Plant-based Proteins

Asian Development Bank

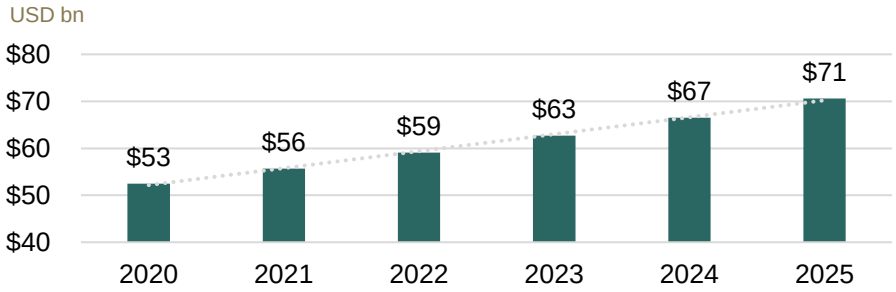
Capital Code

Background - Proteins

What are proteins

- Proteins are a type of macronutrient which are needed by the body to function, generally making up **10 – 15%** of the body's energy needs
- Proteins are made up of amino acids - a human requires 22 types of amino acids to function, of which 9 are labelled as essential – amino acids that the body is unable to produce and can only be obtained from external sources
- A complete protein source is one that contains 9 essential amino acids

Protein ingredient market size and growth (2020-2025)

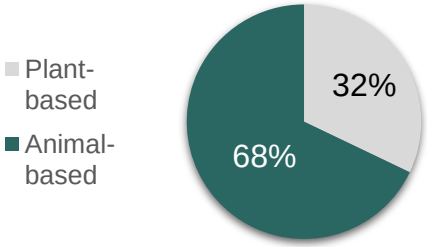


- The global market size of proteins ingredient is about **$52.5 billion in 2020**, and is estimated to grow at **CAGR at 6.1%** over the forecast period to reach a value of **$71 billion by 2025**
- Dairy and plant protein command the highest growth rate, with increasing consumer interests in the nutritional value of products
- The demand for soy is projected to grow the fastest, owing to the proactive positioning of soy as a sustainable food/protein source, the current low level of consumer awareness on non-soy protein as well as cost advantages

Sources of Proteins

Plant-based	Animal-based
• Legumes	• Pork
• Nuts	• Beef
• Seeds	• Poultry
• Whole grains	• Dairy & eggs
	• Seafood

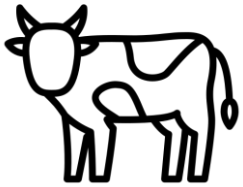
Market share by revenue in 2019 (%)



Most animal-based proteins are **complete proteins**, while only a few types of plant-based proteins are complete – hence animal-based proteins are preferred; and play an important role

Capital Code | Source: Internal analysis, Markers and Markets

Environmental issues with current animal-based protein consumption



CO_2 Emissions

Meat rich diet results in around **7.2 kg** carbon dioxide emission per day per pax, in comparison with **3.8 kg** per day per pax for a fish-only diet and **2.9 kg** for a vegan diet.

Livestock accounts for around **14.5-18%** of global human-induced greenhouse gas emissions, which is a huge factor of climate change and global warming. A University of Oxford study found that, to keep global warming below 2 degrees this century, we need to consume **75% less beef** and **90% less pork** globally.

Deforestation

Livestock and feed production require large areas of land, accelerating the deforestation process. Experts estimate that **around 80%** of deforestation in the Amazon is due to cattle ranching. It takes **20 times less land** to feed someone on a plant-based diet than it does to feed meat eaters.

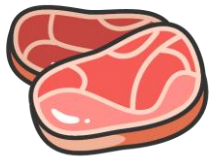
Water consumption

The production of one pound of beef requires **1,799 gallons** of water; one pound of pork takes **576 gallons** of water. As a comparison, the water footprint of soybeans is **216 gallons**; corn is **108 gallons**.

A calorie of meat requires **10 times as much water** to produce a calorie of food crop – production of 1 kg of meat requires between **5,000 to 20,000 litres of water.**

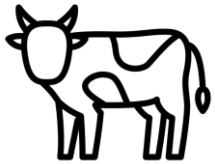
Source: Cargill, GlobalData, World Animal Foundation

Moral concerns and animal welfare issues with meat consumption



Chick culling

Culling of newly hatched male chickens for which egg-producing facilities have no use for – these chicks are killed shortly just after hatching.
Approximately **7 billion** male chicks are culled annually around the world. The top 20 poultry production countries alone culled **3.2 billio**n male chicks a year.



Downed cows

Dairy cows and cows destined for slaughter are usually so sick and/or injured from the abuse heaped on them that they are unable to even stand and have to be dragged around.

No cow can live out its natural lifespan of up to 25 years. ~**20%** of the beef sold in stores comes from cows who were exploited by the dairy industry.

Deviations from regulations of humane animal processing

There are often deviations from regulations like regulations like the Humane Slaughter Act in practice, such as slitting of throats to be bled to death while being conscious and transporting animals for long hours without feeding them. The fines for bleaching such regulations are small as compared to the huge benefits reaped.

Consequently, there have been calls from both activist and consumer groups pressing for development of alternative protein sources

Source: Cargill, GlobalData, World Animal Foundation

Plant-based proteins, a “part-substitute” to animal-based protein consumption

What are plant-based proteins?

Plant-based proteins are products made from non-animal materials. They are designed to mimic animal protein in every way, from taste, texture, smell, and appearance etc. They should also offer similar nutritional value as animal proteins including proteins, vitamins, minerals.

By ingredient

- Peas
- Soy
- Wheat
- Oats
- Beans
- Nuts
- Seeds
- Other sources

By type

- Beef
- Chicken
- Pork
- Fish
- Lamb
- Turkey
- Other types

By application

- Burger patties
- Strips & sausages
- Meatballs
- Other products

Pea is projected to be the fastest growing segment, serving as an alternative for consumers with a soy allergy

Plant-based beef is projected to account for the largest share as it provides similar characteristics to that of beef

Burger patties dominate the product market due to faster production, taste, convenience and abundance in supply

Source: Internal analysis, Markets and Markets

Meat Alternatives in Asia

Mock Meat in China (907)

Tofu in China (965)

Yuba in Japan (1587)

Tempeh in Indonesia (1815)

Asian consumers have long embraced plant-based proteins driven by religion and culture

Asia Pacific Plant-based Protein Market – Size and Growth

Asia Pacific is expected to grow at 18% CAGR over 2018A to 2025F with the highest population demographic and rising protein consumption rate

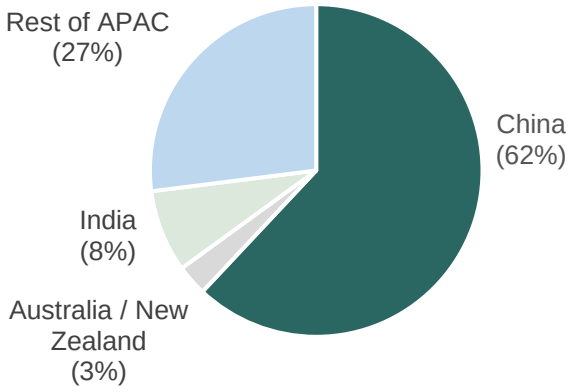
Quick Facts About Asia's Protein Demand Projection

Asia's population is projected to reach 5 billion by 2050

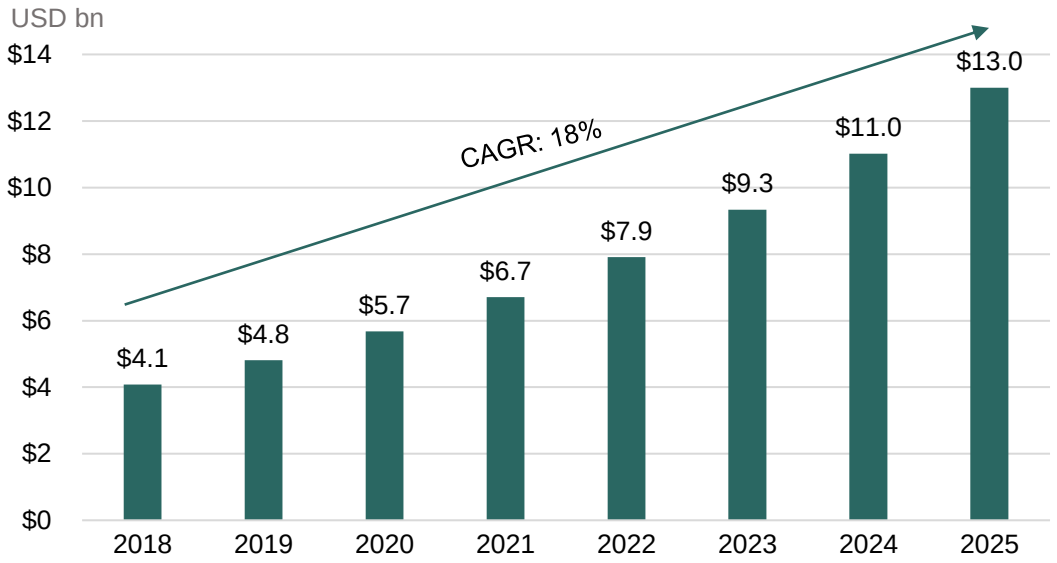
India and China together are estimated to consume 360 million tons of protein by 2025

Animal protein consumption is projected to grow 33% by 2030 and 78% by 2050

APAC Meat Consumption by Country



APAC Market Size and Growth



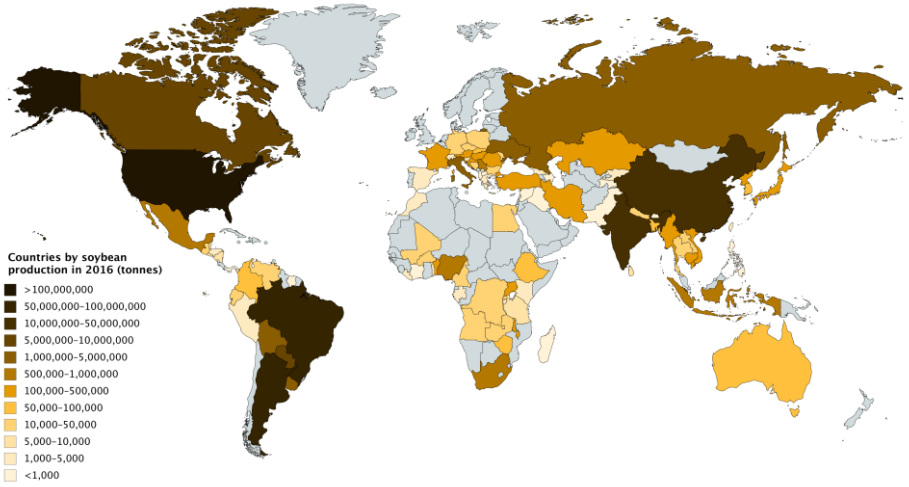
- The Asia Pacific Plant-based Protein market size is c. $4.1 billion in 2018A and is estimated to grow at CAGR at 18% to reach $13 billion by 2025F
- In 2018A, the APAC Meat industry has a meat substitute penetration rate of ~0.5%, which is expected to reach 1.5% by 2025F
- China accounts for the largest Asia Pacific meat consumption with over 60%
  - China is likely to lead the growth of Plant-based Meat market with Plant-based companies leading innovation, predominantly coming from China

Capital Code | Source: UBS, Euromonitor Passport, Asia Research & Engagement

Opportunities in Asia – comparative advantage in raw material production

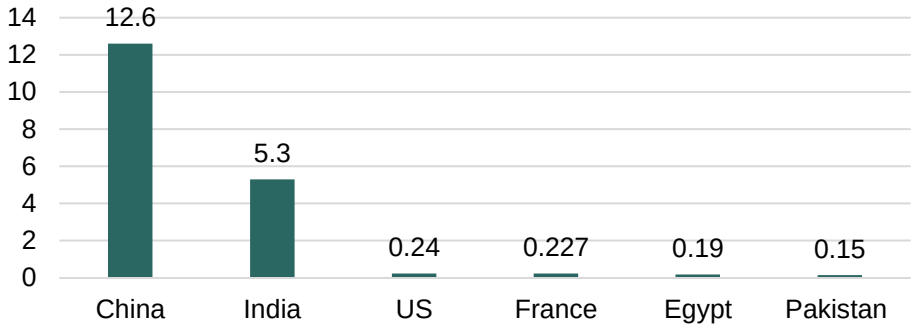
Leveraging Asia's existing strong soybean and pea production can provide a key pathway for the region's new protein ecosystem to flourish, particularly in terms of bringing down production costs and making products widely affordable and accessible to the mass market.

Soybean production



- China and India are among the top 5 world soybean producers in 2016, accounting for **4.0%** and and **3.9%** of the world production respectively
- In 2014, Asia's lentil production **is 2.13 million tons**, accounting for **48.4%** of world production
- Even though Asia does not contribute to the largest share to world soybean and pea production, the commands comparative advantage as the opportunity cost of agriculture production is lower than that of Western producers.

Green pea production



2018 Green pea production volume in million metric tonnes

- China and India are consistently ranked the top 2 green producing countries by volume, together contributing to over 70% of world production

Government policies to support domestic pea production

Restricting imports of peas
- The Indian government put a 50% import duty on peas

Fixing Minimum Support Prices and Whole Price Index to control peas prices

Stock piling peas in warehouses
- The Indian government extended the buffer stocks of peas to support its market growth.

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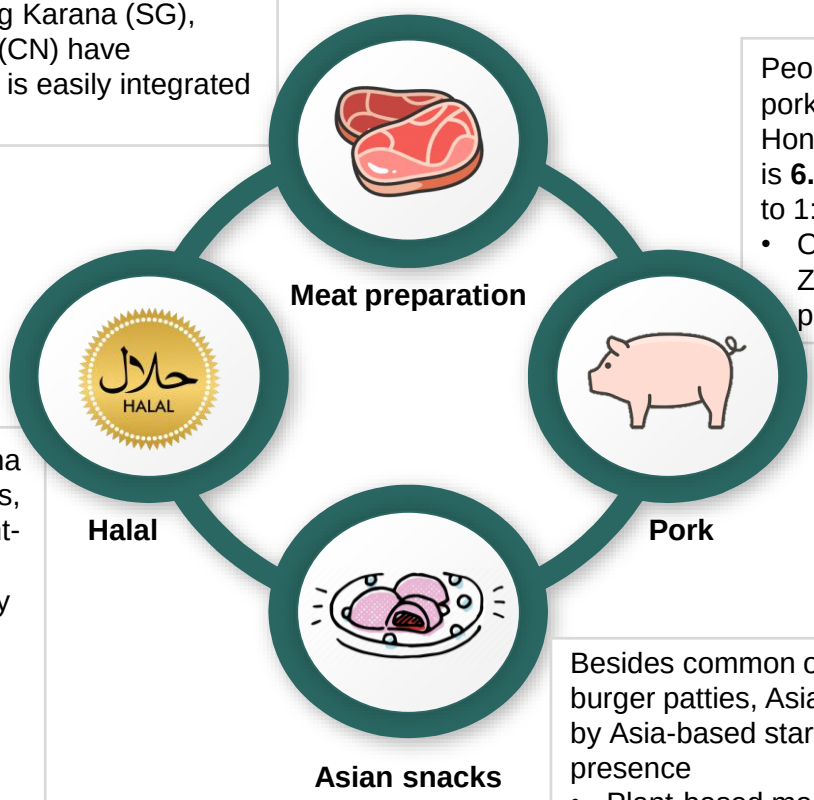
Source: Wikipedia, Green Day Media report, Mordor Intelligence market report

Opportunities in Asia – potential for products tailored to Asian diet

In Asian cuisines, meat is often mixed into a range of dishes with vegetables or used in products like dumplings, in contrast to the Western preference of whole cuts of meat.

- Asia-based startups including Karana (SG), Phuture Foods (ML), Z-Rou (CN) have developed minced meat that is easily integrated into popular dishes



People in Asia consume significantly more pork than any other meat. In mainland China, Hong Kong, and Macao, the pork-to-beef ratio is **6.8:1** and in Vietnam it is **10.8:1,** in contrast to 1:1 in the US.

- Omni Meat (HK), Phuture Foods (ML) and Zhen Meat (CN) developed plant-based pork that carters to such preference.

Several Asian countries including India, China and Indonesia have large Muslim populations, who strictly follow a pork-free halal diet. Plant-based meat products have to obtain halal certification to achieve mainstream popularity in these regions.

- Currently, OmniPork by Hong Kong OmniMeat is Halal-certified. Malaysia's Phuture Team intends to develop plant-based meats for the halal market

Besides common offerings like sausages and burger patties, Asian-style snacks innovated by Asia-based start-ups are gaining market presence

- Plant-based mooncakes developed by Starfield (CN) and Zhen Meat (CN)

Source: Green Queen Media report

Are Plant-based Meats healthier than Animal-based Meats?

The answer is not so straight forward as nutrition is a function of the entire diet rather than specific food types

Base Principle

Health experts and scientists have claimed that reducing consumption of red meat is generally better for health. The reduction in saturated fat and cholesterol could bring various health benefits to the average individual.

Pros and Cons of Animal-based Meat

Calories	✗	• Typically higher
Protein	✓	• Typically higher
Total Fat	✗	• Typically higher
Cholesterol	✗	• Typically higher
Fibre	✗	• Typically lower
Carbohydrates	✓	• Typically lower
Sodium	✓	• Typically lower
General Perception	✓	• Complete source of protein
	✗	• Environment and animal welfare concerns

Pros and Cons of Plant-based Meat

Calories	✓	• Typically lower
Protein	✗	• Typically lower
Total Fat	✓	• Typically lower
Cholesterol	✓	• Typically lower
Fibre	✓	• Typically higher
Carbohydrates	✗	• Typically higher
Sodium	✗	• Typically higher
General Perception	✓	• Better for the planet
	✗	• "Not real food" ◦ Processed & with higher sodium

Capital Code | Source: CNBC

Possible Negative Nutritional Ingredients in Plant-based Products

Overall, the jury is still out…

Potential Health Concerns

PROCESSED FOODS vs WHOLE FOODS	• Nutritionists and dieticians believe that Plant-based Meat options are **not healthier** than their red meat counterparts • **Highly processed**, contain few “whole foods” and use many isolated proteins and fats

NEGATIVE NUTRITIONAL VALUE	• **Higher sodium and carbohydrates**
	  ◦ Too much sodium in the diet can lead to high blood pressure, heart disease, stroke and calcium losses
	  ◦ Guideline for Adequate Intake (“AI”) is 1,500 milligrams a day for men and women >14 years of age and pregnant women
	• However, **lower fat and cholesterol**
	  ◦ Saturated fat and cholesterol content in meat is typically associated with risk of heart diseases and also cancer

MAJORITY OF SOY IS GMO…HEME IS ALSO GMO	• **Most soybeans grown in the US are GMOs**
	  ◦ Make weed control simple for farmers – farmers today spray more than 20x more glyphosate than in the 1990s
	  ◦ Glyphosate is labelled a “probable human carcinogen’ by the International Agency on Cancer Research
	• **Heme** – a key ingredient in Impossible Burgers - **is also GMO**

MANY CONTAIN CHEMICAL COMPOUND	• Chemical compounds such as methylcellulose, soy leghemoglobin and zinc gluconate ◦ While soy is commonly consumed, soy leghemoglobin is not consumed before
PROCESSED MEAT IS CARCINOGENIC…IS PLANT-BASED MEAT THEREFORE CARCINOGENIC?	• WHO stated that there is sufficient evidence from epidemiological studies that **eating processed meat causes colorectal cancer** ◦ Processed meat is meat that has been transformed through salting, curing, fermentation, smoking, etc to enhance flavour or improve preservation (e.g., hot dogs (frankfurters), ham, sausages, etc)
OTHER UNKNOWN VARIABLES AND LACK OF TRANSPARENCY	• Plant-based meat companies **do not have full disclosure** on how the products are made • Minimal oversight from the FDA / complete and clear regulations not in place • Today Plant-based Meat is **not yet fully understood** by the public

Plant Based Proteins - Impacts and Challenges

The sector positively impacts several UN SDGs in a material manner

UN SDGs	Comments	+ / -
	❖ **Efficiency of Food Production** ○ Current world population of **7.9 billion** is projected to reach **9.8 billion** in 2050, with global food production required to be 60% higher than in 2005 ○ ***Plant based protein sources avoid the feed-to-food conversion loss typical of animal protein forms, allowing for a larger quantity of food produced per unit of input***	+
	❖ **Efficiency of Food Production** ○ However, a study conducted by the National Academy of Sciences of the USA estimated that removing farm animals from the food supply would increase total food production; ***however the number of deficiencies in essential nutrients would also increase***	
	❖ **Affordable nutrition** ○ In most countries, alternative protein products derived from soy and pea cost less per kg of protein than animal products	+

Source: Our World in Data, McKinsey

Plant Based Proteins - Impacts and Challenges

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UN SDGs	Comments	+ / -
	❖ **Impact on Mortality** ○ World Health Organisation (WHO) ranks processed meat as a Group 1 carcinogen, with association to high blood cholesterol, heart disease and other cardiovascular diseases which is the leading cause of death in the world ○ Conversely, consumption of plant-based products have an overall **net positive impact on health. For instance, pea protein is expected to have up to 2% reduction in overall mortality rates** ○ FAO report in World Livestock in 2013 found that 70% of new human diseases in recent history have originated from animals agriculture	+
	❖ **Lower risk of Contamination** ○ Waste management in animal products introduces the risk of food contamination ○ Production of plant-based food involves fewer opportunities for contamination or spoilage to occur	+
	❖ **Antimicrobial resistance (AMR)** ○ Use of antibiotics and hormones in livestock management creates **drug resistant infections**, posing a public health risk. Accordingly, higher consumption of protein from plant based protein sources mitigates such risks	+
	❖ **Increased sodium intake** ○ Plant based protein products tend to have higher salt levels than animal meat	−

Source: World Health Organisation (WHO), McKinsey

Plant Based Proteins - Impacts and Challenges

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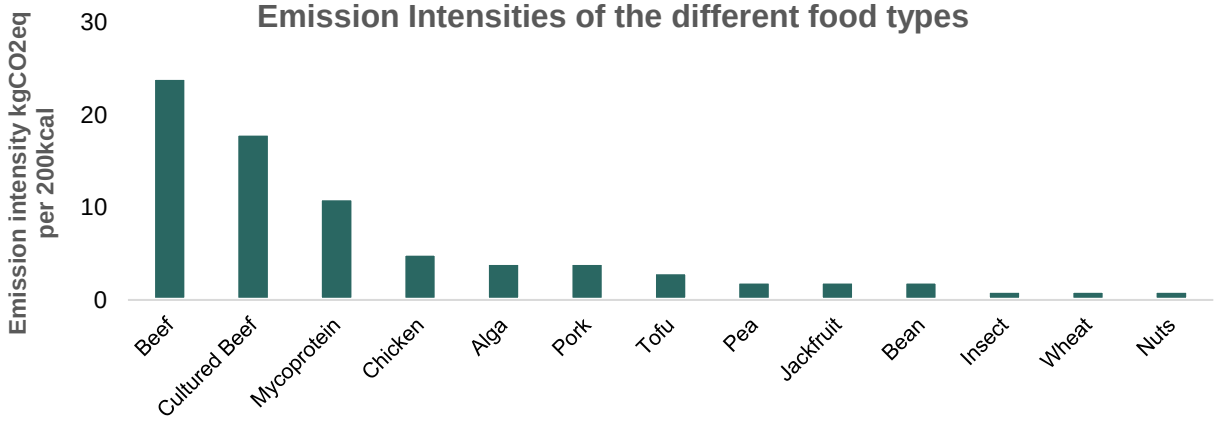
UN SDGs	Comments	+ / -
	❖ **Lower risk of Contamination** ○ Refer to **SDG 3** (Good Health and Well-Being) ○ Alternative proteins potentially reduce **food waste** due to contamination or spoilage in protein production from animals	+
	❖ **Animal Welfare** ○ **~72 billion animals** slaughtered annually for food ○ Poor animal welfare is prevalent in factory farms in the form of overcrowding and poor housing conditions ○ Alternative protein sources do not harm animals and have the potential to decrease the number of animals slaughtered for food	+

Source: United Nations FAO, FoodPrint

Plant Based Proteins - Impacts and Challenges

The sector positively impacts several UN SDGs in a material manner

UN SDGs	Comments	+ / -
	❖ **Greenhouse gas emissions** ○ Global meat production directly accounts for **5% of global GHG emissions** ○ Mainly consist of methane and nitrous oxide from rumen digestion / manure management ○ Comparing foods in terms of either weight, protein content or calories, plant-based foods tend to have a significant lower carbon footprint than meat and dairy ○ For example, producing 100 grams of protein from peas emits just **0.4 kgCO2** while to get the same amount of protein from beef, emissions would be nearly **90 times higher**, at **35 kgCO2** ❖ **Greenhouse gas emissions** ○ However, the over-application of fertilizers in farming practices contribute to higher GHG emissions without enhancing crop production. Having said that, overall it's a net positive from an emission point of view	+



Source: Our World in Data, McKinsey, Environmental Protection Agency (US)

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 	❖ **Deforestation** ○ Livestock and feed production require large areas of land, accelerating the deforestation process. Experts estimate that around 80% of deforestation in the Amazon is due to cattle ranching. It takes 20 times less land to feed someone on a plant-based diet than it does to feed meat eaters. ❖ **Water Consumption** ○ The production of one pound of beef requires 1,799 gallons of water; one pound of pork takes 576 gallons of water. As a comparison, the water footprint of soybeans is 216 gallons; corn is 108 gallons. ○ A calorie of meat requires 10 times as much water to produce a calorie of food crop – production of 1 kg of meat requires between 5,000 to 20,000 litres of water.	+

Source: Our World in Data, McKinsey, Environmental Protection Agency (US)

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