

## Sustainable Protein: Investing for Impact at the Nexus of Environment, Human Health and Animal Welfare



- Advances in agricultural technology, changes in human diet, and rising awareness of the environmental destruction caused by factory farming are accelerating the rise of sustainable protein.
- Investors can target a number of outcomes — access to a sustainable food supply, lower greenhouse gas emissions, more plentiful and cleaner water, and a reduction in animal cruelty — through sustainable protein related investments. Opportunities exist in alternative proteins, organic foods, new agricultural technologies, sustainably managed farmland, and sustainable fisheries and aquaculture.
- In this report we outline how a confluence of behavioral, technological, and regulatory changes have fueled the trend toward sustainable protein; identify emerging developments in the “alternative protein” space; and highlight ways to consider sustainable protein investment across asset classes.

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## Executive Summary

■ **A shift to more sustainable protein is not a new trend**, with gains in agricultural productivity, evolving diets, and changing lifestyles as contributing factors. In recent years, the environmental impacts of large-scale production of animal-based protein (“factory farming”) have become more widely recognized, and seen by many experts as untenable, further fueling demand for more sustainable protein production methods.

### ■ Gains in agricultural productivity:

- While greenhouse gas (GHG) emissions by the livestock sector exceed direct GHG emissions from the global transport sector, further gains in agricultural productivity should lead to a continued decline in global agriculture-related GHG emissions. Combined, global CO<sub>2</sub> emissions from land-use change and global emissions of methane (including that produced by livestock) in 2050 are forecast to be 11% below 2010 levels.
- Similarly, reflecting technological advances and greater efficiency in water use, global water demand for (i) irrigation of crops for animal feed and (ii) livestock drinking water is forecast to decline 13% between 2000 and 2050.
- Demand for animal-based protein is growing rapidly in developing countries, but this will not necessarily offset the trend toward sustainable protein in developed countries. If agricultural productivity gains do not keep pace with demand for protein in developing countries, a relatively small set of actions could provide enough new calories to meet the basic needs of more than 3 billion people: a reduction in crop production devoted to animal feed; an increase in agricultural water productivity; and less food waste.

### ■ Evolving diets and changing lifestyles:

- U.S. per capita consumption of red meat declined 26% between 1971 and 2016, reflecting diet-related health concerns and less- or no-meat lifestyles. Flexitarian, vegetarian and vegan preferences are sometimes driven by animal welfare and climate change concerns. Growth in consumption of alternative proteins — including advanced plant-based protein sources, fermented proteins, and cultured meat — could further reduce demand for meat.
- Per capita consumption of dairy products has also declined steadily while, at the same time, sales of dairy milk alternatives (e.g., almond, soy milk) have grown rapidly.

■ **Investment Implications:** Among the impact opportunities in sustainable protein are investments in alternative proteins, organic foods, and developers of new agricultural technologies. In addition, investments can be made in sustainably managed farmland, and in sustainable fisheries and aquaculture. Public equities and alternatives (private equity, venture capital) offer the most robust and direct opportunities for exposure to this investment theme.

#### Key investment themes:

- ✓ Alternative proteins
- ✓ Organic food manufacturers
- ✓ Aquaculture
- ✓ Sustainable fisheries
- ✓ Sustainably managed farmland
- ✓ Developers of new agricultural technology

#### Opportunities by asset class:

##### Public Equities

- ✓ Portfolio analysis
- ✓ Thematic funds
- ✓ Shareholder advocacy

##### Alternatives

- ✓ Early-stage private equity investments in targeted themes
- ✓ Real asset funds

##### Fixed Income

- ✓ Relevant green, social or blue bonds
- ✓ Selected corporate, sovereign or development bonds
- ✓ Impact notes

## Sustainable Protein: An Overview

There are three key factors behind the trend to more sustainable animal-based protein:

- **Behavioral:** In developed countries, diet-related health concerns and less- or no-meat lifestyles have sharply reduced consumption of red meat. Flexitarian, vegetarian and vegan preferences have been driven, in part, by animal welfare and climate change concerns.
- **Technological:** In developed countries, technological advances have spurred the development of alternative proteins including meat-like products not from animals. In developing countries, productivity gains have improved the efficiency with which agricultural inputs (land, labor, fertilizer, feed, machinery and livestock) are transformed into outputs (gross crop and livestock output).
- **Advisory / Regulatory:** In addition to shifting consumer preferences, dietary guidelines have likely contributed to reduced consumption of animal-based protein. The decline in consumption of red meat in the U.S. began after the American Heart Association recommended reduced intake in order to prevent cardiovascular disease. Today, European countries are at the forefront in issuing dietary guidelines about the consumption of meat, dairy and eggs. Separately, authorities such as the U.S. Food and Drug Administration and the U.S. Department of Agriculture are involved with determining the food safety of alternative proteins.

In terms of the investment implications of these trends:

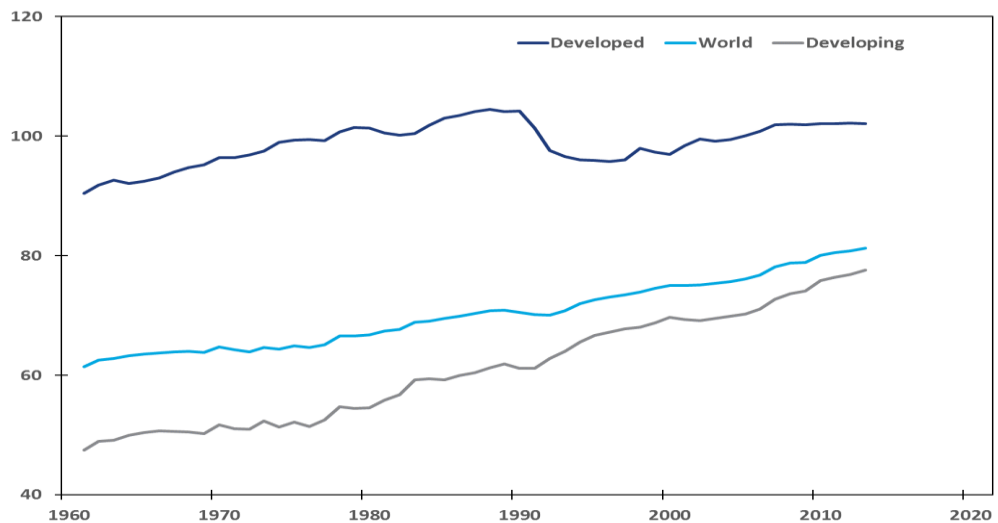
- Growth in consumption of alternative proteins — including advanced plant-based protein sources, fermented proteins, cultured meat — creates a wide range of opportunities for investors, including investments into venture stage firms focused on meat-like products not from animals. In addition, private equity firms have invested in early stage organic food companies. Sustainable farmland funds can acquire traditional cropland and transform it to certified organic land growing organic crops that command higher prices. Similarly, opportunities exist in sustainable fisheries and aquaculture.
- To drive further gains in agricultural productivity, investors can invest in the public equities of companies involved with agricultural technologies, including those focused on water efficiency and food safety. In addition, private equity funds that invest in early-stage companies could provide exposure to businesses experimenting with various agricultural technologies, including “precision agriculture” or “satellite farming,” which is a farming management concept based on observing, measuring and responding to variability in crops.
- Using shareholder advocacy, individual investors (asset owners and asset managers) and broad investor initiatives have highlighted important food-related issues to companies. Having companies take action before they are required to do so by regulators would likely advance a range of food-related issues.

## The Evolution of Protein in Modern Diets

Protein consumption levels today are much higher than they were 50 years ago, especially in developing regions

Protein is an important part of the human diet and is necessary for the growth and renewal of human cells.<sup>1</sup> Between 10% and 35% of daily calorie intake should be in the form of proteins. The nutrient is found in a wide variety of foods, including cereals, meat and milk. Figure 1 illustrates that protein consumption levels today are much higher than they were 50 years ago, especially in developing regions. (In a section below, we discuss factors behind the stabilization in protein consumption in developed countries.)

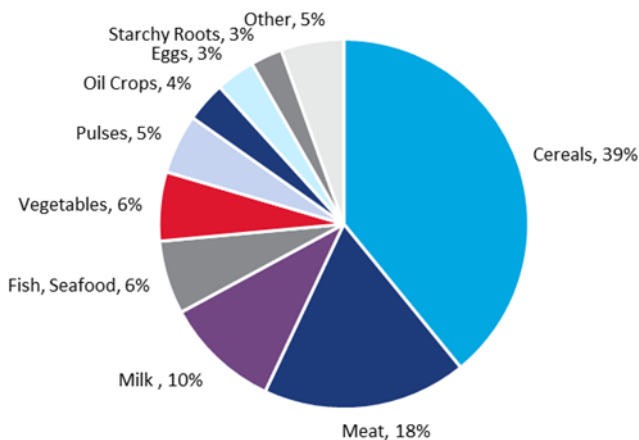
**Figure 1: Evolution in Protein Consumption Per Capita**  
*Grams per capita per day by region*



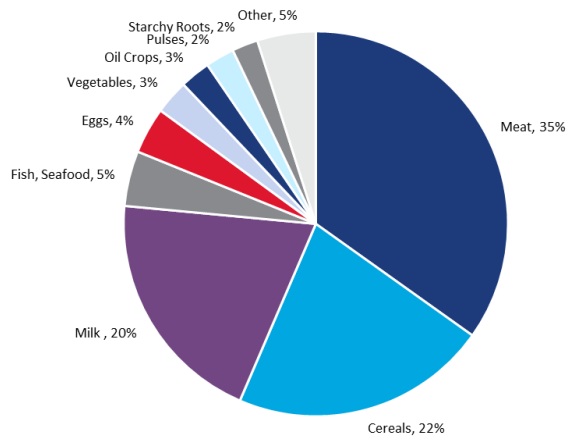
Source: FAOSTAT

Figure 2 and Figure 3 illustrate the current sources of protein globally and in the U.S.

**Figure 2: Global Protein Supply**



**Figure 3: U.S. Protein Supply**



\*Other includes: Infant food, non-alcoholic beverages, ice cream, other food preparations

Source: FAOSTAT



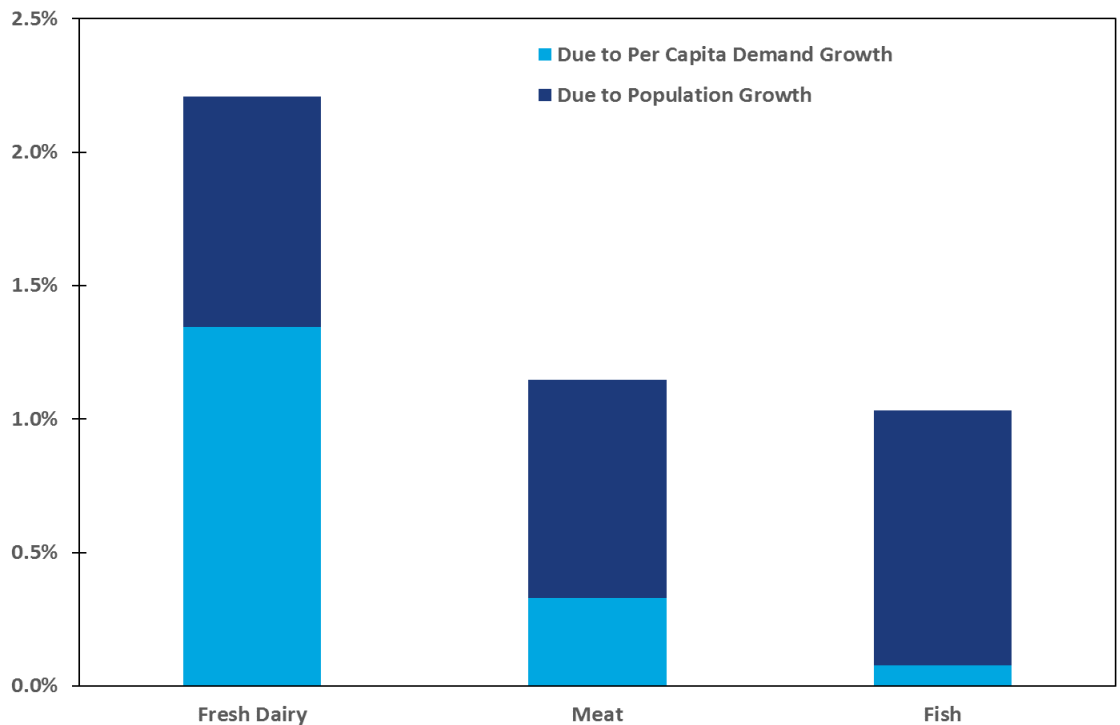
Globally, *plant-based foods* form the primary sources of protein, accounting for almost 60% of protein supply: cereals (39%), vegetables (6%), pulses (5%), oil crops (4%), starchy roots (3%). Corn (maize), rice and wheat are the main cereal proteins consumed globally.

In the U.S., *animal-based foods* form the primary supply of protein, accounting for over 60%: meat (35%), milk (20%), fish and seafood (5%), eggs (4%). Research has shown<sup>2</sup> that animal-based proteins are also predominant in other developed countries.

Demand for animal-based proteins continues to rise, reflecting population growth and per capita demand growth

Demand for animal-based proteins continues to rise — global consumption of fresh dairy,<sup>3</sup> meat and fish is forecast to grow by 1-2 percentage points each year for the next decade (Figure 4).

**Figure 4: Estimated Annual Growth in Global Consumption of Proteins by Source, 2018-27**



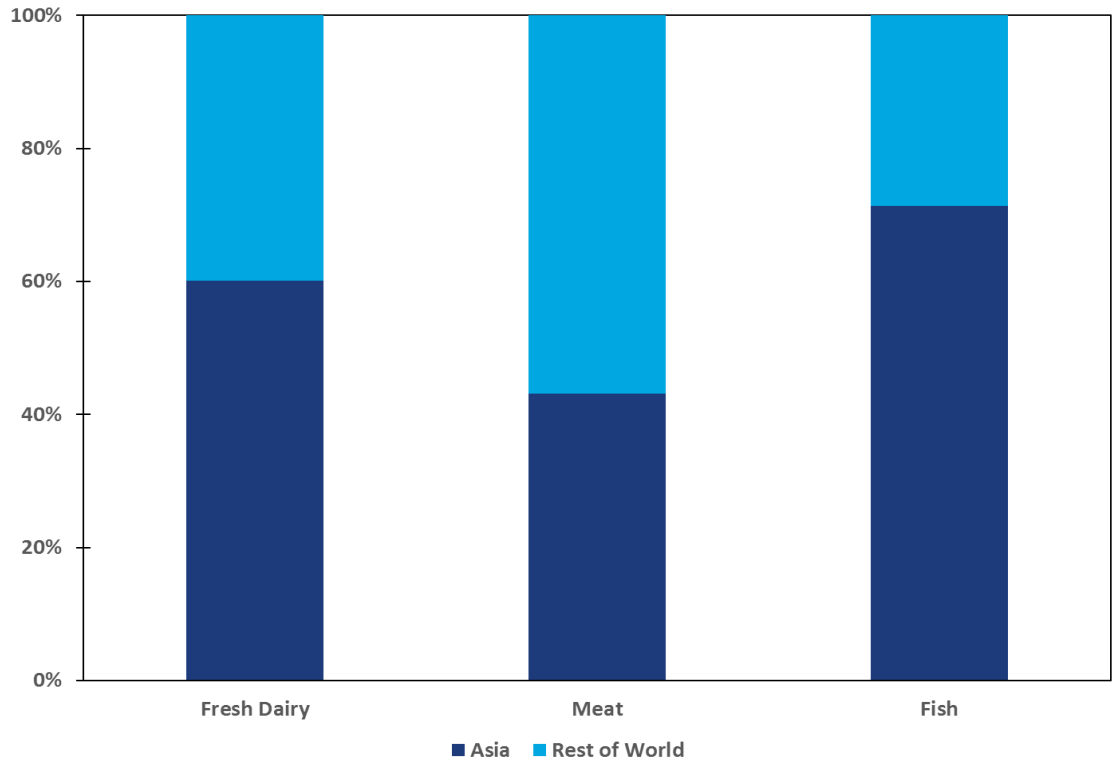
Source: OECD-FAO

As Figure 4 illustrates, population growth will be one factor driving increased demand for proteins. According to the United Nations, the current world population of 7.3 billion is expected to reach 8.5 billion by 2030.<sup>4</sup> In addition, rapidly expanding middle classes in developing countries are creating demand for more varied, high-quality diets, resulting in increased per capita consumption of animal-based protein.

Then, too, urbanization in countries such as China has provided new infrastructure capable of supporting distribution chains for chilled products, including dairy. The combination of these factors — population growth, increased per capita consumption, refrigeration — is driving particularly rapid growth in demand for fresh dairy products in Asia — Figure 5.



**Figure 5: Growth in Asian Consumption of Proteins, 2017-26**



Source: OECD-FAO

In addition, reflecting increased per capita demand for meat in the region, Asia is also forecast to account for a large share of the additional consumption of meat globally. And while Asia will drive increased global consumption of fish (Figure 5), this will almost entirely be due to population growth rather than increased per capita consumption (Figure 4).

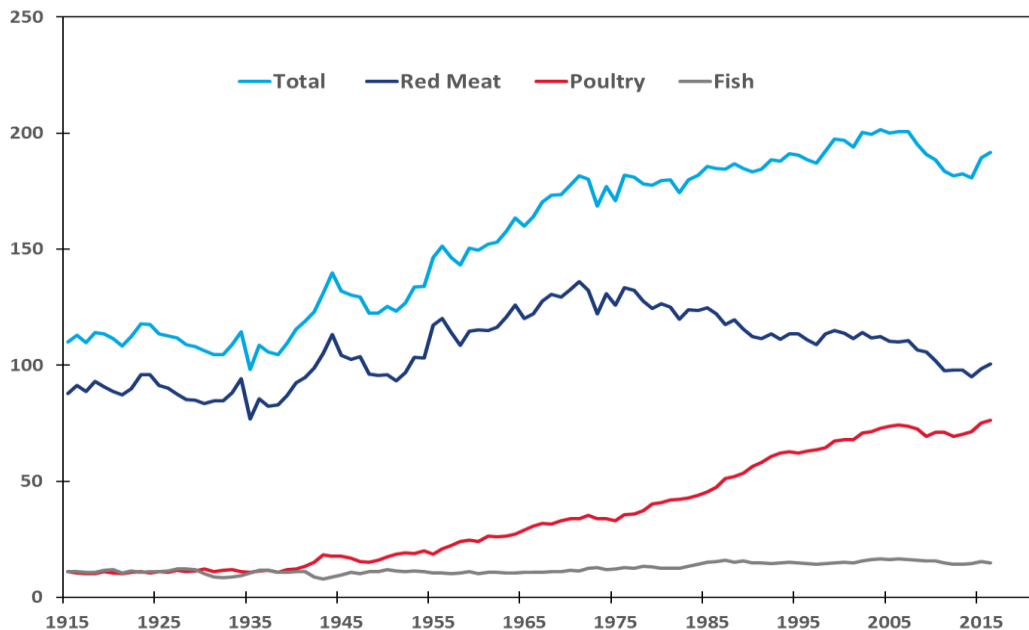




## Meat Consumption Trends in Developed Countries

As noted above (Figure 3), meat is the primary protein source in the U.S. and other developed economies. According to the U.S. Department of Agriculture, red meat (including beef, veal, pork, lamb, and mutton) accounted for over three quarters of the meat and fish consumed in the U.S. for much of the 20th century — Figure 6. (Note that fish consumption has remained low and stable over the past century.)

**Figure 6: Annual U.S. Meat and Fish Availability Per Capita in Pounds**



Source: USDA

In the late 1950s, the American Heart Association first recommended that red meat consumption be reduced for the prevention of cardiovascular disease. Subsequent studies found that high red meat consumption was correlated with higher rates of other chronic diseases, including cancer, the leading cause of mortality in the U.S. and other Western countries.

Public health alerts and consumer concerns ultimately led to a marked reduction in the consumption of red meat. In addition, the bovine spongiform encephalopathy (BSE) or “mad cow disease” outbreak identified in the U.K. in the 1980s, and later in the U.S. in 2003, acted as another blow to the beef industry.

Figure 6 illustrates that the decline in red meat consumption was accompanied by a rise in poultry consumption. (In this analysis, poultry products include chicken and turkey.) Awareness about the hazards of fat and cholesterol in diets spurred demand for lean meat, especially poultry. At the same time, vertical integration and the development of “factory farming” resulted in a large, low-cost supply of poultry.

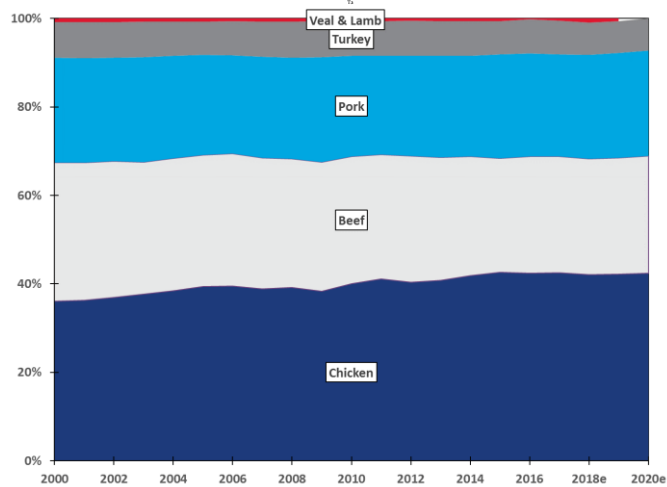
The pattern of declining consumption of red meat and increased consumption of poultry experienced in the U.S. (Figure 7) has also occurred in Europe (Figure 8).

Public health and consumer concerns have fueled a decline in red meat consumption and rise in poultry consumption in the U.S. and other Western countries in recent decades



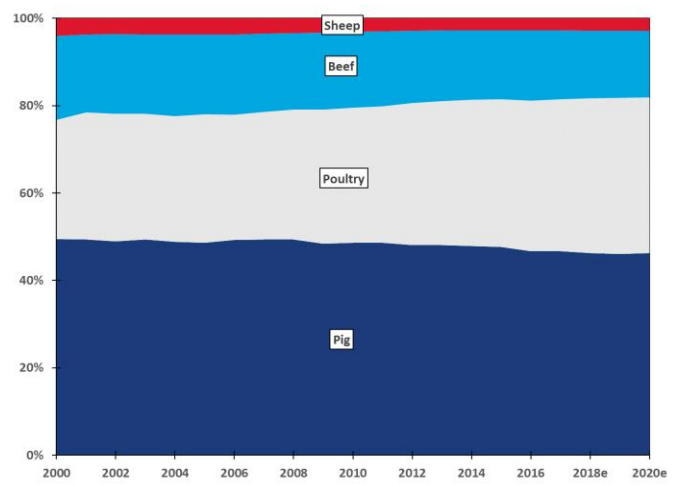


**Figure 7: Annual U.S. Consumption of Animal Protein**



Source: USDA

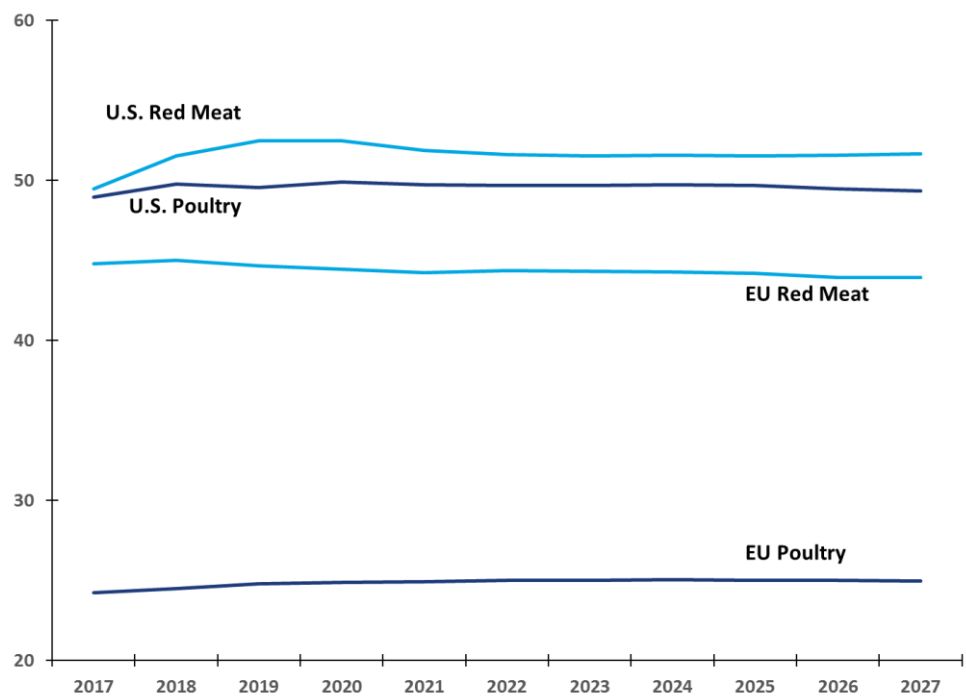
**Figure 8: Annual E.U. Consumption of Animal Protein**



Source: OECD

The Food and Agriculture Organization of the United Nations forecasts<sup>5</sup> that per capita consumption of red meat and poultry in both the U.S. and the EU will essentially remain flat for the next decade — Figure 9. In the context of Figure 7 and Figure 8, this would suggest that the downward trend in the consumption of red meat and the upward trend in the consumption of poultry have both run their course.

**Figure 9: Annual Per Capita Consumption of Red Meat and Poultry in Kilograms**



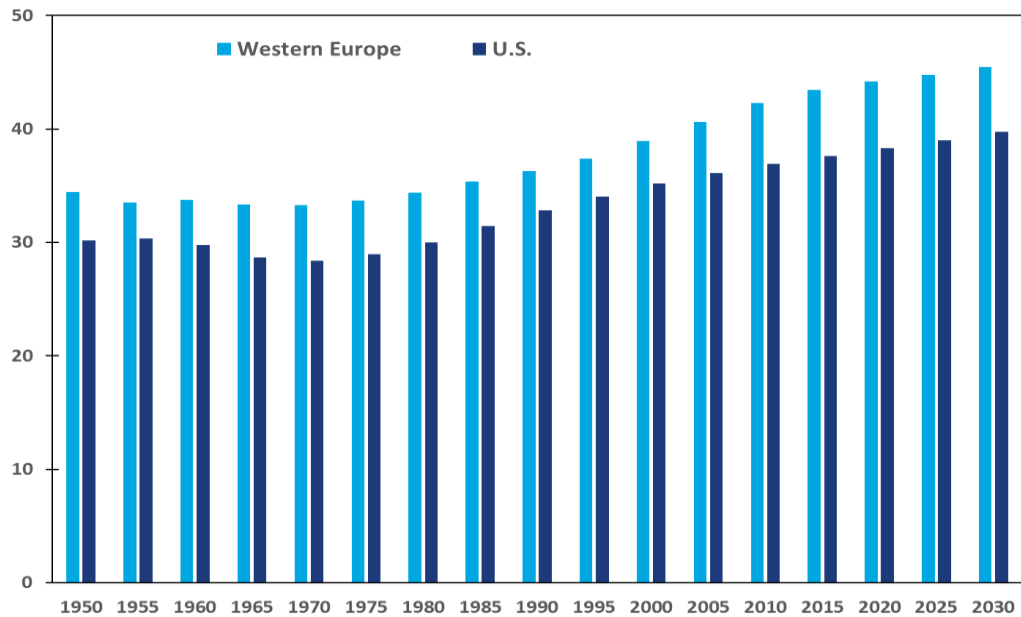
Source: OECD-FAO



As for the reasons why, an OECD report<sup>6</sup> stated that “only marginal growth in per capita meat consumption is anticipated in the developed countries to 2022 as a result of aging populations, changing lifestyles and diets affecting consumption.”

■ An academic study<sup>7</sup> found that elderly “households (HH-head is 65+) show significantly lower (95% significance) meat purchase *frequencies* when compared with households from all other age cohorts in the sample. When meat *expenditure* is concerned, elderly households spend significantly less (99% significance) on meat products.” It is projected that by 2030 the median age of the population in both Western Europe and the U.S. will be 40 or higher — Figure 10.

**Figure 10: Median Age of Population in Western Europe and U.S.**



Source: United Nations

■ Less- or no-meat lifestyles are being reflected in flexitarian, vegetarian and vegan preferences. According to a *Washington Post* article<sup>8</sup>, “In 1979, Wendy’s became the first nationwide fast-food chain to introduce the salad bar...By 1983, a National Restaurant Association study showed that four out of 10 consumers had changed their ordering habits when eating out because of nutrition concerns.”

31% of Americans practice a “flexitarian” diet, with another 13% vegans or vegetarians

Today, a flexitarian diet – one that doesn’t adhere to a specific eating style and may combine plant-based and meat-based dishes – is now practiced by 31% of Americans, with another 13% subscribing to a specific eating lifestyle such as veganism or vegetarianism.<sup>9</sup> In the U.K., almost 13% of the population is now vegetarian or vegan, with a further 21% identifying as flexitarian, according to a 2018 survey of British consumers.<sup>10</sup>



- Diets have long been impacted by health-related issues. As noted above, concerns regarding fat and cholesterol led to a marked reduction in the consumption of red meat and greater demand for lean meat, especially poultry. Responding to more recent health-related concerns of consumers, McDonald's announced a new beef antibiotic policy affecting 85% of its global supply chain intended to reduce the use by its beef suppliers of antibiotics important to human health.

## Protein Consumption and Animal Welfare

Animal welfare has become a key focus of companies involved with animal-based protein

In addition to lifestyle and demographic trends, animal welfare issues have played a role in how consumers think about animal-based protein. In a 2017 survey<sup>11</sup>, more than half of U.S. consumers (58%) said they were more concerned about farm animal welfare than they had been two years previously. Shareholder advocacy organizations and campaigns have likely played a significant role in raising awareness of this issue and in engaging with corporations. As a result, animal welfare has become a key focus of companies involved with animal-based protein:

- In 2015, McDonald's announced it would begin phasing out the use of eggs from hens housed in cages. The company uses two billion shell and liquid eggs annually. McDonald's rival Burger King was one of the first major fast-food chains to pledge to use cage-free eggs, with a promise to have its supply chain converted by 2025. Companies including Unilever, General Mills and Sara Lee are committed to using cage-free eggs exclusively.
- All major retailers in the U.K. now offer cage-free eggs or have committed to do so by 2025. The U.K.<sup>12</sup> implemented a mandatory egg labeling program in 2012<sup>13</sup>, and free-range eggs accounted for 54% of sales in Q3 2018<sup>14</sup>, an 11 percentage point increase from prior to the requirement<sup>15</sup>.
- Consumer concerns about the way other types of agricultural livestock are raised have also increased. Big agricultural enterprises, including Cargill, have responded by moving sows out of small stalls into group housing. Similarly, in the U.K., British food company Cranswick gets all of its pork from Red Tractor approved farms<sup>16</sup>, where it is a requirement not to confine sows during the gestation period. In addition, Cranswick does not source any beef from suppliers who use concentrated animal feeding operations (CAFOs).

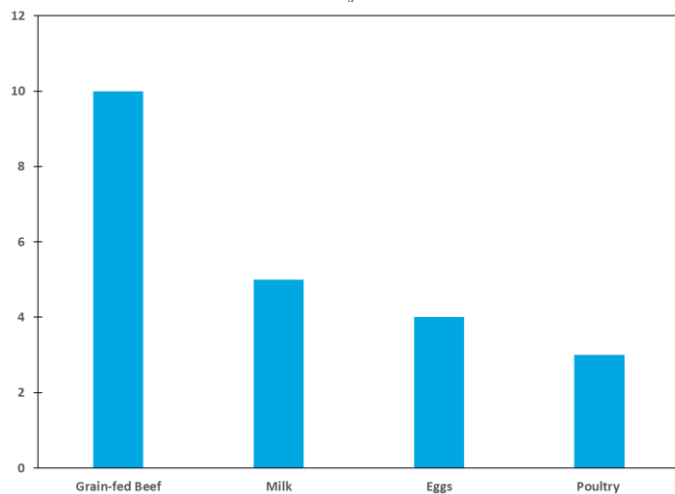
## Protein Consumption Trends and the Environment

The shift from red meat to poultry in developed countries has had important implications for the environment. The U.K. Government Office for Science has defined<sup>17</sup> sustainable production as:

- A method of production using processes and systems that are non-polluting, conserve non-renewable energy and natural resources, are economically efficient, are safe for workers, communities and consumers, and do not compromise the needs of future generations.

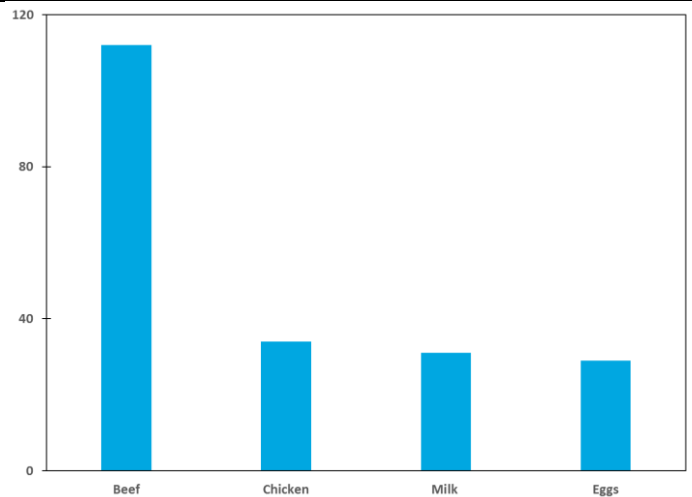
In that context, the production of poultry requires significantly less grain (Figure 11) and water (Figure 12) per unit of protein than red meat such as beef.

**Figure 11: Kilograms of Grain Per Kilogram of Protein**



Source: Riddet Institute

**Figure 12: Water Footprint per Unit of Protein (Liters)**



Source: Mekonnen & Hoekstra 2012<sup>18</sup>

All the same, some consumers are reducing or stopping their consumption of meat because of climate change concerns: In a 2018 survey of British consumers, of those answering the question “why have you become vegetarian or vegan?” 38% answered “environmental concerns.”

In the following sections we examine the linkages between farming and the environment.



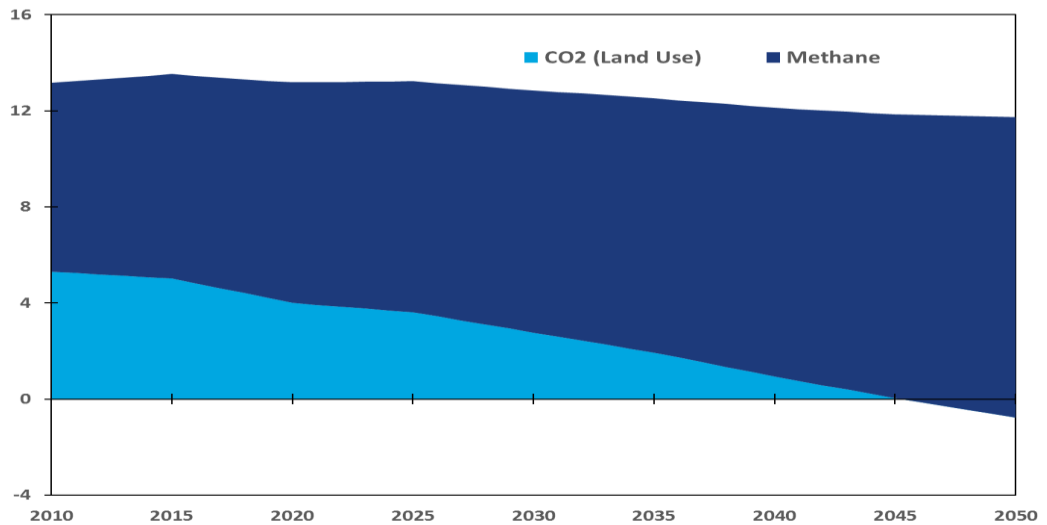
## Land Use and Climate Change

Greenhouse gas emissions by the livestock sector are estimated to exceed direct GHG emissions from transportation — that may soon change

It has been claimed that greenhouse gas (GHG) emissions by the livestock sector exceed direct GHG emissions from the global transport sector.<sup>19</sup> That may soon change. According to the OECD *Environmental Outlook to 2050*:<sup>20</sup>

- Historically, global net CO<sub>2</sub> emissions from land-use change (mainly deforestation driven by the expansion of agricultural land) have been in the order of 4-8 [giga tons of CO<sub>2</sub> equivalent] a year...In the Baseline scenario, the global agricultural land area is projected to expand until 2030, and to decline thereafter, due to a number of underlying factors such as demographics and *agricultural yield improvements*...These agricultural developments are among the main drivers of land-use change, and consequently of developments in GHG emissions from land use [Figure 13]. From about 2045 onwards, a net reforestation trend is projected – with CO<sub>2</sub> emissions from land use becoming negative [italics added].

**Figure 13: Global Agriculture-Related GHG Emissions: Baseline Scenario (Giga tons of CO<sub>2</sub> equivalent)**



Source: OECD *Environmental Outlook to 2050*

The OECD report also noted that:

- Over 50% of global methane emissions are from human activities, such as fossil fuel production, animal husbandry (enteric fermentation in livestock and manure management), rice cultivation, biomass burning and waste management.

Figure 13 illustrates that, combined, global CO<sub>2</sub> emissions from land-use change and global emissions of methane in 2050 are forecast to be 11% *below* 2010 levels.

Global CO<sub>2</sub> emissions from land-use change and global emissions of methane in 2050 are forecast to be 11% below 2010 levels

### Water Usage

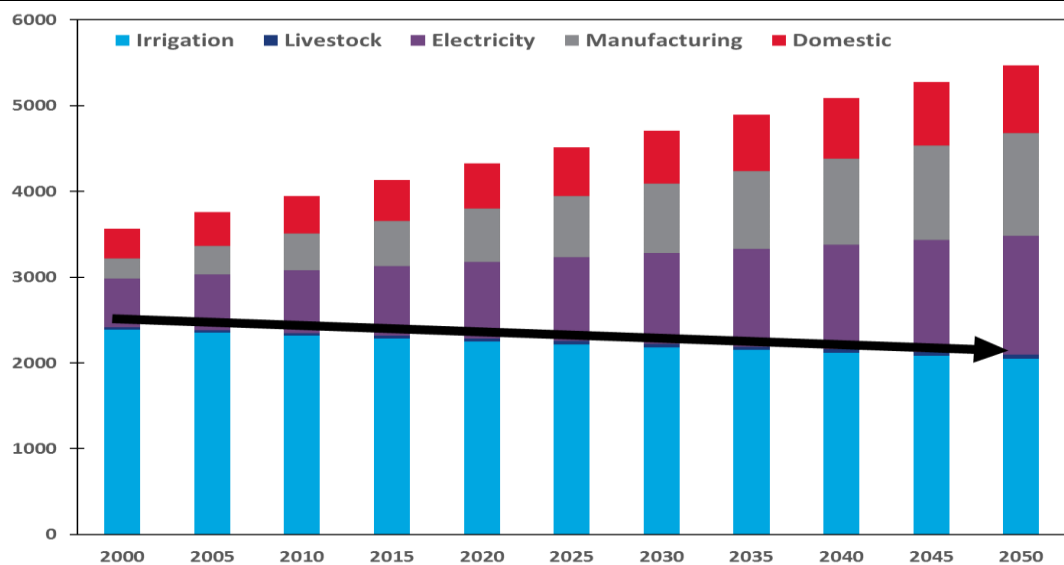
Reflecting the trends in the global agricultural land area outlined above, the OECD *Environmental Outlook to 2050* stated that:

- The Baseline shows some reduction in water for irrigation. This reflects no increase in irrigated land and *significant improvements in efficiency* [italics added].

Water demand for irrigation and livestock will decline 13% between 2000 and 2050, according to the OECD

Figure 14 shows that the OECD forecast is that water demand for irrigation and livestock will decline 13% between 2000 and 2050.

**Figure 14: Global Water Demand: Baseline Scenario (Cubic Kilometers)**



Source: OECD *Environmental Outlook to 2050*

In terms of water-efficient irrigation technologies, the OECD report referenced “drip emitters, and better maintenance of irrigation infrastructure.” According to *National Geographic*,<sup>21</sup> “compared with conventional flood or furrow irrigation, drip methods can reduce the volume of water applied to fields by up to 70 percent, while increasing crop yields by 20-90 percent.” Drip irrigation technology was developed by Israeli engineers in the 1950s but has only recently been put into widespread use globally, particularly in emerging markets.

Moreover, with regard to effluents from agriculture, the OECD report pointed out that:

- Nutrient surpluses in agriculture occur if more nutrients are added to the soil than are withdrawn. If there is a surplus of nitrogen, it is likely to be leached into the groundwater, run off the fields into watercourses, or be lost to the atmosphere through conversion to ammonia...Surpluses of nitrogen in agriculture are projected to *decrease* [italics added] in the Baseline in most OECD countries by 2050. This is because the efficiency of fertilizer use is likely to improve more rapidly than increases in productivity.



## Alternative Proteins

Concomitant with the trends outlined above (e.g., less red meat), alternative proteins — including advanced plant-based protein sources, fermented proteins and cultured meat — will likely continue to grow in popularity.

### Advanced Plant-Based Protein Sources

Meat substitutes are made from ingredients such as soy and pea protein and fashioned to provide a comparable taste and texture to meat.

Advanced plant-based protein sources include meat substitutes that are made from ingredients such as soy and pea protein and fashioned to provide a comparable taste and texture to meat. In Beyond Meat's meat-free products, for example, ingredients are mixed and fed into a food extrusion machine that cooks the mixture while forcing it through a specially designed mechanism that uses steam, pressure, and cold water to form the product's meat-like texture. In terms of environmental impact, the production of the "Beyond Burger" requires 99% less water, 93% less land, and 46% less energy than a regular beef burger. Beyond Meat's products are available nationwide in the U.S. at various food retailers, including Whole Foods Market, now owned by Amazon.

### Fermented Proteins

According to Impossible Burger, its product takes 95% less land and 74% less water, and emits 87% less GHG, than a beef burger

A molecule called heme is found in exceptionally high concentrations in meat from animals. That high concentration is what makes meat taste uniquely like meat. Impossible Foods uses the heme-containing protein from the roots of soy plants to make its "Impossible Burger." To make plant-based heme in large quantities, it takes the DNA from soy plants and inserts it into a genetically engineered yeast, which is fermented.

Heme is just one of many ingredients in the "Impossible Burger." Textured wheat protein, a popular animal-product substitute, provides the foundation of the patty. According to the company, the production of its "Impossible Burger" uses 95% less land and 74% less water, and it emits about 87% less greenhouse gas than a ground beef burger patty made from cows.

### Cultured Meat

In a 1931 essay<sup>22</sup> entitled "Fifty Years Hence," Winston Churchill predicted that "We shall escape the absurdity of growing a whole chicken in order to eat the breast or wing, by growing these parts separately under a suitable medium."

Lab-cultured meat is in the development process and could become commercial within a few years

Today, artificial muscle tissue is produced in vitro by mass-culturing stem cells from animals. Memphis Meats' cell-culture production process currently takes three to six weeks. Using samples from a range of sources, the company's scientists isolate cells that have the capacity to renew themselves, and feed them oxygen and nutrients to produce skeletal muscle.

In 2016, Memphis Meats unveiled a lab-cultured meatball that cost \$18,000 per pound to grow. In 2017, it released samples of lab-grown chicken and duck meat, with the cost per pound reduced to \$9,000. As prices fall, it hopes to launch commercially in 2021. The company has said that its protein products use just 1% of the land and 1% of the water used by traditionally produced meat products.

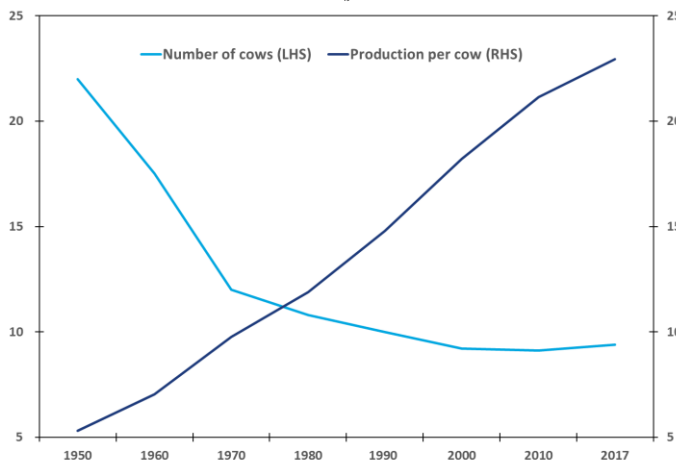




## Dairy-Based Sources of Protein in Developed Countries

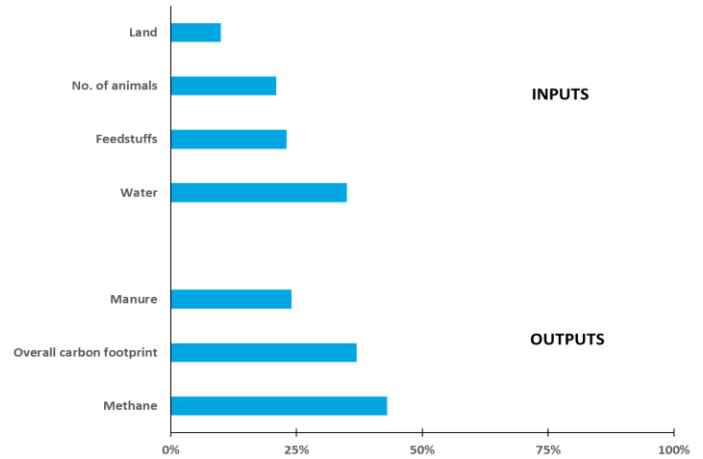
After meat, milk is the second-largest animal-based source of protein in the U.S. (Figure 3). Here, too, the trend has been toward greater sustainability. An academic study<sup>23</sup> pointed out that modern dairy practices require considerably fewer resources than dairying in 1944 — Figure 15 and Figure 16.

**Figure 15: Number of U.S. Dairy Cows (millions) and Annual Production per Cow (thousands of pounds)**



Source: USDA

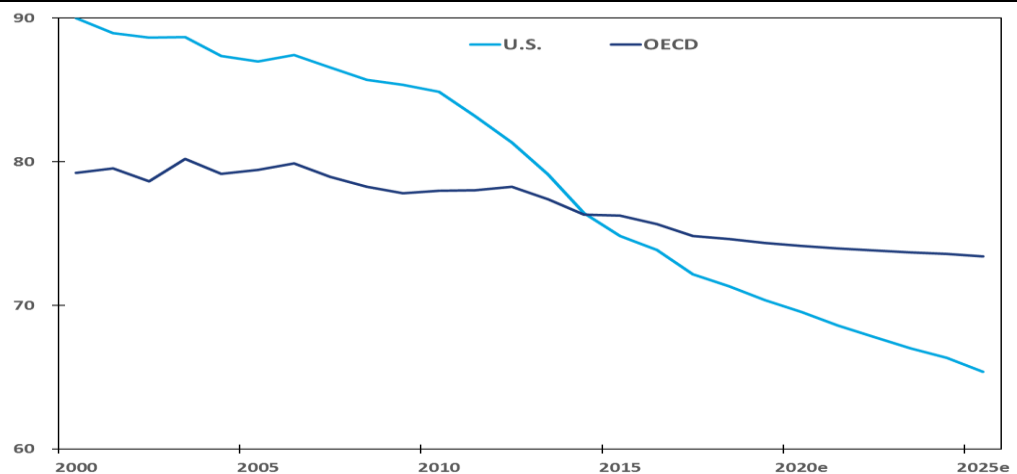
**Figure 16: U.S. Dairying Inputs and Outputs: 2007 as a percentage of 1944 practices**



Source: <https://www.ncbi.nlm.nih.gov/pubmed/19286817>

Moreover, just as patterns of meat consumption have shifted in developed countries, consumption of dairy-based sources of protein has also been evolving. Per capita consumption of dairy products has declined steadily in the U.S. and in other OECD countries, with that trend forecast to continue — Figure 17.

**Figure 17: Annual Consumption of Fresh Dairy Products<sup>24</sup> Per Capita (kilograms)**

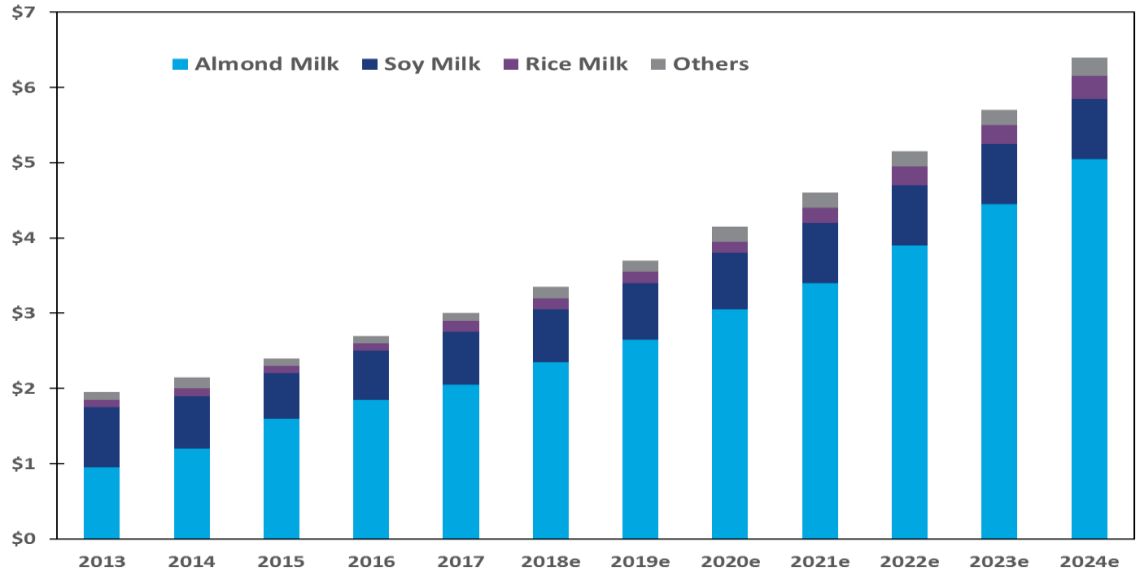


Source: OECD-FAO



At the same time, sales of dairy milk alternatives have grown rapidly — Figure 18 — although they are still dwarfed by the global dairy market, which was valued at \$336 billion in 2014.

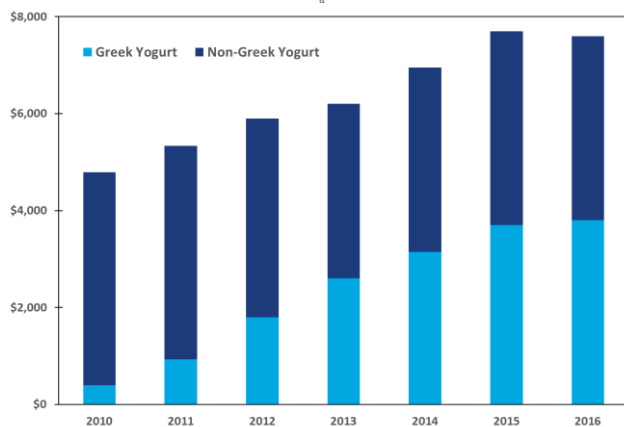
**Figure 18: Market Value of Dairy Milk Alternatives Worldwide (\$ billions)**



Source: Euromonitor

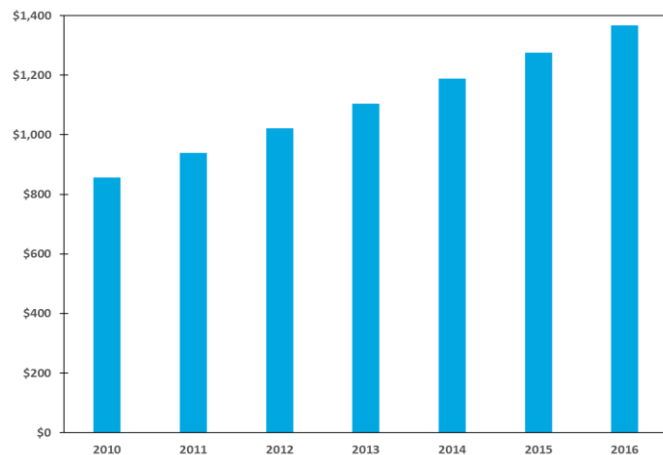
As is the case with meat, changing lifestyles and diets affecting consumption have also impacted the market for dairy products. So, for example, there has been rapid growth in demand for Greek-style yogurt (Figure 19), and for bars based on milk protein (Figure 20).

**Figure 19: U.S. Yogurt Sales – Greek and Non-Greek (\$m)**



Source: Euromonitor

**Figure 20: U.S. Sales of Nutrition and Energy Bars (\$m)**



Source: Euromonitor



## Protein Consumption and Dietary Guidelines

In addition to shifting consumer preferences, dietary guidelines have also likely contributed to reduced consumption of animal-based protein. European countries have been at the forefront in issuing dietary guidelines.

- The National Food Agency of Sweden recommends no more than 500 grams (about one pound) of red and processed meat a week.<sup>25</sup>
- The government-funded Netherlands Nutrition Centre said in 2016 it recommended people eat just two servings of meat a week, setting an explicit limit on meat consumption for the first time.<sup>26</sup>
- The German Society for Nutrition recommends the average adult should eat no more than 300 – 600 grams (maximum 1.5 pounds) of lean meat and sausage per week.<sup>27</sup>
- Public Health England’s new dietary advice in 2016 recommended people halve their dairy intake and eat less meat, replacing it with beans and pulses.<sup>28</sup>

In addition, the various agencies also issued guidance about the consumption of dairy products — Figure 21.

**Figure 21: National Dietary Guidelines**

	Meat	Dairy	Eggs
Sweden	Maximum 500g per week (4 meals) - only a small amount should be processed	200-500ml per day	Advice to focus on vegetarian foods / eggs instead of meat
Netherlands	Maximum 500g per week (only 300 grams of red meat)	2-3 portions, plus 40g of cheese daily	2-3 eggs per week
Germany	Maximum 300-600g of lean meat and sausage per week. White meat highlighted as a healthier option	250-300g per day, milk and cheese combined	Up to 3 eggs per week
United Kingdom	"Less red and processed meat" in pictorial guide, max 70g per day (490g per week) specified in accompanying booklet	"Some" dairy - no precise specification	"Some" eggs - no precise specification

Source: <https://www.eating-better.org/blog/135/How-do-UK-dietary-guidelines-compare-for-sustainability.html>



## Rising Demand for Protein in Developing Countries

We pointed out above that demand for animal-based protein is growing rapidly in developing countries. Reviewing the “thirty years into the livestock revolution,” a report<sup>29</sup> by the Food and Agriculture Organization of the United Nations pointed out that:

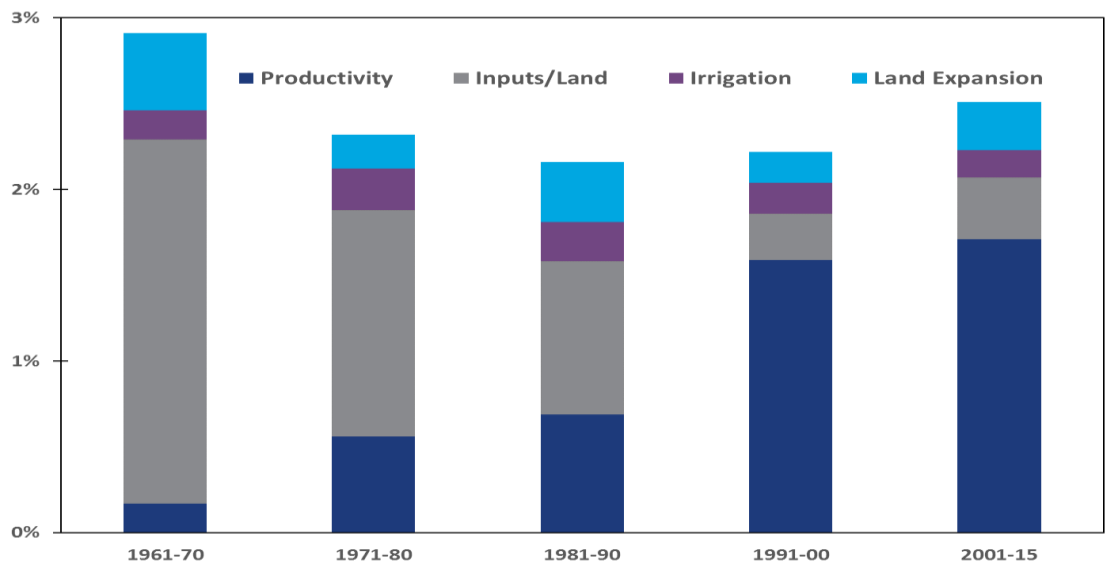
■ Since the late 1970s, increasing population, growth in per-capita GDP and urbanization have combined to boost demand for animal-source foods in developing countries – a phenomenon that has been termed the ‘livestock revolution.’

Agricultural productivity has played a key role in meeting the demand for meat and other animal based sources of protein in recent decades

Agricultural productivity has played a key role in meeting the demand for meat and other animal-based sources of protein in recent decades. As part of the “Green Revolution” in the late twentieth century, the widespread adoption of pesticides and fertilizers, among other factors, created substantial gains in global agricultural production.

A quantitative measure of agricultural productivity reflects changes in the efficiency with which agricultural inputs (land, labor, fertilizer, feed, machinery and livestock) are transformed into outputs (gross crop and livestock output) — dark blue bars in Figure 22.

**Figure 22: Sources of Growth in Global Agricultural Output, 1961 - 2015**



Source: USDA Economic Research Services

As agricultural productivity increased in recent decades (blue bars in Figure 22), the contribution of agricultural inputs to agricultural output declined:

- **Inputs/Land:** The gross amount of fertilizer, machinery, feed, labor and other inputs per hectare of agricultural land (gray bars).
- **Irrigation:** The extension of irrigation to agricultural land (purple bars).
- **Land Expansion:** The opening up of additional land resources to extend production (turquoise bars).



In terms of the location of these productivity gains a report<sup>30</sup> by the U.S. Department of Agriculture pointed out:

- While productivity has been the major source of agricultural growth in *developed* countries for at least half a century, the acceleration of global [agricultural productivity] growth since 1990 came about largely because of improved productivity performance in *developing* countries [italics added].

The report highlighted three countries in particular:

- Long-term investments in agricultural research were especially important to sustaining higher agricultural [productivity] growth rates in large, rapidly developing countries such as Brazil and India. Chinese agriculture benefited enormously from institutional and economic reforms as well as technological changes resulting from investments in research.

Whether agricultural productivity can continue to increase at current rates remains to be seen. However, a report<sup>31</sup> by a team of environmental scientists observed that “a relatively small set of places and actions could provide enough new calories to meet the basic needs of more than 3 billion people.” Among the steps necessary to achieve these goals:

- **Reduce crop production for non-food uses.** Although crops used for animal feed ultimately produce human food in the form of meat and dairy products, it is neither an efficient nor a sustainable method of animal-based protein production. Today, almost 80% of the global soybean harvest is processed into animal feeds, with rainforest in Brazil being cut down to make way for the cultivation of soy. If current crop production used for animal feed and other uses (including biofuels) were targeted for direct consumption in countries with high non-food uses of crops, such as China and Brazil, that could provide enough calories to meet the basic needs of 2.4 billion people.
- **Reduce agricultural water use.** Agriculture accounts for approximately 70% of global water consumption. India, Pakistan, and China account for 64% of all irrigation water used in precipitation-limited areas. Raising very low water productivity in precipitation-limited regions up to the twentieth percentile of productivity would increase annual production on rainfed cropland by enough to provide food for an estimated 110 million people. (We discussed above the use of drip irrigation technology.)
- **Reduce food waste.** Today, 30-50% of food production is wasted, largely reflecting food spoilage due to improper storage across the supply chain from field and farm to supermarket to consumer. Reducing waste of major crops and meat in a number of countries with large populations, including China and India, could feed 413 million people annually.

A relatively small set of places and actions could provide enough new calories to meet the basic needs of more than 3 billion people

## Investment Implications

Among the opportunities in sustainable protein are investments in alternative proteins, organic foods and developers of new agricultural technologies. In addition, investments can be made in sustainably managed farmland, and in sustainable fisheries and aquaculture. While it is not our practice to list specific asset managers and policies, each of the strategies discussed below is currently accessible to accredited investors.

Investing directly in public or private companies involved with sustainable protein may not be advisable — or feasible — for many investors. However, both institutional and individual investors can consider the opportunities posed by demand for sustainable protein and the risks associated with conventional agriculture in various ways.

### Public Equities

Although significant exposure to non-livestock-based protein may be difficult to achieve in public equities currently, health, nutrition, and resource efficiency have long been important considerations for investment managers focused on sustainability and impact. There are a number of approaches investors can pursue to address the trend toward sustainable protein.

Health, nutrition, and resource efficiency have long been important considerations for investment managers focused on sustainability and impact

- **Portfolio analysis:** The kinds of companies associated with sustainable protein that a manager chooses can be analyzed from a sustainability perspective. Managers who practice the discipline of incorporating environmental, social, and governance (ESG) factors in their analysis would assess portfolio companies in relevant sectors — e.g., food companies and restaurants — in terms of their exposure to issues such as factory farming, food safety and animal welfare, in addition to other environmental and social factors.
- **A thematic approach:** There are thematic strategies that focus on sustainable protein, either entirely or in part. Themes include alternative proteins, and agricultural technologies focused on water efficiency, sustainable land management, and reduced pesticide and herbicide use.
- **Shareholder advocacy:** Public equity owners have the benefit of shareholder rights. Many of the managers running strategies such as those outlined above are active shareholder advocates on various sustainability issues. To date, individual investors (asset owners and asset managers) and broad investor initiatives have highlighted food safety<sup>32</sup> and access to nutrition<sup>33</sup> as important issues for companies. Investors have access to information on how their investment managers utilize shareholder rights to advance the value and positive impact of their portfolios. Encouraging companies in related sectors to explain or establish a position on these issues could also be effective.

### Alternatives

Several alternative asset classes offer exposure to sustainable protein.

- In private equity, funds investing in earlier stage companies (venture) provide exposure to businesses experimenting with new proteins or new agricultural technologies. These include investments into venture stage firms focused on meat-like products not from

animals, or into organic food companies. By way of example, Stonyfield Farm, a manufacturer of organic yogurt founded in 1983, was given seed capital by a private equity fund that invests in early stage organic food and consumer products companies. Stonyfield now holds roughly 13% of the North American organic yogurt market. Separately, some private equity funds investing in early stage companies also provide exposure to businesses experimenting with various agricultural technologies, including “precision agriculture” or “satellite farming,” which is a farming management concept based on observing, measuring and responding to variability in crops.

- There are also opportunities in real assets, including farmland. Managers looking to make sustainable investments in the space should be familiar with the PRI’s Responsible Investment in Farmland guidelines<sup>34</sup> and the World Bank’s Responsible Agriculture Investment initiative.<sup>35</sup> One fund acquires traditional cropland and transforms it over a number of years to certified organic land. The value of the land is highly tied to the income generation potential of the crops that are grown on it. Organic crops, which tend to generate higher levels of income than non-organic varieties, result in higher valuations for the land on which they are grown.

Opportunities also exist in sustainable fisheries and aquaculture. There are strategies that invest with dual goals of supporting the recovery of depleted fishery biomass and increasing the value of the landed catch by introducing better management systems. Strategies also exist that invest in the development of responsible seafood supply chains, which receive, handle, process, and market seafood responsibly.

## Fixed Income

As an asset class, fixed income does not offer the same breadth of product as equities or alternatives. However, fixed income does offer similar opportunities to equities for investors to choose corporate issuers that are more aligned with forward-looking agricultural activities and technologies. In addition, bonds issued by development institutions and government agencies may have positive consequences for sustainable agricultural production.

There are various investment strategies that invest in green, social or blue (i.e., ocean) bonds, any of which could seek to make agricultural production more sustainable, accessible or safer. Green bond strategies and green bonds are typically focused on issues related to energy, climate change and the environment but there are significant relationships between these issues and access to safe, sustainable, nutritious food.

Several organizations aggregate private capital and lend that money to non-profit or for-profit social enterprises, notably agricultural cooperatives in emerging markets. Investors in these “impact notes” receive a modest return that is often below market, but usually reliable. Some offerings allow investors to focus on a particular theme or themes but nearly all have some exposure to agriculture.



## Cornerstone and the Food Theme

In recent years, Cornerstone Capital Group’s research team has written a number of reports focused on food as a thematic issue. This research is available on our website via the links below.

### Antibiotics

- [Antibiotics and Animal Health: Value-Chain Implications in the U.S.](#)
- [Antibiotics and Animal Health: California Raises the Bar](#)
- [Poultry Antibiotics in Emerging Markets](#)
- [Antibiotics and Animal Health: Recent Data Points](#)

### Food Safety

- [Food Safety: In a State of Transformation](#)
- [Tracking Our Thesis on Food Safety](#)
- [Food Safety: Is Whole Foods Prepared?](#)

### Alternative Animal Feeds

- [Tracking Our Thesis on Nutritional Feed Additives](#)

### Restaurants

- [The Economics of Automation — Quick Serve Restaurant Industry](#)
- [Tracking our Thesis on Automation in Restaurants](#)



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## Endnotes

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- <sup>1</sup> Although the word “protein” comes from the Greek proteios, meaning “of prime importance,” protein is no more important than the other nutrients required for good health.
- <sup>2</sup> “Trends in Meat Consumption in the United States,” National Institutes of Health, 2011
- <sup>3</sup> “Fresh dairy” does not include eggs.
- <sup>4</sup> “World Population Prospects: The 2015 Revision,” New York: United Nations, 2015
- <sup>5</sup> [https://stats.oecd.org/Index.aspx?datasetcode=HIGH\\_AGLINK\\_2018#](https://stats.oecd.org/Index.aspx?datasetcode=HIGH_AGLINK_2018#)
- <sup>6</sup> OECD-FAO Agricultural Outlook 2013: Highlights
- <sup>7</sup> <https://ideas.repec.org/p/ags/eaa115/116442.html>
- <sup>8</sup> [https://www.washingtonpost.com/archive/business/1986/04/10/mcdonalds-tosses-up-a-salad/4a37a920-d7c2-43b0-a2e5-dd6c1042db84/?utm\\_term=.37383aa7c655](https://www.washingtonpost.com/archive/business/1986/04/10/mcdonalds-tosses-up-a-salad/4a37a920-d7c2-43b0-a2e5-dd6c1042db84/?utm_term=.37383aa7c655)
- <sup>9</sup> <https://nypost.com/2018/10/26/one-third-of-americans-consider-themselves-flexitarian/>
- <sup>10</sup> <https://www.waitrose.com/content/dam/waitrose/Inspiration/Waitrose%20&%20Partners%20Food%20and%20Drink%20Report%202018.pdf>
- <sup>11</sup> <https://certifiedhumane.org/survey-reveals-half-u-s-consumers-concerned-animal-welfare/>
- <sup>12</sup> <https://www.gov.uk/guidance/eggs-trade-regulations>
- <sup>13</sup> <https://www.economist.com/news/britain/21711062-2006-annual-production-free-range-eggs-has-doubled-unstoppable-rise-free-range>
- <sup>14</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/664752/eggs-statsnotice-5dec17.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/664752/eggs-statsnotice-5dec17.pdf)
- <sup>15</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/332045/eggs-statsnotice-07nov13.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/332045/eggs-statsnotice-07nov13.pdf)
- <sup>16</sup> Red Tractor is a U.K. food standard-setting organization that covers animal welfare, food safety, traceability and environmental protection.
- <sup>17</sup> “The Future of Food and Farming,” The Government Office for Science, 2011
- <sup>18</sup> <http://waterfootprint.org/media/downloads/Hoekstra-2012-Water-Meat-Dairy.pdf>
- <sup>19</sup> [https://www.chathamhouse.org/sites/default/files/field/field\\_document/20141203LivestockClimateChangeForgottenSectorBaileyFroggattWellesleyFinal.pdf](https://www.chathamhouse.org/sites/default/files/field/field_document/20141203LivestockClimateChangeForgottenSectorBaileyFroggattWellesleyFinal.pdf)
- <sup>20</sup> <http://www.oecd.org/environment/indicators-modelling-outlooks/oecd-environmental-outlook-1999155x.htm>
- <sup>21</sup> <https://blog.nationalgeographic.org/2012/06/25/drip-irrigation-expanding-worldwide/>
- <sup>22</sup> <http://teachingamericanhistory.org/library/document/fifty-years-hence/>
- <sup>23</sup> <https://www.ncbi.nlm.nih.gov/pubmed/19286817>
- <sup>24</sup> “Fresh dairy” does not include eggs.
- <sup>25</sup> <https://www.livsmedelsverket.se/en/food-habits-health-and-environment/dietary-guidelines/adults/red-and-processed-meat>
- <sup>26</sup> <https://www.nationalgeographic.com/people-and-culture/food/the-plate/2016/03/23/another-nation-trims-meat-from-diet-advice/>
- <sup>27</sup> <https://www.dge.de/ernaehrungspraxis/vollwertige-ernaehrung/ernaehrungskreis/>
- <sup>28</sup> <https://www.vivahealth.org.uk/resources/meat-truth/uk-meat-consumption-%E2%80%93-going-down-online>
- <sup>29</sup> “Mapping Supply and Demand for Animal-Source Foods to 2030,” Food and Agriculture Organization, 2011
- <sup>30</sup> <https://www.ers.usda.gov/data-products/international-agricultural-productivity/summary-findings/>
- <sup>31</sup> “Leverage points for improving global food security and the environment,” Science Magazine, 2014
- <sup>32</sup> <https://www.asyousow.org/our-work/environmental-health/antibiotics-factory-farms>
- <sup>33</sup> <https://www.accesstonutrition.org/global-index>
- <sup>34</sup> <https://www.unpri.org/download?ac=4001>
- <sup>35</sup> <https://www.worldbank.org/en/topic/agriculture/publication/responsible-agricultural-investment>





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