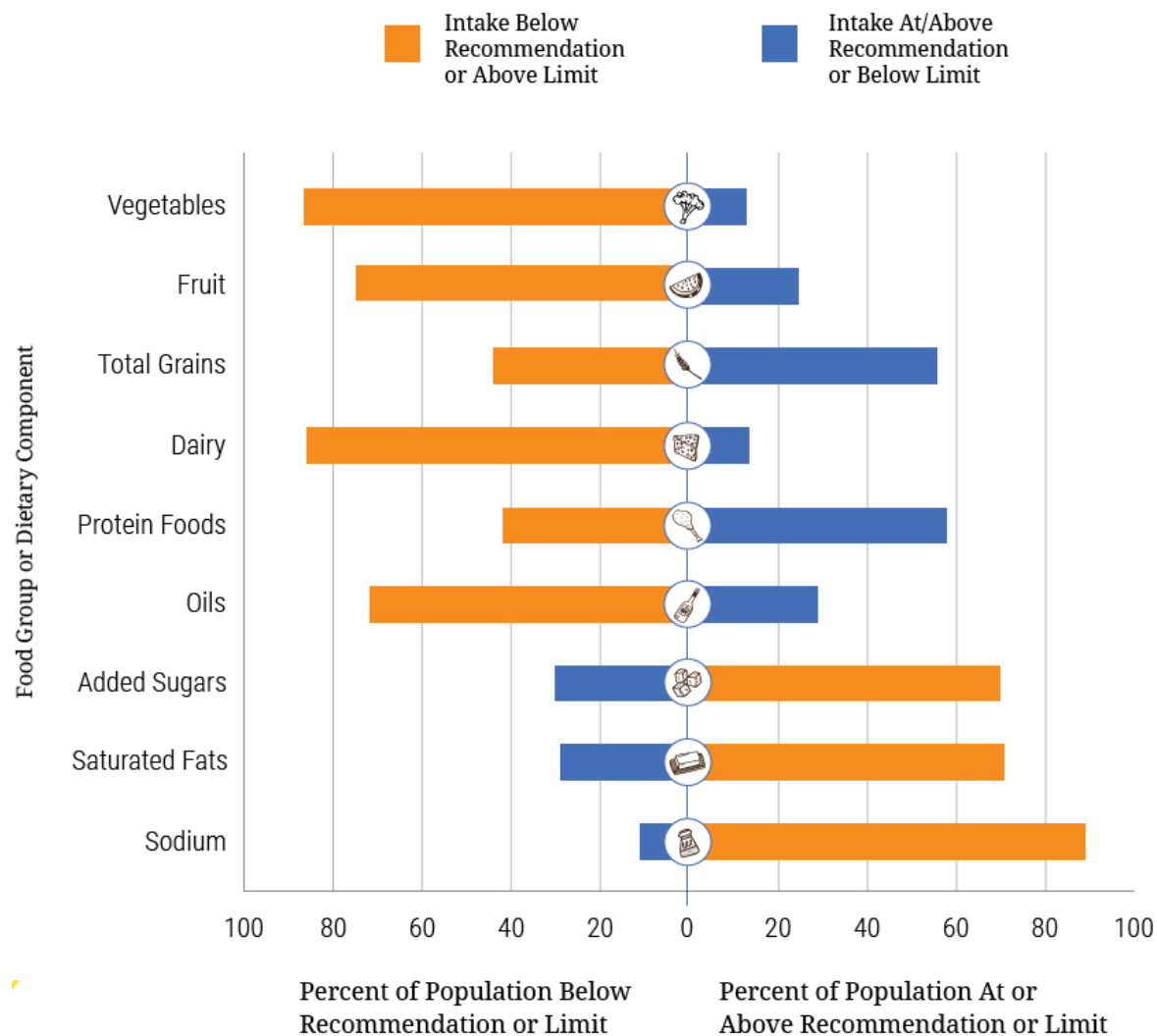
Global prevalence of obesity (BMI  $\geq 30$ ) among adults aged 18 years and over, 2000–2016



Source: NCD Risk Factor Collaboration.



# Dietary Intake of Americans Doesn't Meet Recommendations



Source: National Health and Nutrition Examination Survey

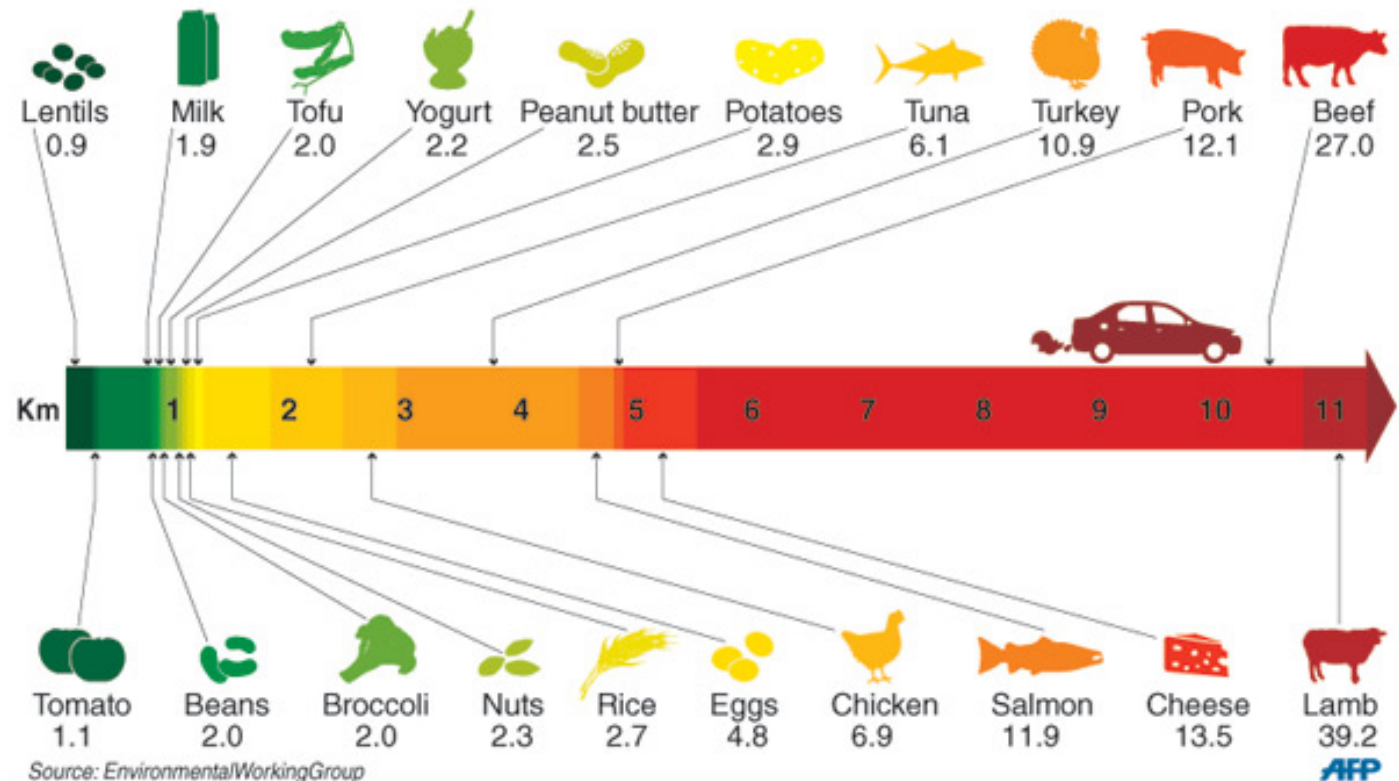
# Food Production Places Greater Stress on Ecosystems than any Other Human Activity

## Carbon footprint of what you eat

Calculations of greenhouse gas emissions from the production, processing and transportation of specific food items

■ Main chart compares 110g of food against a journey in a mid-sized car

■ Number shows kg of carbon dioxide equivalent produced per 1kg of food



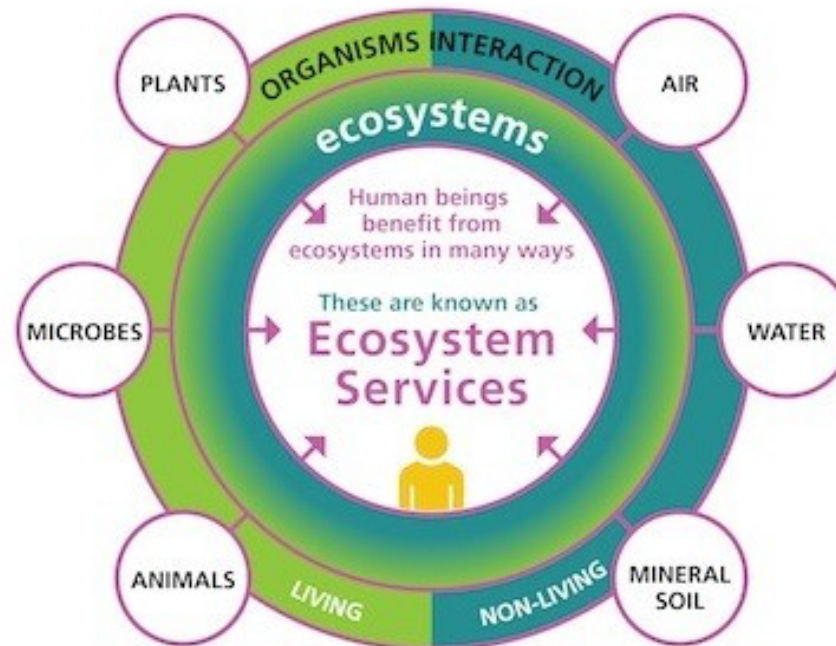
Source: EnvironmentalWorkingGroup

AFP



# Food Production is Critically Dependent on Multiple Ecosystem Services

- ◀ Pollination
- ◀ Pest and disease management
- ◀ Fresh water, food, fibre, habitat and genetic resources
- ◀ Recreation and tourism
- ◀ Spiritual health, cultural identity



- ▶ Erosion prevention
- ▶ Protection from natural disasters
- ▶ Carbon sequestration and storage
- ▶ Air and water pollution control
- ▶ Nutrient cycling and soil fertility

# Diversified Agricultural Systems can Support Environmental and Human Health

Total Catechin Content (TCC)



218 mg TCC / g tea

>

86 mg TCC / g tea

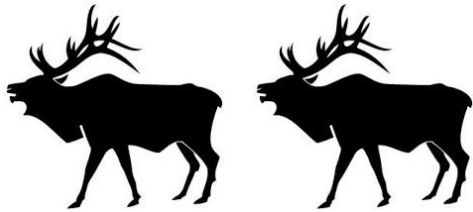
$p < 0.0001$



# Much of What is Produced is Wasted

SFBS 499 and NUTR 351  
Student Project on Food Waste

Three Days of Student  
Food Waste =



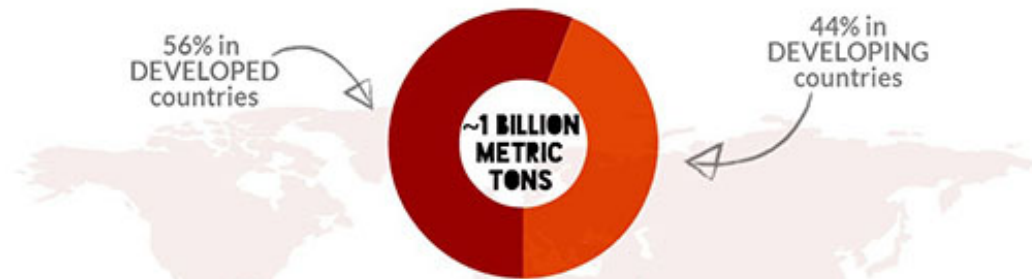
Weight of 2 Adult Bull Elk  
Help Reduce Food  
Waste

TAKE WHAT YOU CAN EAT -  
GET SECONDS IF YOU WISH!



## 1/4 TO 1/3 OF ALL FOOD PRODUCED FOR HUMAN CONSUMPTION IS LOST OR WASTED

HERE'S THE BREAKDOWN:



THOSE LOST CALORIES COULD FILL HUNGER GAPS IN THE DEVELOPING WORLD

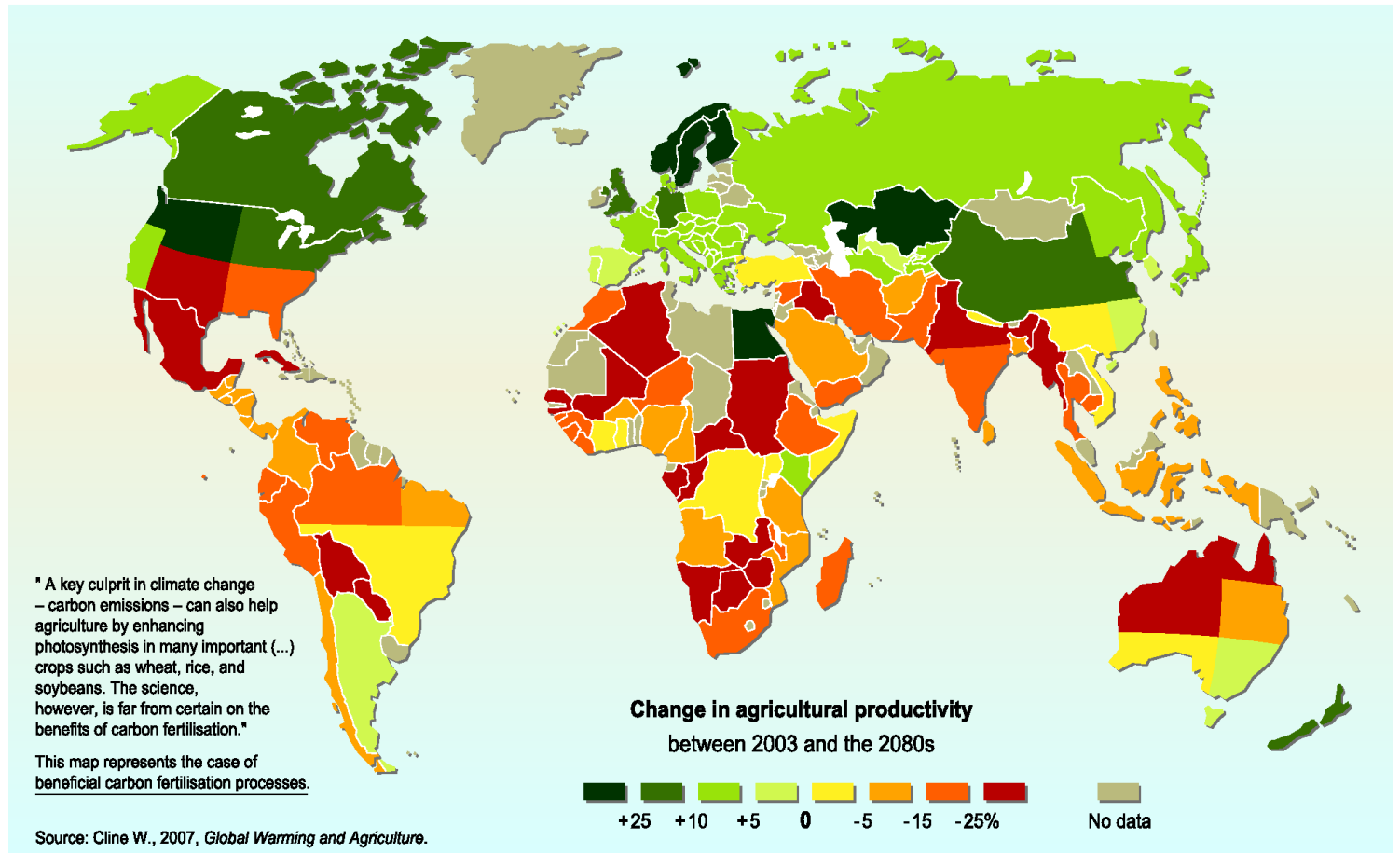


LEARN MORE AT [WWW.WORLDBANK.ORG/FOODPRICEWATCH](http://WWW.WORLDBANK.ORG/FOODPRICEWATCH)

SOURCES: FAO AND WORLD RESOURCES INSTITUTE

# Global Change Exacerbates Food System Challenges

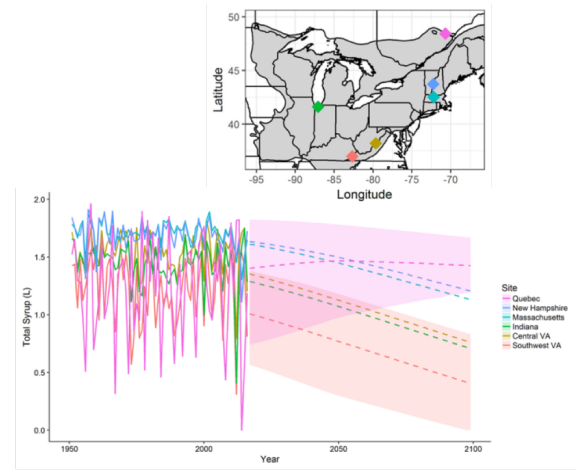
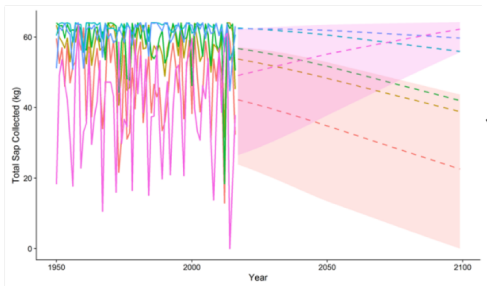
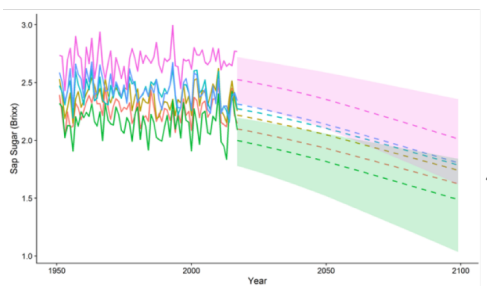
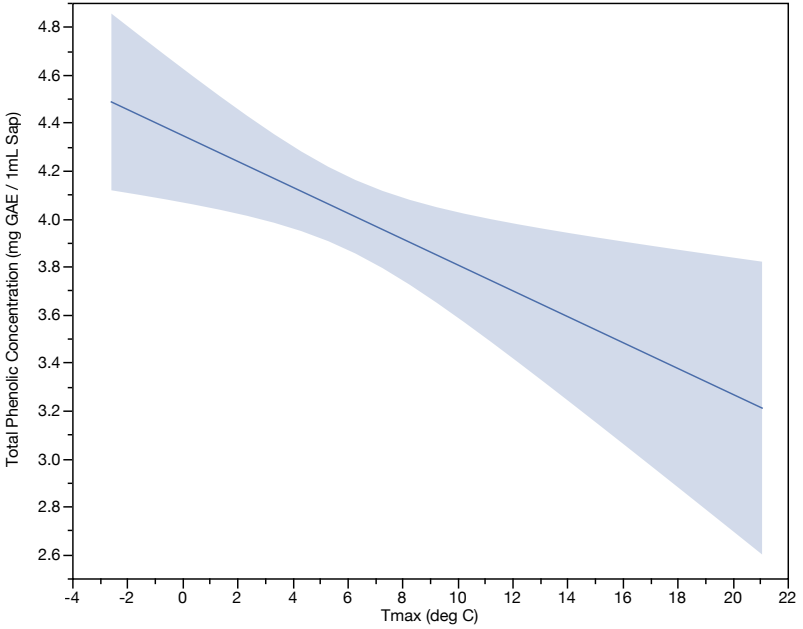
## Projected impact of climate change on agricultural yields



13 CLIMATE ACTION

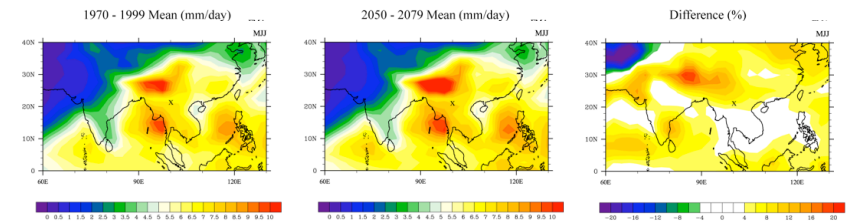
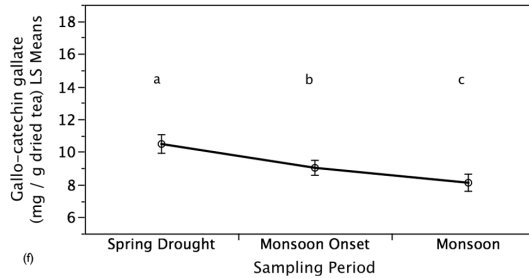
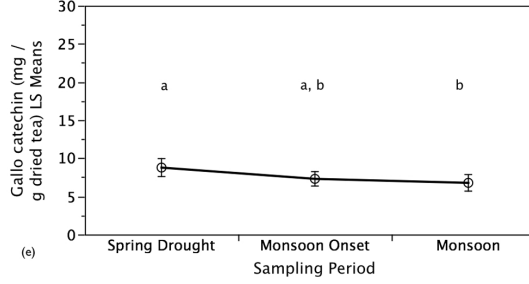
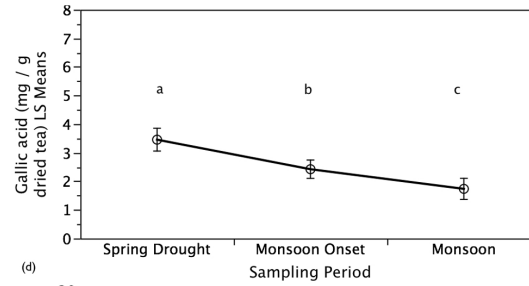
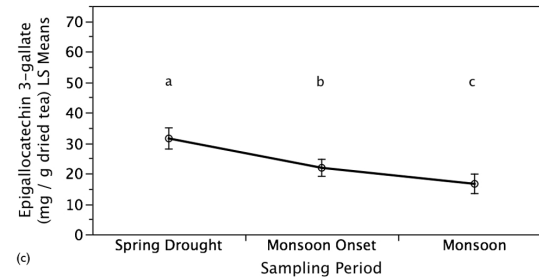
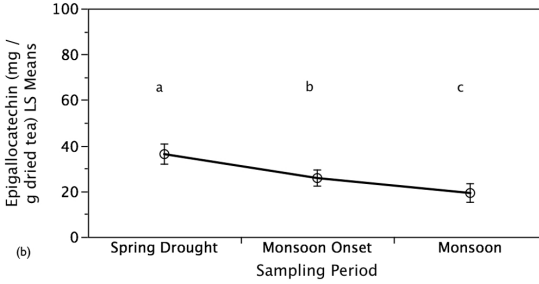
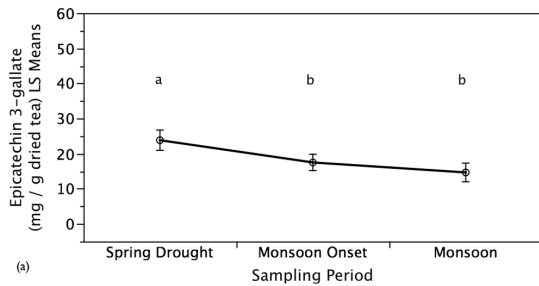


# Crop Quality is Predicted to Shift with Climate Change



Ahmed et al. FEMC Annual Conference 2017

# Crop Quality is Already Significantly Impacted by Climate Variability



Ahmed et al. *PLoS One* 9 (2014)

# Sustainable Diversified Agriculture Can Mitigate Climate Change Effects on Crop Quality



Change in secondary metabolite concentrations between  
Spring and Monsoon harvests

-24.9 mg TCC / g tea

>

-32.2 mg TCC / g tea

$p < 0.0001$

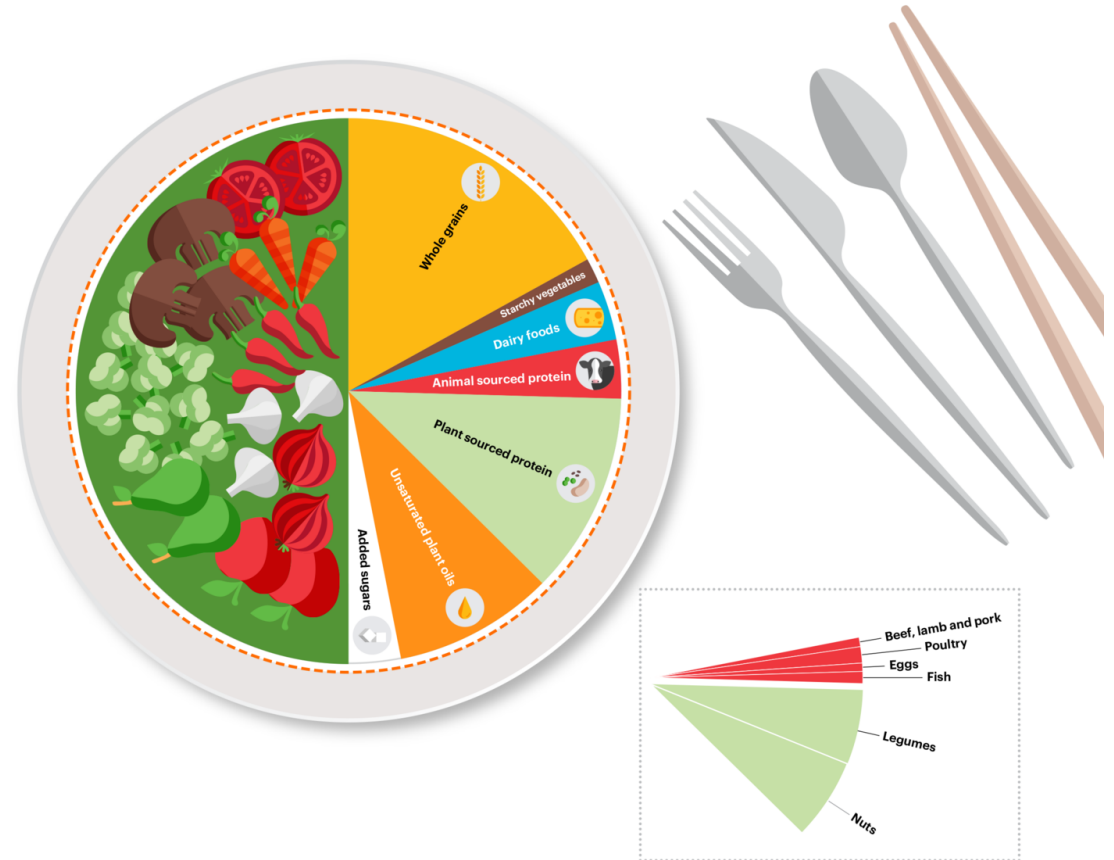
# Sustainable Food Systems



Source: <https://www.esdw.eu>

# Sustainable Diets

**Sustainable diets are healthy diets from sustainable food systems that advance the human condition and conserve ecological resources in socially acceptable ways.**

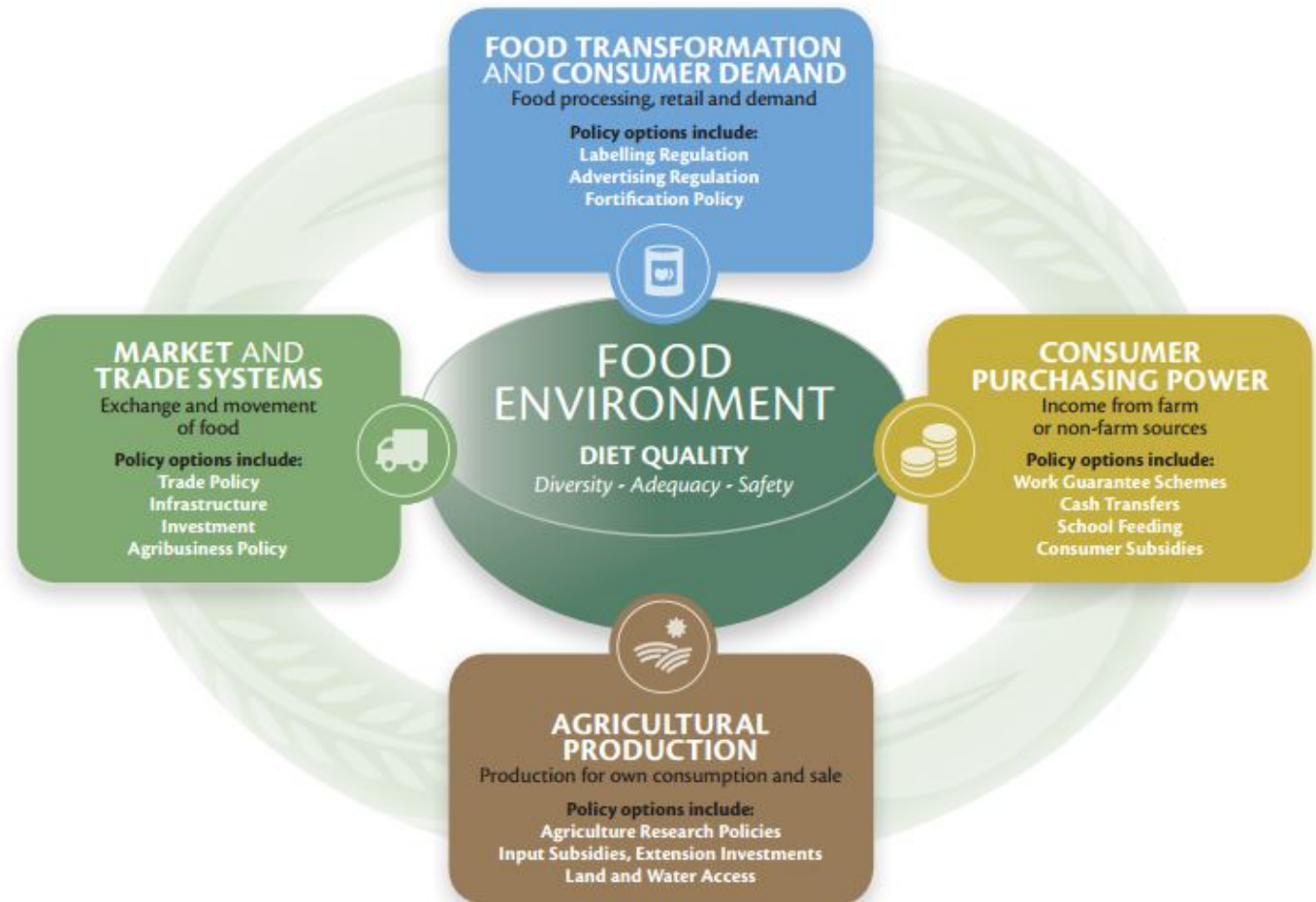


Source: The EAT-Lancet Commission on Food, Planet, Health

# The Food Environment is the Consumer Interface with the Food System

Sustainable diets are the results of a consumer's food choices within the food environment.

The food environment influences the availability, affordability, convenience, and desirability of food.



Source: <https://www.glopan.org/nutrition>



# Not all Food Environments Support Sustainability



Individuals interact in the food environment to make food choices based on personal / cultural factors (preferences, income, knowledge, values, time etc.)

# Food Environment Disparities based on Rurality



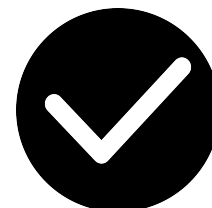
Availability



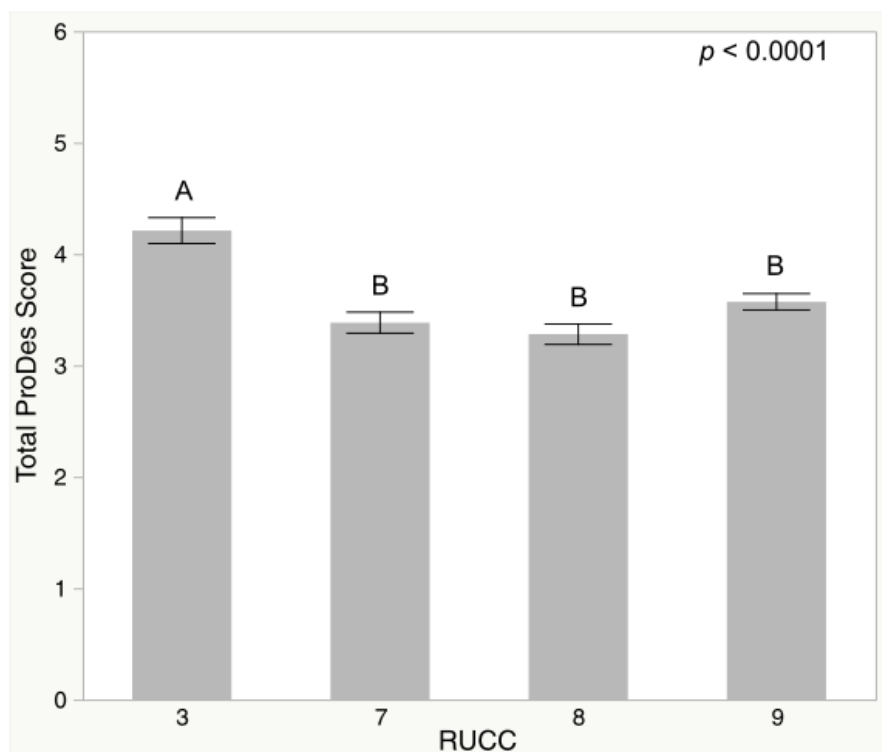
Affordability




Convenience

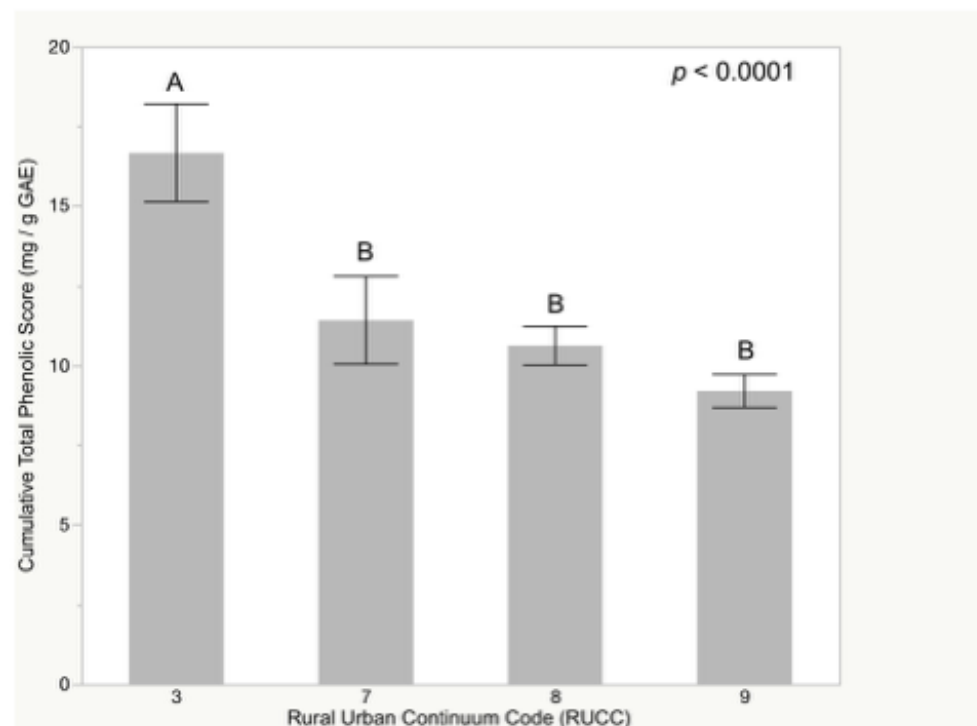


Desirability



Fruit and vegetable desirability is lower in more rural built food environments of Montana, USA using the Produce Desirability (ProDes) Tool

Selena Ahmed<sup>1</sup> · Carmen Byker Shanks<sup>1</sup>  · Teresa Smith<sup>2</sup> · Justin Shanks<sup>3</sup>

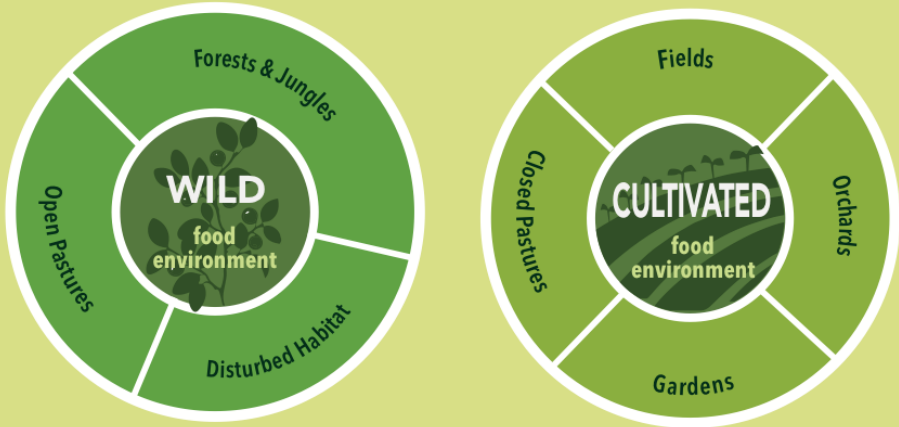


Quality of Vegetables Based on Total Phenolic Concentration Is Lower in More Rural Consumer Food Environments in a Rural American State

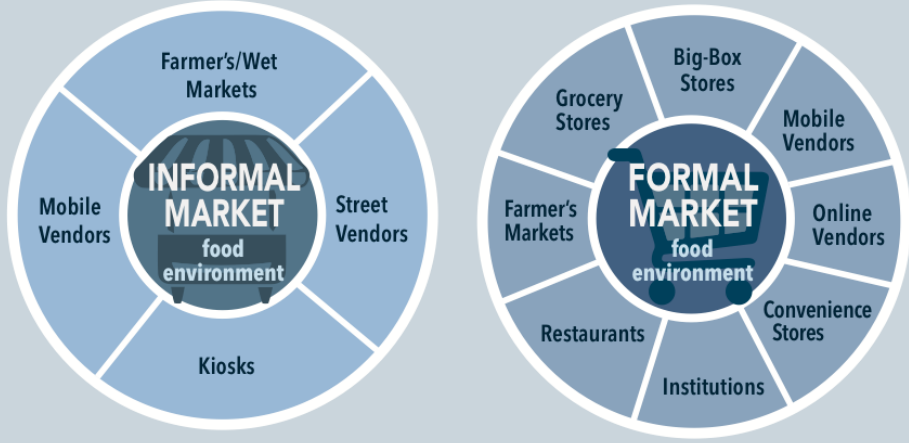
Selena Ahmed \*  and Carmen Byker Shanks 

**FOOD ENVIRONMENT TYPOLOGIES**

**NATURAL FOOD ENVIRONMENTS**



**BUILT FOOD ENVIRONMENTS**





# Indigenous Yunnan food environments



# Biodiversity of the Natural Food Environment is Linked to Dietary Diversity

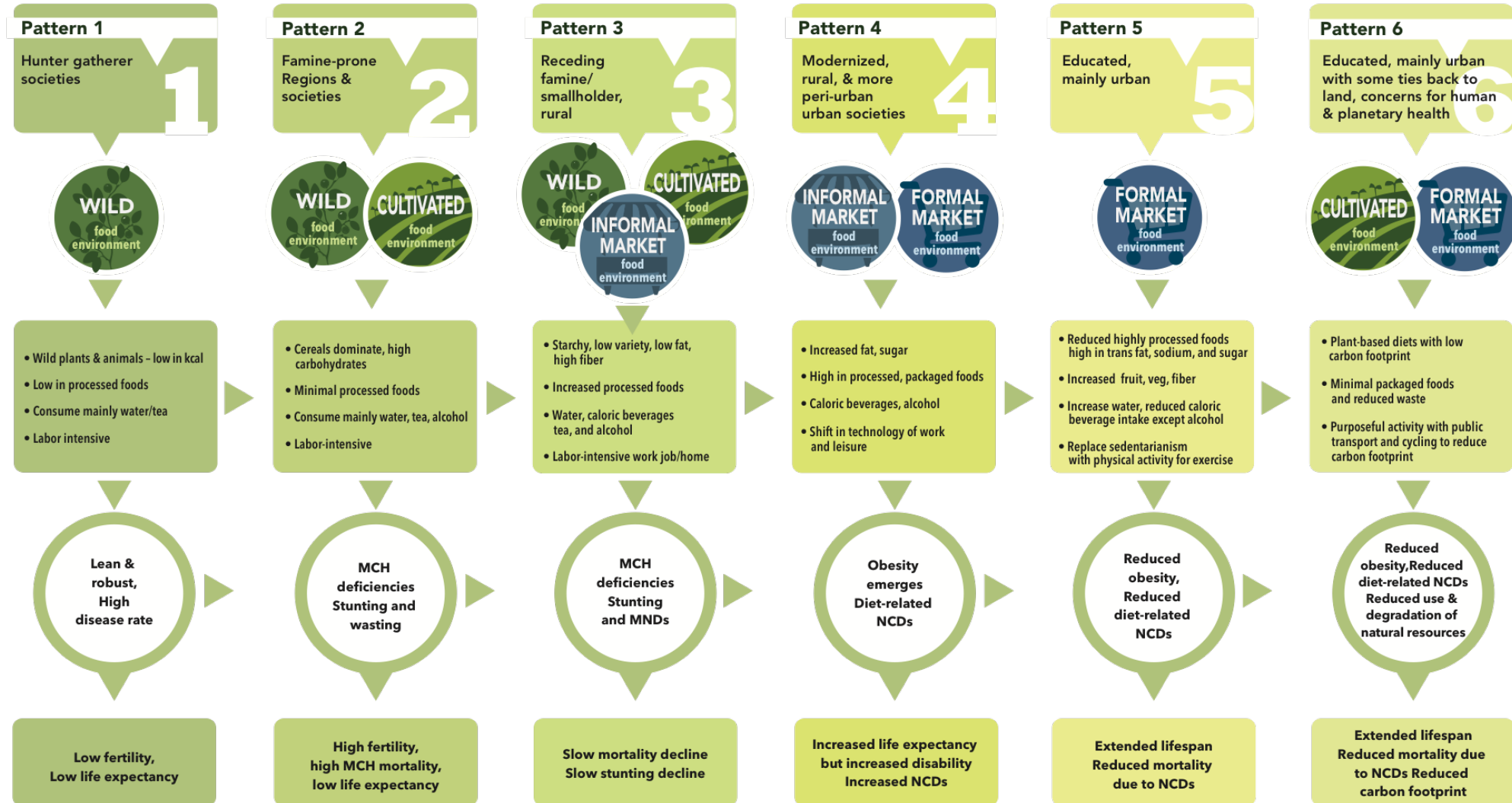


# Food Environments are Changing





# THE FOOD ENVIRONMENT AND NUTRITION TRANSITION TOWARDS SUSTAINABLE DIETS





# Changes in Food Availability

**Table 1.** TOP TEN SPECIES IN TERMS OF THEIR INCREASE IN ABUNDANCE IN NATIONAL FOOD SUPPLIES, 1961 TO 2009

Crop*	Increase in relative abundance and contribution to calories (rank)	Change in spread (rank)	Risk category
Soybean	1	2	Harmful**
Palm oil	2	5	Harmful
Sunflower	3	3	Neutral
Wheat	4	35	Neutral
Rape and mustard	5	6	Neutral
Rice	6	15	Neutral
Sweeteners	7	4	Harmful
Vegetables	8	-	Protective
Cacao beans	9	17	Neutral
Treenuts	10	26	Protective

**Notes:**

\* These top ten species are ranked in terms of increase of spread (Khoury et al. 2014), and dietary risk (Murray 2014). Khoury et al. (2014) did not analyze animal-source foods. The geographic spread is defined as the change over time in a country's food supply in each year; a higher number indicates less change in geographic spread relative to other crops.

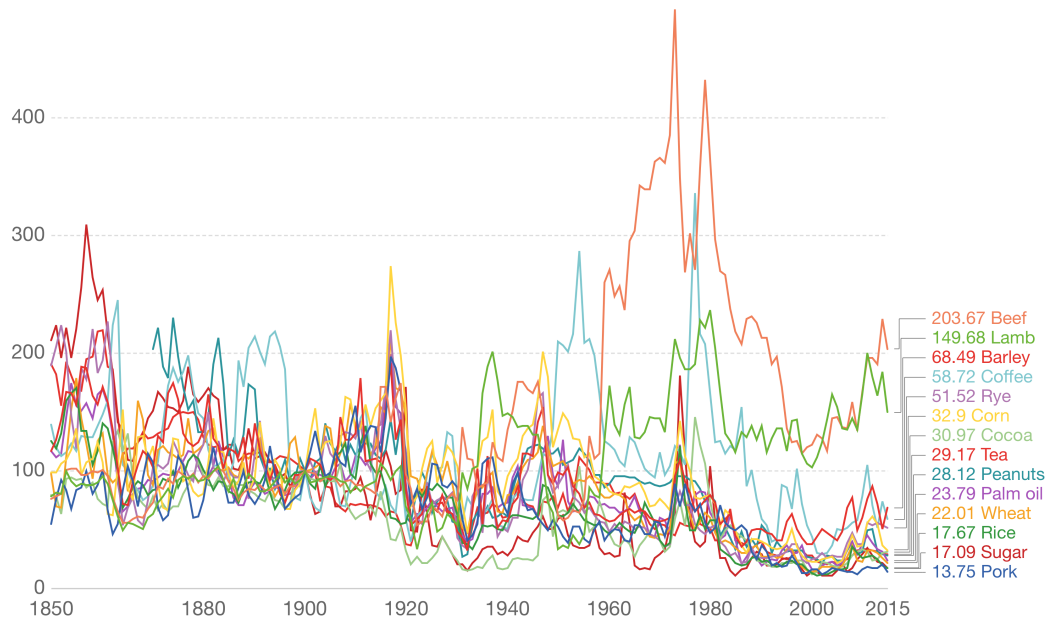
\*\*Soybeans themselves would be in the "protective" risk category, but the increase in their production is mostly for livestock feed to produce red meat destined for middle- and high-income countries, which is classified as "harmful" with relation to the global burden of disease.

**Sources:** Derived from Figures 1A and 1B in Khoury et al. (2014) and Murray (2014).

# Changes in Food Affordability

Long-term price index in food commodities, 1850-2015, World  
Commodity price index in food items dating 1850-2015, measured relative to real prices in 1900 (i.e. 1900 = 100).

Our World in Data

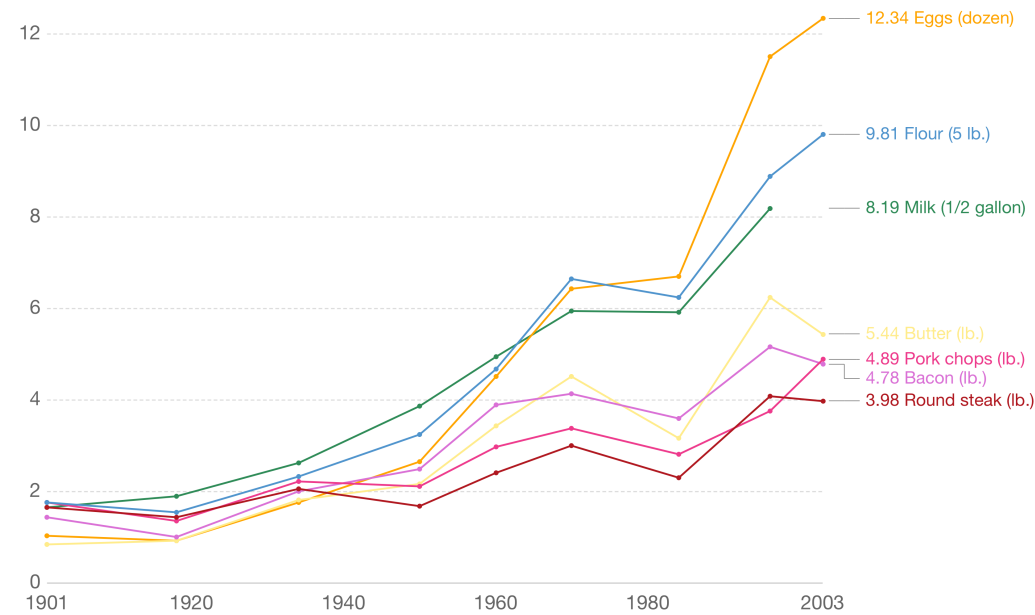


Source: Commodity Prices since 1850 - Jacks (2016)

OurWorldInData.org/food-prices/ • CC BY

How much food can you buy for working one hour in the manufacturing sector?

Our World in Data



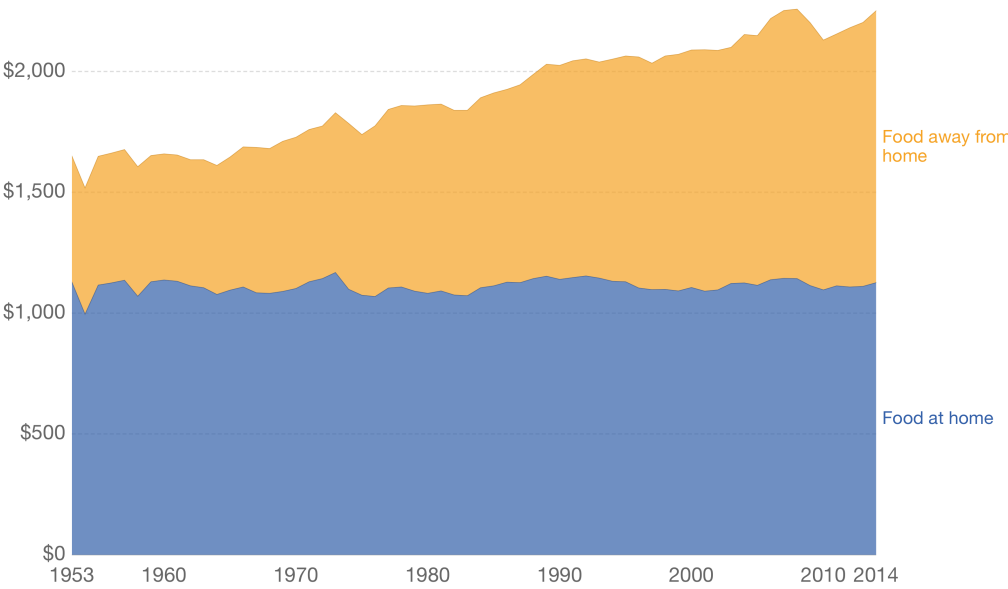
Source: U.S. Bureau of Labor Statistics (2015)

OurWorldInData.org/food-prices/ • CC BY

# Changes in Food Convenience

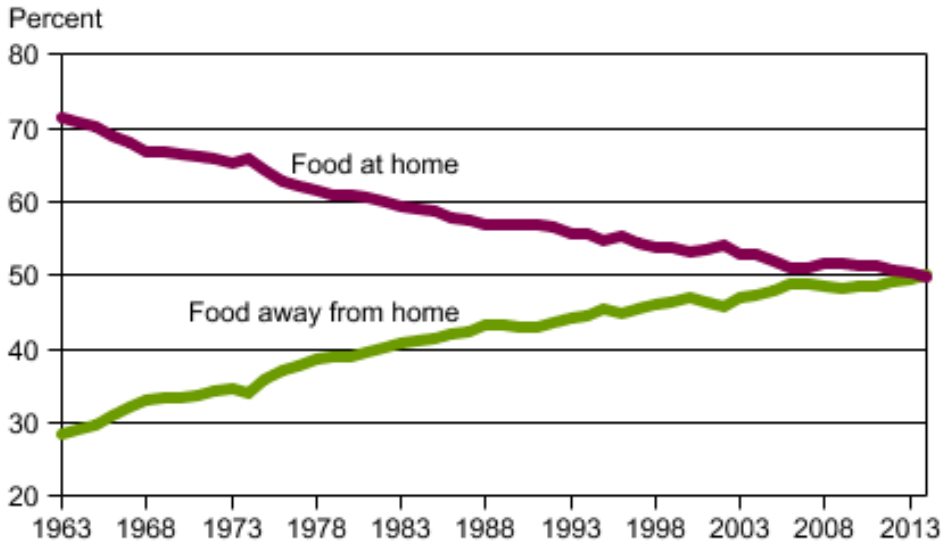
## Food expenditure per person, United States

Average annual food expenditure per person, differentiated between that spent on food at home versus away from home (such as restaurants, cafes, colleges, work etc.). Alcoholic beverages and tobacco are not included. This is measured in constant 1988 US\$.



Source: United States Department of Agriculture (USDA)

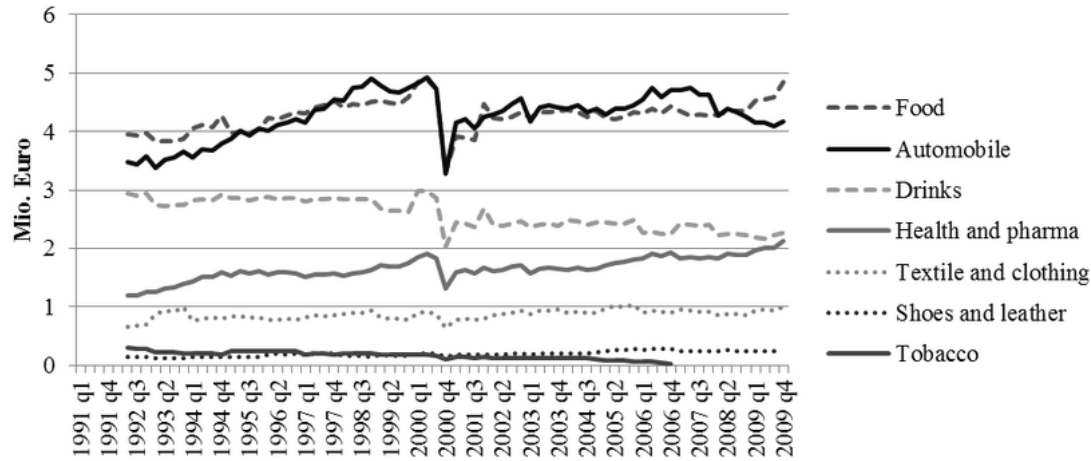
## Shares of total food expenditures



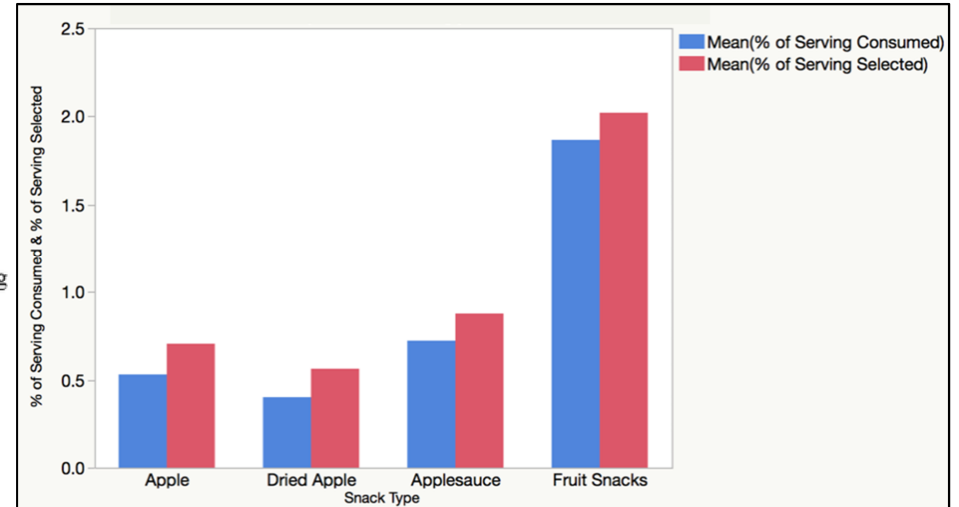
Source: USDA, Economic Research Service, using data from the Food Expenditures data series.

CC BY

# Changes in Food Desirability

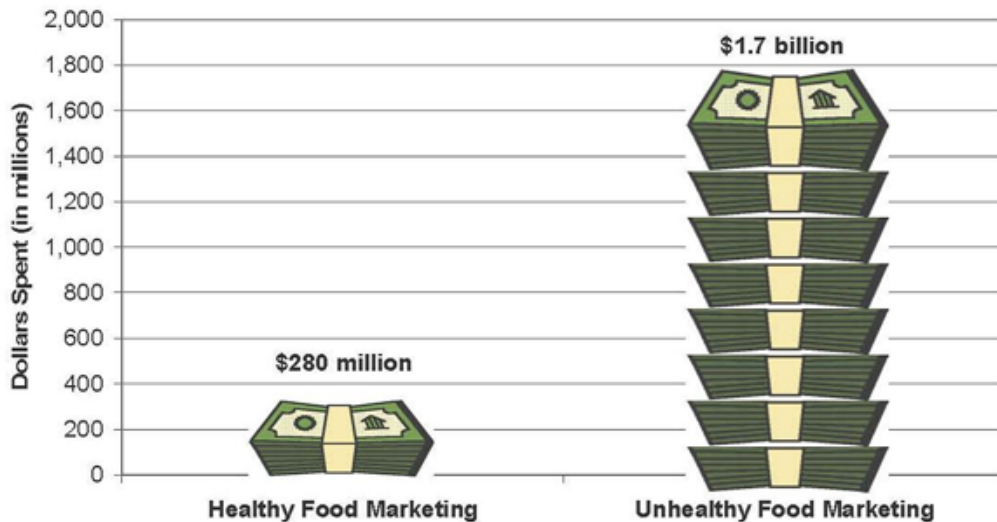


Source: Lischka et al. 2014




Source: Svisco et al. 2019

## Spending on Food Marketing to Kids\*




\*Federal Trade Commission (FTC). *Marketing Food to Children and Adolescents: A Review of Industry Expenditures, Activities, and Self-regulation*. Washington, D.C.: FTC, 2008.  
Powell L, Scherbeck R, Szczypka G, Chaloupka F, Braunschweig C. "Trends in the Nutritional Content of TV Food Advertisements Seen by Children in the US: Analyses by Age, Food Categories and Companies." *Archives of Pediatric and Adolescent Medicine*, Published online August 2011. doi:10.1001/archpediatrics.2011.131.

# Promoting Sustainable Diets: Nutrition and Human Health

<i>Nutrition and health dimension of sustainable diets</i>		
<b>Component</b>	<b>Characterization</b>	<b>Metrics</b>
<b>Plant-based foods</b> 	Consumption of plant-based foods including fruits, vegetables, legumes, nuts, and seeds versus consumption of animal-source foods (including meat and dairy) as part of a diet with adequate consumption of calories and protein.	Survey data of dietary intake; Food balance sheet data; Healthy Eating Index; Dietary Diversity Scores
<b>Dietary diversity</b>	Consumption of a diverse range of foods in different food groups that support healthy diets.	Survey data of dietary intake; Dietary Diversity Scores
<b>Dietary quality</b>	Consumption of high-quality foods including nutrient-dense foods and those rich in phytochemicals such as superfoods and seasonal foods as part of diet that has adequate consumption of calories and protein.	Healthy Eating Index; Plate Waste measurement
<b>Limitation of energy and ultra-processed foods</b>	Diets that have reduced portion sizes and caloric intake including low consumption of ultra-processed foods that are high in sugars, fats, and salts; reduced consumption of sugar-sweetened beverages; and decreased consumption of processed meats.	Survey data of dietary intake; Healthy Eating Index
<b>Food safety</b>	Diets comprised of safe foods including those without pathogens.	Pathogen colony counts; Toxicity tests

# Promoting Sustainable Diets: Environmental Factors


## *Environmental dimension of sustainable diets*

Component	Characterization	Metric
<b>Biodiversity</b> 	Diets that support biodiversity in the food system including through consumption of diversified foods; foods sourced from diversified farms; and foods produced in ways that do not endanger the survival of other organisms.	Shannon Weiner Index
<b>Ecosystem services</b>	Diets that support ecosystem services during food production including pollination, fertility, and nutrient cycling such as those from farms with low pesticide use.	Water quality; Bee counts
<b>Soil health and agricultural management practices</b>	Consumption of foods that support soil organic matter and healthy agriculture including organic food, free-range, and diversified farming; management practices that prevent eutrophication.	Soil Organic Matter; Life Cycle Analysis
<b>Efficient resource use including water, energy, and land</b>	Diets based on foods that make efficient use of natural resources including water, energy, and land; this includes reduced use of synthetic fertilizers and reduced food waste.	Life Cycle Analysis; Ecological Footprint; Total per capita land requirements; Water footprints of crops; Land use; Energy use; Food waste measurements
<b>Low greenhouse gas emissions</b>	Diets that include the procurement and consumption of food low in greenhouse gas emissions; have low carbon footprints, or are carbon neutral; have low food miles; are local, seasonal, and purchased through direct trade such as farmers' markets.	Life Cycle Analysis; Per capita GHGs; Agriculture- and distribution related NH <sub>3</sub> , CH <sub>4</sub> , N <sub>2</sub> O emission factors

Source: Ahmed and Byker Shanks 2019

# Promoting Sustainable Diets: Socio-Economic Factors

## *Socio-economic dimension of sustainable diets*

Component	Characterization	Metric
<b>Food traditions</b> 	Diets that include foods that are part of cultural, religious, community, and family traditions.	Surveys
<b>Flavor and cultural preferences</b>	Diets that include foods that meet personal preferences based on flavor and culture including foods that are local and seasonal and those purchased through direct trade such as farmers' markets.	Surveys; Choice experiments
<b>Equity</b>	Diets that support, and are supported by, equity in the food system based on gender, class, race, livelihoods, and distribution, among other factors.	Surveys; Household food expenditures
<b>Food environment access</b>	Diets that are supported by food environments that provide access to healthy food that is available, affordable, convenient, and desirable; this includes foods that have transparent and understandable labels.	ProDes; NEMS; Cost of Diets; Food environment observations
<b>Food sovereignty</b>	Diets that support and are supported by education, skills, empowerment, and safe advertising (that which does not encroach on children through unfair means).	Surveys

# Thank You

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