ASIAN CROPPORTUNITIES

SUPPLYING RAW MATERIALS FOR PLANT-BASED MEAT

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FOREWORD

BY ELAINE SIU
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If 2019 was a tipping point for the alternative protein sector, with the IPO of Beyond Meat marking a shift from niche to mainstream, then 2020 has been the beginning of a paradigm shift.

As Covid-19 exposes the vulnerabilities of our existing food system and supply chains, and raises awareness of the public health risks inherent in industrial animal agriculture, innovative replacements to conventional animal-based food products have emerged as a beam of light in the dark. While many food service providers struggle, new plant-based offerings continue to be launched around the world, raking in net sales and growth rates that surpass their animal-based counterparts. During this year of extraordinary uncertainty, we continue to see more large-scale funding rounds announced in the alternative protein space, including USD $230 million into Asia Pacific-based companies.[1] And in the wake of a global pandemic, policymakers now have more reasons than ever to help grow the plant-based meat sector, including an urgent need for increased food security and safety.

"While many food service providers struggle, new plant-based offerings continue to be launched around the world, raking in net sales and growth rates that surpass their animal-based counterparts."

While alternative proteins have emerged as an area of growth, some remain skeptical as to whether that growth is sustainable or just a fad. Our stance is clear: We believe that the alternative protein sector is one of the most promising solutions to many of the world's most pressing problems, from climate change to antimicrobial resistance and global poverty, and we're here to ensure that the sector realizes its full potential. To that end, we created this report to start a conversation on a very specific opportunity proposition.

It all begins with a simple question: *"What are plant-based meats made of?"*

With a quick glance at Appendix 2 of this report, where we have compiled the ingredient lists of over 100 plant-based meat products currently sold around the world, the answer is clear. Soy and wheat dominate plant-based meat recipes globally, with pea protein adding a bit more color.

It all begins with a simple question: *"What are plant-based meats made of?"*

Monoculture is not a problem that alternative proteins have primarily set out to solve. It is also worth mentioning that the alternative protein sector has played a role in stimulating innovations, such as crop breeding, to create "better strains" of the same crop, thereby increasing yields, nutritional value, and functionality.

Rather, what we seek to address in this report is that due to cultural differences, which are further outlined in our "Foundational Considerations and Dynamics" section, this lack of ingredient diversification may hinder the growth potential of the plant-based food sector in Asian markets. In the 2020 China consumer insights research conducted by CBN Data, the top five reasons for purchasing and consuming plant-based meat products are: "low fat," "zero cholesterol," "taste good," "mouthfeel less greasy," and "more nutritious;" in that order and with "low fat" clearly outperforming other factors.[2] That is quite different from what most people understand to be the motivations of consumers in other markets. Meat analogues that have been widely distributed for many decades in China, mainly serving the large Buddhist community, fall into the well-established industry category of "soy products" (豆製品). Forty-one percent of Chinese consumers surveyed by IPSOS in 2020 said that they think plant-based meat can be used to replace what they've known as "soy products."[3] The use of new ingredients may play a key role in differentiating a plant-based meat product from the association with traditional "mock meat," which is expected to be sold at a low price point, comes with historical image baggage, and has not succeeded in attracting a broader audience over the years.

Where there is risk, there is opportunity. Diversified plant proteins just need a competitive value proposition to bring about growth. Here we seek to present the intersection of three dynamics: the need to de-risk the plant-based meat sector through more diversified product offerings (in terms of base ingredients); the existing portfolio of

crops that now has a new and fast-growing customer called the "plant-based industry;" and finally, Asia. While most eyes are on Asia for the sheer size and growth rate of its domestic consumption, this report illustrates why the greater opportunity in many parts of the continent may actually be on the supply and manufacturing side, where Asia has the capacity to rapidly scale up and reduce worldwide production costs for plant-based raw materials. Hence, the title of this report: *Asian Cropportunities*.

There are clear signs of demand and adaptation by consumers of "newer" ingredients. Seventeen of the top twenty-five plant-based meat products in the U.S. market are made of soy or a blend with soy protein; but dollar sales of the four pea-based products collectively grew at 339 percent in 2019, while sales of the other twenty-one products grew at only two percent.

The market has spoken and the yearning for further ingredient innovation is palpable.[4]

"This report is aimed at the visionaries."

This report is aimed at the visionaries—whether you are an entrepreneur starting a plant-based venture, an investor searching for the next big thing, a food manufacturer seeking to diversify into plant-based offerings, or a policymaker looking for ways to capitalize on a rising sector and boost your country's economy. After taking a close look at the fourteen raw materials and seven Asian countries featured in this report, you may find yourself asking "Am I sitting on a gold mine and just need to start digging?"

Source: Green Monday

CONTENTS

Click on a page number to jump to a desired section.

PREFACE

Plant-Based Meat, *Defined*

For the purposes of this report, we use the term "plant-based meat" to refer to plant-based products that are direct replacements for animal meat. This definition includes products that use a biomimicry approach to replicate the taste, texture, and appearance of animal meat, and are marketed as such. It does not include soy or wheat products not explicitly branded as meat replacements (such as tofu, bean curd products, seitan, and tempeh) because these food products do not primarily function as meat substitutes in Asian food cultures. Please also note that although they are not biologically classified as plants, we include fungi-based products in our definition of plant-based meat, as they are still derived from non-animal sources.

Common Misconceptions, *Debunked*

PROTEIN CONTENT

Neither animal- nor non-animal food sources are entirely composed of protein. For example, chicken meat has a protein content of approximately 24 percent,[5] shrimp has 20 percent,[6] and chicken eggs have 12 percent.[7] When we examine the protein content of a plant-based food source, such as wheat, its inherent protein content is slightly less than 15 percent,[8] but as vital wheat gluten it exceeds 75 percent.[9] Food ingredients exist in multiple forms, including fresh or as-is, and wet or dry formats that range from whole products to fats, pastes, flours, concentrates, and isolates. The protein content may vary greatly depending on what form the ingredient is in.

MEAT PROCESSING

Both animal meat and plant-based meat are accessible to consumers in two main forms:

- Whole muscle meat, such as a chicken breast, pork chop, or steak
- Restructured meat products (e.g. ground, shredded, and bound meat products) such as meat patties, balls, nuggets, and sausages

Consumers generally regard restructured meat products as "processed," however there is no fixed definition of what "processing" means. We have included a crash course in making plant-based meat in this report to cover some basics in food-processing technologies, particularly extraction and extrusion. While these techniques are commonly used in plant-based meat production, in this report we also investigate raw materials such as jackfruit and lion's mane mushroom that do not require extraction or extrusion when used to create products that mimic whole muscle meat.

PLANT-BASED DIETS

As outlined in the definition above, plant-based meat products function as direct replacements for animal meat. Plant-based meat is not a substitute for vegetables, fruits, or legumes, but rather replaces a person's dietary portion that is originally animal-based, thereby creating a net impact on their environmental footprint, the number of animals used in food production, and natural resources deployed. In this report, we investigate the variety of raw materials that can be used to produce plant-based meat and examine factors such as nutritional content and environmental impact within this context.

Brand: OmniPork

Origin: Hong Kong SAR

Dish: Stir fry vegetables with OmniPork® Strip, served with soup noodles

Featured plant-based meat ingredients: Soy protein concentrate and wheat starch

Brand: Unlimeat

Origin: South Korea

Dish: Vietnamese-style beef pho made with Unlimeat sliced beef, sold at Kind Kitchen

Featured plant-based meat ingredients: Wheat protein, soy protein isolate, roasted lentil bean powder, roasted chickpea powder, rice powder, and roasted quinoa powder

Brand: Whole Perfect Food (also known as Qishan)

Origin: Shenzhen, China

Dish: Qishan's vegan version of braised pork with preserved vegetable (梅菜扣肉), a signature Chinese dish where a slice of pork is expected to show layers of fat and meat

Featured plant-based meat ingredients: Soy isolate and konjac powder

Brand: Vegefarm

Origin: Taiwan

Dish: Vegetarian fried shrimp, prawn, fish stick, and squid ring over rice

Featured plant-based meat ingredients: Glucomannan, a water-soluble, fermentable dietary fiber extracted from the tuber or root of konjac

INTRODUCTION

Across rising economies in Asia, warning lights are flashing bright red for the future of animal agriculture. Conventional meat production is ill-equipped to handle the escalating pressures of skyrocketing protein demand, increased climate disruption, land and water scarcity, and threats of viral outbreaks. Business as usual clearly cannot continue, which is why forward-thinking stakeholders from both the public and private sectors have begun to rally around more sustainable protein alternatives.

> **"The development and implementation of plant-based meat in China is not only a market opportunity, but also an effective way to improve the food structure of Chinese residents and solve environmental and social problems."**
>
> SUHE MENG, Chairperson of Chinese Institute of Food Science and Technology [10]

Production of animal meat is an inherently inefficient system, which puts significant risk on investors in a world of diminishing natural resources. Producing conventional chicken, for example, requires feeding nine calories of chicken feed to an animal, to only get one calorie back in the form of meat.[11] To reduce their risk exposure, companies and investors are **diversifying** and mining the untapped potential of plant-based protein sources.

Brands like Beyond Meat and Impossible Foods have proven that meat made from plants can be produced more efficiently, while still delivering all the familiar flavors that consumers expect.[12] Major fast-food companies like KFC, Pizza Hut, McDonald's, Burger King, and Starbucks have already begun offering plant-based proteins in Asia, but current offerings are just the tip of the iceberg.

Source: Taco Bell China, Shanghai

Source: McDonald's Hong Kong

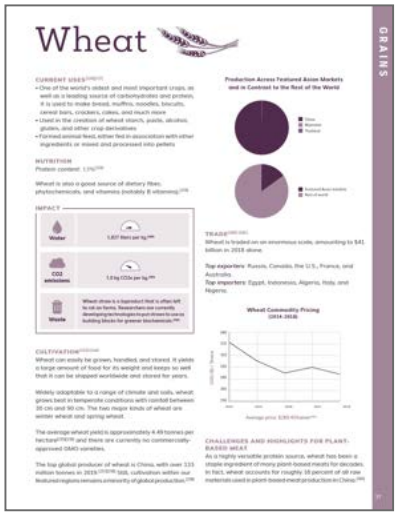
Source: KFC Hong Kong

Source: Starbucks China, Shanghai

China alone will account for 35 percent of the global protein market by 2025,[13] and food industry surveys have shown that 62 percent of Chinese consumers are "very likely" or "extremely likely" to buy plant-based meat.[14] Similar shifts are likely to take place throughout Asia and will represent one of the largest changes to global dietary habits in modern history.

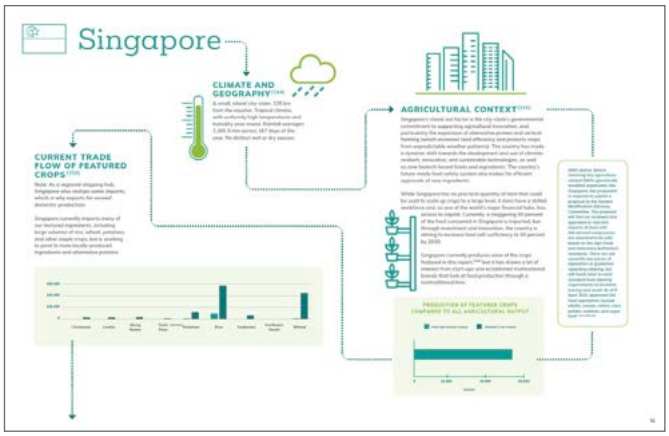
> **"The current Covid-19 situation underscores the importance of local food production, as part of Singapore's strategies to ensure food security. Local food production mitigates our reliance on imports and provides a buffer in the event of food supply disruptions."**
>
> SINGAPORE FOOD AGENCY[15]

At the same time, the vast majority of current plant-based meat products are reliant on only two main crops—soy and wheat.[16] While innovative applications of these two ingredients have ushered in the latest generation of alternative proteins, relying exclusively on such a small handful of crops may mean that we are overlooking the massive potential of locally sourced ingredients in Asia that could reduce costs and reap huge rewards for domestic producers.



In this report, we will highlight some of the many promising ingredients that both established brands and start-ups can tap into to further diversify the range of plant-based meats. This was achieved through direct interviews with industry experts and extensive research of secondary data. By assessing raw materials based on their nutritional content, cultivation methods, environmental impact, and other important criteria, we seek to illuminate the unique attributes that each alternative protein ingredient contains.

Some crops will align better with individual countries than others. In a wealthy city-state like Singapore, for example, where arable land is in short supply but market demand is high, intensive cultivation and development of fermentation-based mycoprotein or lion's mane mushroom could help the country achieve its national food self-sufficiency goals and reap rewards for local investors. By contrast, in a developing agricultural economy like Myanmar, it may make more sense to ramp up production of chickpeas or mung beans, which would allow the centrally-located nation to become a primary exporter of raw materials for meat alternatives to their Indian and Chinese neighbors. We refer to these potentially lucrative country-specific suggestions as "cropportunities."



> **"As much as possible, you either want to be at the source of your raw materials or you want to be at the market destination, so that your distribution costs will be very low. For plant-based protein, it makes more sense to be manufacturing the protein close to the origin, while producing the finished product near the final destination."**
>
> VISHAY VIJAY, Agrocorp

Our final section will illustrate the financial rewards that could accompany an embrace of plant-based meat in Asia, and some highlighted examples of how forward-thinking innovators are putting raw materials to work in new and interesting ways. Armed with this report, you will be better positioned to capitalize on the lucrative opportunities presented by a fast-moving societal shift towards alternative proteins. We look forward to seeing what you will bring to the table.

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ARE is a specialist firm based in Singapore that brings the voice of institutional investors to address Asia's sustainable development challenges. It does this through structuring collaborative engagements and providing relevant research. ARE's collaborative engagements include Energy Transition and Sustainable Protein.

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FOUNDATIONAL CONSIDERATIONS AND DYNAMICS

Asian Agriculture 2.0: Changes to Asian Food Infrastructure Are Underway, Right as Plant-Based Meat Demand is Exploding

Asia's reputation for dynamism and proven ability to accelerate change quickly are on full display right now in the food and agriculture space. New technologies and approaches to agriculture are constantly cropping up, so to speak, to provide the region with more efficient ways to harvest raw materials; and hunger for alternative sources of protein is one of the driving forces.

In forward-thinking cities like Singapore, there is an explosion underway of vertical farming, urban farming, and community farming with the use of digital technologies and artificial intelligence. In agricultural powerhouse nations like Thailand and Vietnam, older subsistence farmers are increasingly offering up their lands to younger entrepreneurs, who can invest in more advanced machinery to increase output and provide ingredients at a more competitive price. Many farmers in China are now using drones to monitor their fields, and some Vietnamese processors have the capability to analyze every grain of rice at high rates of speed and sort them by color, size, and condition, using laser technology. Together, these changes represent a fundamental shift towards a smarter way of feeding a growing planet. The shape of agriculture is evolving and this more strategic form of producing food—and specifically, protein—has the potential to be extremely profitable for those who get in early.

"Together, these changes represent a fundamental shift towards a smarter way of feeding a growing planet."

It would be a missed opportunity though to simply use these technological advances to increase the efficiency of existing products, without also working to diversify the raw materials we are working with. Paddy rice fields, for example, are the second-biggest source of methane emissions, after animal farming,[18] and there is ample room for both underutilized local crops and futuristic novel ingredients to play a larger role in powering the regional food supply. Beyond the benefits that ingredient diversification brings for public health and sustainability, it also reduces the financial risk for stakeholders, by not putting all of their plant-based eggs in one basket. A food system built with a wide array of raw materials that are nutrient-dense but also attuned to our finite natural resources has a better chance of thriving over the long term.

As a transitional step, for example, smart farmers across Southeast Asia are now increasingly looking to the soil nitrogen-fixing power of legumes[19] like chickpeas, lentils, and mung beans, to balance out the nitrogen-depleting impact of traditional rice farming.[20] Many of the latest alternative proteins are also reliant on these legumes, such as the **plant-based eggs** made by Eat Just, Inc., which feature mung beans as their primary ingredient. Not coincidentally, Eat Just also announced in October 2020 that they will soon open their first protein production plant in Asia, to be located in Singapore, as part of their strategy to create "a fully-integrated supply chain" in the region.[21] As the market for proteins that come from non-animal sources continues to expand, all stakeholders who help construct those alternatives stand to benefit.

As a large and heterogeneous region, Asia is uniquely primed to capitalize on the shift towards alternative proteins. Between the rich agricultural landscapes of Southeast Asia, the expansive infrastructure and manufacturing power of mainland China, the world-renowned innovation hubs in Singapore and Hong Kong, and an unparalleled potential market audience, Asia now has the ability to source a nearly unlimited range of ingredients, process them in new and innovative ways, and manufacture the next generation of plant-based meat; all in the same corner of the world.

Dr. Sayed Azam-Ali, CEO of Crops for the Future, believes that too often the food industry is directed by "supply-driven research," when it is ultimately demand that drives the market. Dr. Azam-Ali says that in recent years, alternative proteins have proven a clear market demand, which therefore justifies increasing the supply side of the equation.[22] To achieve that goal, all that is required is for each part of the region to lean into what they do best.

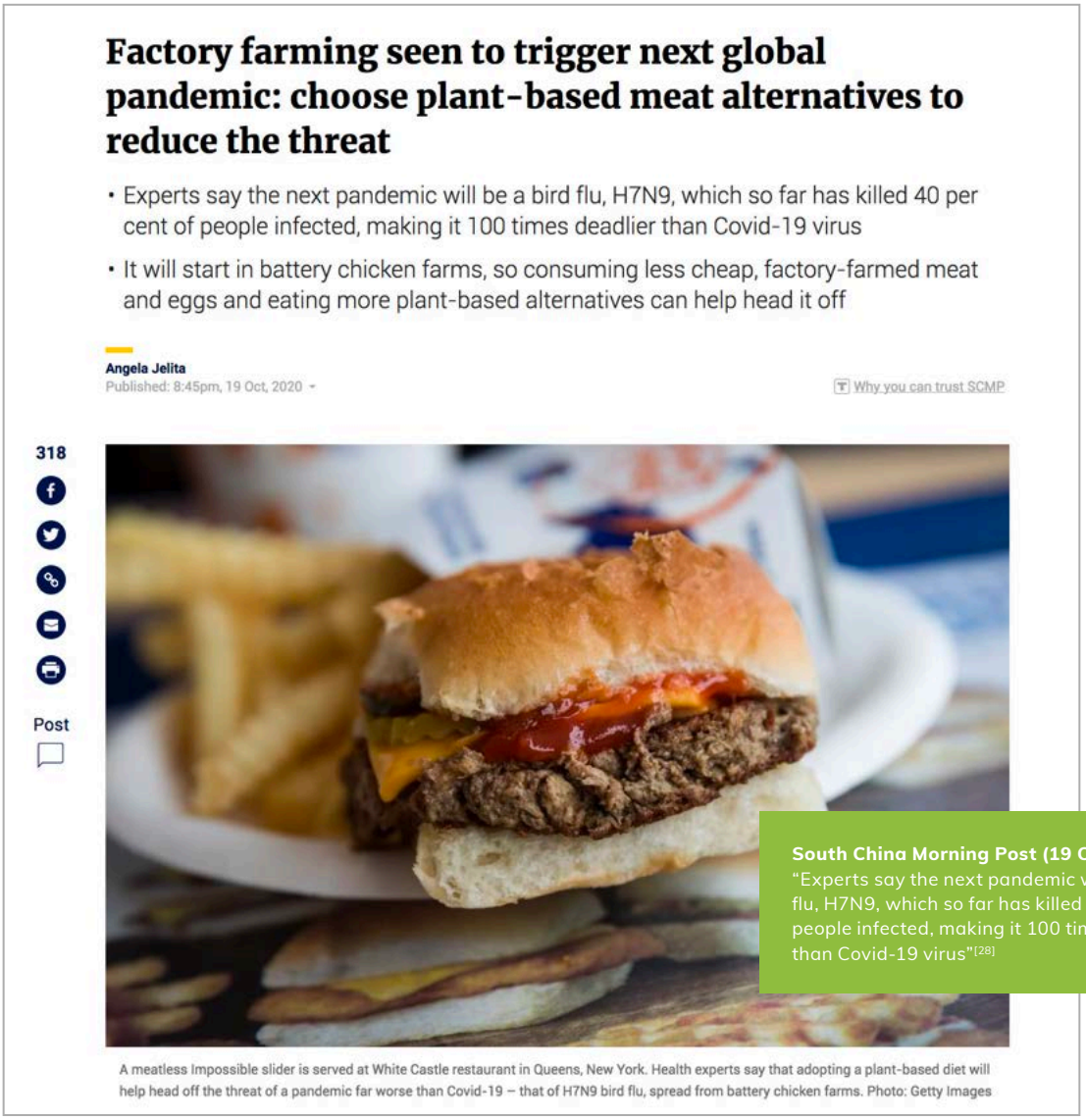
"Too often the food industry is directed by 'supply-driven research,' when it is ultimately demand that drives the market."

Covid-19 and the Stability of Plant-Based Meat

The coronavirus pandemic, and the associated policy restrictions implemented to contain its spread, have put food supply chains under unprecedented strain. Existing transport and logistics systems have been upended as both restaurants and borders open and close unpredictably, while farmworkers and front-line workers at production facilities have fallen ill in massive numbers, causing industry-wide bottlenecks.[23] The food and beverage industry alone accounts for 17 percent of ASEAN's gross domestic product and 35 percent of the total labor force, which means that an industry-wide disruption has dire ramifications for both private-sector stakeholders and regional stability.[24] Priority number one for people across the industry is keeping their head above water.

The Covid-19 pandemic has also had a significant impact on consumer perceptions. This is particularly true in Asia, which had already been reeling from an epidemic of African swine fever in China that resulted in a 40 percent reduction in that country's pig herd by the time the coronavirus outbreak began.[25] Driven by increasing fears of animal-borne diseases, health concerns, and demand for natural products, Asia Pacific is now projected to be the fastest-growing producer region of plant-based meat, according to market analysis by FutureBridge.[26] In total, the plant-based meat market is estimated at roughly USD $7.3 billion, but following the Covid-19 pandemic, the compound annual growth rate is now projected to increase by more than 17 percent.[27]

In this era of shocks and instability, building a low-risk value chain means focusing on where the opportunities are, and the shift towards plant-based meat shows no signs of slowing down. In these turbulent times, standing still means moving backwards, so rather than growing crops to feed them to animals, now is the time to center agricultural systems around alternative proteins.



Factory farming seen to trigger next global pandemic: choose plant-based meat alternatives to reduce the threat

- Experts say the next pandemic will be a bird flu, H7N9, which so far has killed 40 per cent of people infected, making it 100 times deadlier than Covid-19 virus
- It will start in battery chicken farms, so consuming less cheap, factory-farmed meat and eggs and eating more plant-based alternatives can help head it off

Angela Jelita
Published: 8:45pm, 19 Oct, 2020

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318

Post

A meatless Impossible slider is served at White Castle restaurant in Queens, New York. Health experts say that adopting a plant-based diet will help head off the threat of a pandemic far worse than Covid-19 – that of H7N9 bird flu, spread from battery chicken farms. Photo: Getty Images

South China Morning Post (19 October 2020): "Experts say the next pandemic will be a bird flu, H7N9, which so far has killed 40 percent of people infected, making it 100 times deadlier than Covid-19 virus"[28]

The Untapped Potential of "Future Fit Crops"

Seventy-five percent of all food currently consumed by humans is derived from only twelve crops and five animals, even though there are roughly 300,000 plants fit for consumption.[29] As producers and consumers, we are barely scratching the surface of the plant kingdom's potential. This lack of dietary variety is harmful to human health and contributes to a loss of ecological resources and soil biodiversity, which is why intergovernmental organizations and food advocates are calling for an embrace of "future fit crops," also sometimes called "neglected and underutilized species" or "future smart food."

In a seminal 2018 report titled "**Future Smart Food**," the Food and Agriculture Organization of the United Nations (FAO) wrote "These foods are smart because they can bolster dietary diversification, improve micronutrient intake, enhance soil health, require fewer inputs such as chemical fertilizers, and often prove resilient to climate change and adverse farming conditions."[30] All of the future smart foods identified by the FAO are plant-based, with a particular emphasis on legumes and pulses, as well as raw materials common in developing economies, like millet and jackfruit. These impactful ingredients are "nutritionally dense, climate resilient, economically viable and locally available or adaptable."[31] Many are already grown in Asia, or could be.

Other indigenous crops have made a similar leap from underutilized and nutrient-dense local ingredients to globally-distributed commodities, with the South American superfood quinoa perhaps being the most well-known example. Building the infrastructure for quinoa to make that jump took years of collaborative work from policymakers, farmers, and the private sector to enhance productivity, educate consumers about the crop's many health benefits, and develop a value chain to bring quinoa-based products to the world market. Once quinoa scaled up though, people who got in on the ground floor and helped to build its success story began to see a major return on their investment. In the U.S. alone, imports of quinoa grew between 2007 and 2013 from only seven million pounds to nearly seventy million,[32] resulting in huge financial rewards for supplier countries.

Asia has an enormous and growing need for affordable and accessible protein as a means of reducing the hunger and undernutrition of hundreds of millions of people.[33] Rather than addressing this through deeper investment in conventional meat production, which exacerbates current food-security concerns by rapidly depleting natural resources and destabilizing local ecosystems,[34] forward-thinking leaders in government and business can elevate underutilized raw materials by turning them into nutrient-dense meat alternatives and trading them throughout the region. For shoppers, taste and cost continue to be top factors, but perceptions of health, nutrition, and sustainability can also be decisive.[35]

Opting for ingredients hardy enough to grow on degraded land also potentially opens the door to cultivation in places like Malaysia, where large-scale palm-oil production has resulted in diminished soil quality.[36] Harvesting crops from degraded land, rather than fighting for plots of richer soil that could accommodate any mainstream crop, is also likely to come with a cost savings for producers; that's a competitive advantage. In the process, they also deliver a reliable cash infusion to local economies and increase food security for decades to come. For investors, that combination means a resilient business model and more sustainable long-term returns.

Despite the financial benefits and potential consumer appeal, "future fit crops" are still underrepresented among mainstream brands of plant-based meat, meaning that there is a market gap waiting to be filled.

> **"Moving from four crops that feed over 70 percent of humanity right now to five crops isn't going to make much difference. Nor is having ten crops. You need a whole selection of crops that are best suited to the climate now and in the future. We need to move forward fast but on a broad front, viewing diversity as a strength rather than an inconvenience."**
>
> DR. SAYED AZAM-ALI, Crops for the Future[37]

Cultural Considerations

Markets around the world are at very different stages in terms of developing and adopting plant-based alternatives to animal products.

In China, plant-based meat substitutes, often referred to as "mock meat" or "vegetarian meat," were first recorded in the Tang dynasty one thousand years ago, if not earlier, but many of the industry leaders were established within the past twenty years. Notably, since Chinese plant-based meats were born out of the Buddhist tradition and have primarily served the vegetarian inclinations of some of the estimated 245 million national followers,[38] replication of the taste and texture of meat was never pushed past a relatively basic level. In fact, being too similar to real meat could be deemed non-religious. That being said, due to the long history of product development and market adoption, the variety

of products available is amazingly broad. Customers can easily find products mimicking all types of meat, from chicken and beef to pork, fish, shrimp, duck, abalone, lobster—the list goes on. And given that processed animal-based meat products, such as meat patties and nuggets, are not traditionally consumed in most Asian food cultures, a lot of vegetarian meat products seek to recreate the whole muscle meat experience instead of restructured meat, such as ground meat. This background has created quite different consumer expectations as to the level of biomimicry or other value-adds that "2.0" plant-based meat products need to achieve in order to be distinguishable from traditional mock meat products.

Companies in Asia have begun producing 2.0 plant-based meats—products that are attractive not only to vegetarians, but also to meat eaters. These consumers are different from their religious vegetarian counterparts. They have long been familiar with mock meat products predominantly made from soybean and wheat. The raw materials within traditional products are often perceived as inferior sources of protein compared to animal protein, and have been consumed instead of meat due primarily to their affordability or for religious reasons. Meat analogues that have been widely distributed for many decades in China fall into the well-established industry category of "soy products" (豆製品). Forty-one percent of Chinese consumers surveyed by IPSOS in 2020 said that they think plant-based meat can be used to replace what they've known as "soy products."[39] Consumers of 2.0-level plant-based meats are unlikely to be satisfied with plant-based meat products that are primarily soy- or wheat-based. The use of new ingredients may play a key role in differentiating a plant-based meat product from the association with traditional mock meat, which is expected to be sold at a low price point, comes with historical image baggage, and has not succeeded in attracting a broader audience over the years.

Furthermore, many meat eaters are incorporating plant-based meats as part of their diet primarily for health reasons, so the importance of *balance* in Chinese medicine and other traditional Asian health modalities means that most people consciously (or subconsciously) avoid overconsumption of any one type of food. If a meat eater normally consumes pork, fish, and duck in his or her daily diet, replacing these with plant-based pork, fish, and duck that are primarily made of soybean can actually be construed as less healthy, not because it is soybean per se but due to the overrepresentation of any one food in one's diet. In the 2020 China consumer insights research conducted by CBN Data, the top five reasons for purchasing and consuming plant-based meat products are: "low fat," "zero cholesterol," "taste good," "mouthfeel less greasy," and "more nutritious;" in that order and with "low fat" clearly outperforming other factors.[40] That is quite different from what most people understand to be the motivations of consumers in other markets.

Source: Kind Kitchen

While meat consumption in Asia is projected to rise rapidly, it is important to note that the baseline, i.e. the current per capita meat consumption in most Asian countries, is much lower than in the U.S.[41] A higher percentage of people's protein intake is already acquired from plant-based foods such as tofu, which are staple foods perceived to be more "natural" and do not act as meat substitutes but rather exist in their own rights. These considerations all point to the dire need to diversify the raw materials used in plant-based meat production in order to create products that are fit for Asian markets.

A Crash Course in Making Plant-Based Meat Through Dry Extraction, Wet Extraction, and Extrusion

Many plant-based meat ingredients have an innate texture that lends itself to replacing animal meat with minimal processing or alteration. Jackfruit, for example, is often noted for its naturally chewy, pork-like consistency.

However, to achieve a desired flavor, nutritional combination, or texture, some processors prefer to extract proteins from plants through either wet or dry extraction methods, which allows them to combine the plant proteins with other ingredients to make a unique formulation.*

Apart from maximizing the protein content obtained from new raw materials, experimenting with combinations supports diversification as well. For example, konjac—a plant native to East and Southeast Asia with a starchy edible root—has low protein content but is immensely useful as a supporting ingredient when paired with other plant proteins to provide a meat-like texture.[42] Similarly, pea protein extracts are less sticky compared to soy protein extracts.[43] This necessitates the introduction of other inputs to produce convincing plant-based meat.

*** A NOTE ON FOOD "PROCESSING"**

If the idea of food "processing" seems off-putting, consider the humble process of making bread. When creating bread from scratch, bakers take flour, which contains protein, and then add water and yeast before kneading and folding the dough in on itself. As a result, the proteins in the flour have changed by slowly becoming elongated. The processing of bread involves transforming plant proteins in a fundamental way, but few of us would describe baking bread as unnatural.

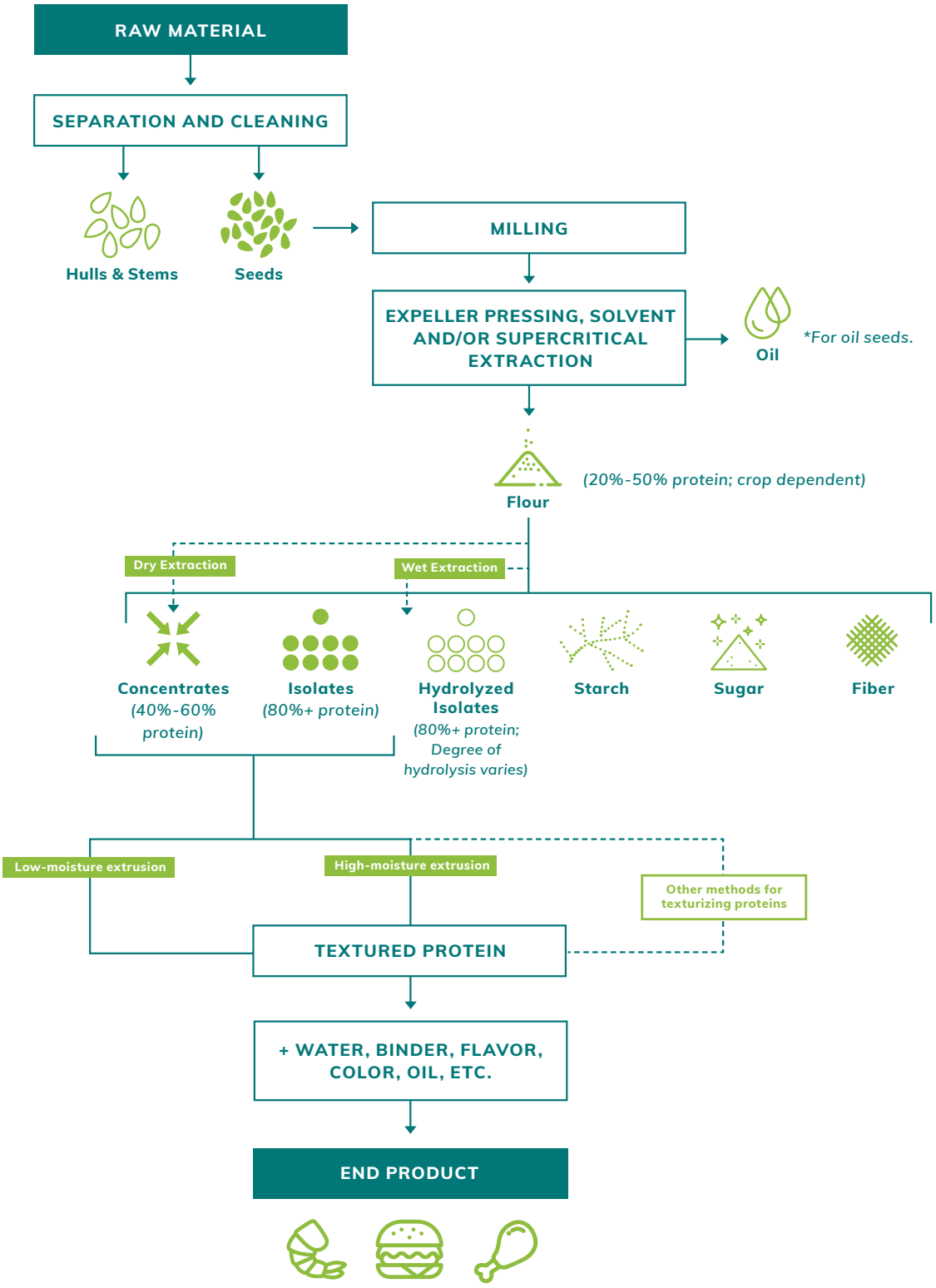
In fact, many of the traditional foods already widely consumed in Asia, including tofu and tempeh, are also created through some form of "processing," but are still broadly considered to be healthy and natural. Below are some examples of methods used to create common products.

What are the methods of texturizing proteins?

METHOD	EXAMPLE
Coarse aggregate gelation	Tofu
Fine network gelation	JUST Egg
Hydrocolloid gelation	Plant-based yogurts
Low moisture extrusion	Textured vegetable protein (TVP)
High moisture extrusion	Gardein
Freeze texturization of a gel	Freeze-thaw tofu
Deep-fry texturization	Tofu puffs
Dry heat	Tofu crumbles, baked tofu
Skin formation on boiling	Tofupi □ vegetarian duck
Dough formation	Seitan
Mycelia	Quorn, tempeh
3D printing	Redefine Meat

Source: OMNIPORK

PLANT-DERIVED INGREDIENTS AND PROCESSING OVERVIEW



Dry extraction

Refers to the process of drying a crop and grinding it into a flour, after which air classification and electrostatic separation methods are used to separate the particles in the flour. Dry extraction is less energy-intensive and less water-intensive than wet extraction, but protein isolate purity from dry fractionation is much lower than wet extractive processes, and that difference is vast and important. For example, according to research published in *Biopolymers for Food Design*, "pea proteins can be produced based on dry-milling and wet-milling technologies which will have protein content ranging from 48% to 90%."[44] Additionally, a high level of oil content makes certain legumes, like soybeans and chickpeas, unsuitable for dry extraction.[45]

Wet extraction

Uses a combination of dissolving and precipitating an ingredient, followed by centrifugation and membrane separation. Additional steps may be required for wet extraction if the crop has exceptionally high starch or oil content, or if the crop contains a unique substance that must be capped under certain limits. As wet extraction is a comparatively more intensive process, facilities that perform this step require access to a lot of water, though technologies have been developed to reduce this concern through the use of water recycling.[46]

Extrusion

By contrast to extraction, extrusion means taking ingredient inputs and turning them into a semi-solid output using heat, shear, pressure, and moisture. Through this process—which is also commonly used in the production of cereals, puffed snacks, and pastas—many alternative proteins are reconstituted into a finished product with the desired texture and flavor profile of animal meat.[47]

Source: Kind Kitchen

FEATURED RAW MATERIALS

The raw materials profiled in this report were selected based on a series of criteria, including their nutritional value, regional availability, level of establishment within its supply chain, GMO status, and consumer or industry perception.

For the sake of comparison, we have included both traditional ingredients already widely used for plant-based proteins—namely soy, wheat, and pea—as well as innovative ingredients that have not yet been fully seized on to develop commercial-grade meat alternatives.

This list is by no means exhaustive, but we did aim to highlight those that are ready for a brighter spotlight in Asia. Each ingredient comes with its own set of benefits and challenges, but in reading their profiles, we hope that you too will see each ingredient's enormous potential for growth, and consider how you could bring that to fruition.

FAMILY	RAW MATERIAL
Oilseeds	Sunflower seed
	Soybean
Root Vegetables	Konjac
	Potato
Pulses	Field pea
	Chickpea
	Lentil
	Mung bean
Fungi	Lion's mane mushroom
	Mycoprotein
Grains	Wheat
	Millet
	Rice
Fruits	Jackfruit

Sunflower Seed

CURRENT USES

- Snack food (striped sunflower seeds)
- Extracted for sunflower oil, which is used in margarine, cooking oil, and salad oil[48]
- Feed for farmed animals
- Sunflower seed flour, meal, milk, or paste
- Hulls can decompose and be burned as biomass fuel[49][50]

NUTRITION

Protein content: 19.33%[51]

Sunflower seeds are high in Vitamin E and selenium, a powerful antioxidant.[52] They are also purported to reduce risk of inflammation, heart disease, and diabetes.[53]

IMPACT

Water	3,366 liters per kg.[54]
CO_2 emissions	0.88 kg of CO_2 equivalent (CO_2e) per kg.[55]
Waste	Seed hulls are a major byproduct, often used as a feed additive for cattle. Hulls have also been sold as poultry litter, fireplace logs, and fillers for plastics; however, demand is limited and they are often burned for energy.[56]

Additional note: Sunflowers are considered environmentally-friendly for many objective reasons: they require limited amounts of nitrogen fertilizer, no irrigation, and limited use of pesticides. They also have potential for providing multiple ecosystem services in diverse cropping systems (e.g. pollinator feeding).[57]

CULTIVATION

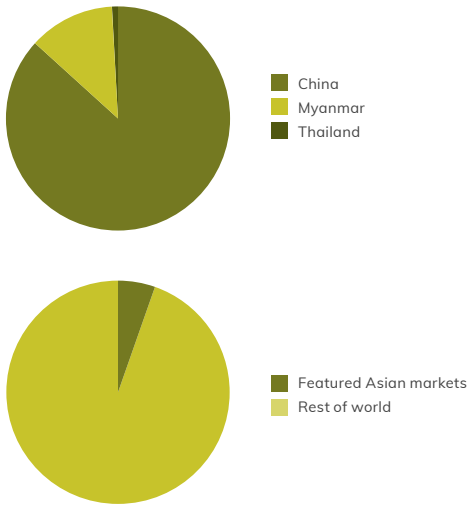
Native to North and South America, Ukraine and Russia are now the world's top producers (16.5 million and 15.31 million tonnes in 2019, respectively), with more than half of the global output.[58]

Sunflowers are remarkably tough and will grow in any kind of soil as long as it is not waterlogged. They can grow to between 1.5 and 3.6 meters tall and thrive in soils that are slightly acidic to somewhat alkaline.[59]

Average yields are about 2.5 tonnes per hectare[60] and there is no widespread GMO cultivation of sunflowers.

The vast majority of sunflower production takes place outside of our featured Asian countries, but the portion produced within the featured region is mostly in China (87 percent).[61]

Production Across Featured Asian Markets and in Contrast to the Rest of the World

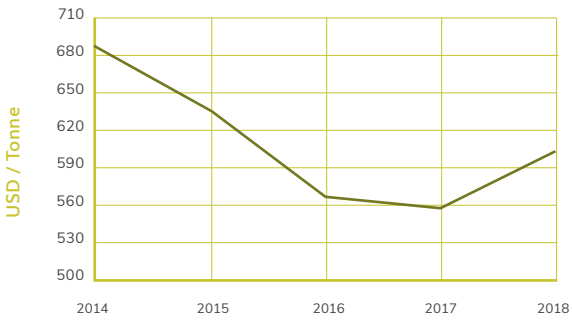


TRADE

Top exporters: Romania, Bulgaria, and France.[62] Ukraine is the world's largest exporter of sunflower oil, shipping 4.4 million tonnes a year.[63]

Top importers: The Netherlands, Russia, and Ukraine.[64] (Ukraine has excess domestic seed-crushing capabilities, which may be why they continue to import seeds despite being the world's top producer.[65])

Sunflower Seed Commodity Pricing (2014-2018)



Average price: $607.22/tonne[66]

Sunflower Seed (CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

As a healthy raw material that is already grown around the world in large volumes,[67] sunflower protein has enormous potential. Sunflower seeds are already a commonly-consumed snack food, so there is a familiarity for consumers that makes it seem less foreign as an ingredient. Sunflower texturates are naturally dark in color, which can be a plus for burgers and ground beef products, but presents some concerns for light-colored products like plant-based chicken. Such concerns can be alleviated by combining sunflower protein with other ingredients.[68]

Sunflower seeds are already a fairly common ingredient in plant-based meats, but most often in the minor form of sunflower oil or lecithin (fat). Such ingredients can currently be found in Beyond Meatballs, Tofurky's Plant-Based Chick'n, Omnimeat, and South Africa-based Fry Family Food Co.'s Golden Crispy Vegan Fish Fillets. However, some smaller brands, like Sunflower Family, have made textured sunflower protein the star ingredient in their line of plant-based burgers, pasta sauces, and chili meat.[69]

Soybean

CURRENT USES

- Feed for farmed animals, over half of which is fed to chickens, turkeys, and other poultry[70]
- Used to produce soymilk and tofu
- Boiled or steamed to serve as edamame
- Fermented into soy sauce, tempeh, miso, or fermented bean paste
- Processed for soybean oil, which is refined for cooking, frying, and other edible uses, or sold for biodiesel production or industrial use
- Soybean oil byproducts include margarine, salad dressings and mayonnaise, baked breads, crackers, cookies, and cakes
- Soy protein concentrates and isolates are used for a wide array of products, including plant-based meat and ready-to-drink beverages[71]

NUTRITION

Protein content: 34.3 - 36.3%, depending on environmental conditions, management practices (conventional, organic, etc.), and crop genetics.[72][73]

Soybeans contain very little starch, making them an excellent protein source for diabetics. Soy foods are also a great source of B-vitamins, iron, zinc, and antioxidants.[74]

IMPACT

Water

2,145 liters per kg on average.[75] Soy is a primarily rain-fed crop in South America, but is much more heavily irrigated elsewhere.

CO_2 emissions

0.45 kg of CO_2e per kg of crop, on average.[76]

Waste

The sheer scale of global soybean cultivation results in tens of millions of tons of waste every year. Cultivation waste does have properties that make it potentially useful in other contexts, such as the production of fiberboard for building materials.[77]

Additional notes: Soy cultivation continues to put pressure on forests, including the Amazon, and forest loss is a key factor in climate change. Taking this into account, the carbon footprint of soybean cultivation in some areas may be substantially higher than what is stated here.[78][79]

CULTIVATION

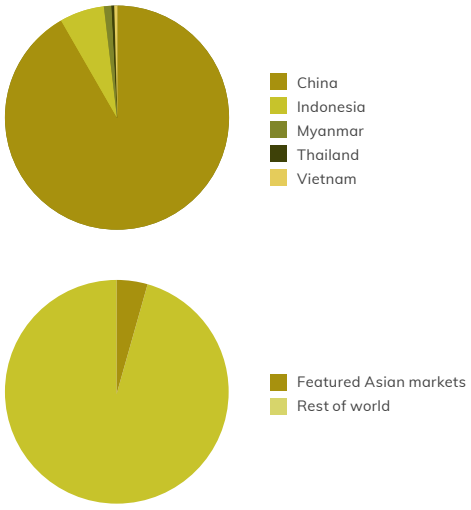
Soybeans, also called soya beans, are legumes native to East Asia. A cheap and abundant source of protein, soy is a global staple for humans and farmed animals. It is a resilient crop that thrives in a range of soil conditions, typically in temperatures of 20°C to 30°C and moist alluvial soils containing good organic content. Temperatures lower than 20°C and over 40°C impede growth.

Average soybean yields are about 2.81 tonnes per hectare.[80] Crop rotation between soybean and corn seems to benefit corn yields, and this is a common approach, but there may be a long-term degradation in the organic matter.[81]

According to the USDA in 2018, 94 percent of soybeans in the U.S. are genetically modified,[82] usually to tolerate herbicides.

The vast majority of soybeans are cultivated outside of this report's featured regions in Asia, but among the countries within our research scope, China is the single largest producer, constituting nearly 92 percent of local cultivation.[83]

Production Across Featured Asian Markets and in Contrast to the Rest of the World



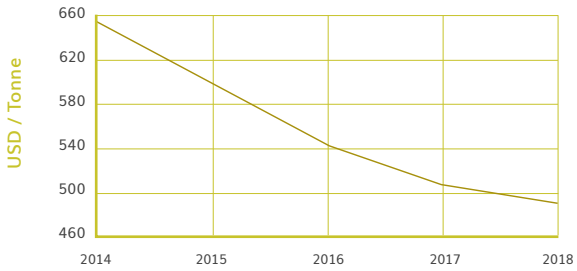
Soybean (CONTINUED)

TRADE

China is the world's largest consumer of soybeans, once consuming 60 percent of U.S. soybean exports before a trade dispute affected shipment levels.[84] Trade tensions have dried up the flow of soybeans from the U.S. to China, so China now buys most of its soybeans from Latin America, especially Brazil (80 percent) and Argentina.[85] As a result, Brazil is currently the world's leading producer of soybeans, with 130 million metric tons forecast for 2020.[86]

Top exporters: Brazil, the U.S., Canada, Paraguay, and Argentina.
Top importers: China, Argentina, Mexico, the Netherlands, and Japan.[87]

Soybean Commodity Pricing
(2014-2018)



Average price: $558.26/tonne[88]

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

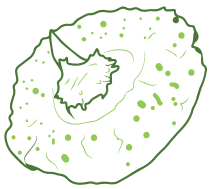
Soy is a very common ingredient in all food categories, but it also has a long history as the go-to protein source for plant-based meat. In fact, soy accounts for a staggering 75 percent of all raw materials in Chinese plant-based meat production.[89]

Soybeans have been praised as highly digestible and more versatile than many other proteins. Isolated soy proteins have excellent nutritional qualities and some isolates can emulsify fat and bind water. This allows producers to enhance moistness or provide an elastic gel texture, which results in a meaty mouthfeel.[90] While soy protein can contain undesirable beany notes and residual off-flavors, progress has been made in reducing and masking those elements to allow the intended meat flavors to dominate.[91]

Soy is among the most commonly-reported food allergens in European and North American populations, though that pattern does not appear to hold in Asia, where soybeans have been a traditional ingredient for centuries.[92]

Some of the mainstream products that feature soy protein concentrate, soybean fiber, isolated soy protein, or soy flour include the Impossible Burger, OmniPork Luncheon, and Tofurky's chorizo-style crumbles.

Konjac



CURRENT USES[93][94][95]

- Konjac's large starchy corm (underground stem) is used to create flour or jelly, which can then be prepared to mimic certain textures such as squid, shrimp, and animal fats
- Made into a plant-based substitute for gelatin
- Konjac flour is used to make noodles and other products[96]
- Prominently featured in oden, a traditional Japanese dish
- Prepared as a vegan seafood alternative
- Featured in dietary supplements for weight loss and cholesterol management, particularly within traditional Chinese medicine

NUTRITION

Protein content: 1.2%[97][98]

Clinical studies have shown that consuming konjac can significantly lower plasma cholesterol and improve carbohydrate metabolism.[99]

IMPACT

Water

343 liters per kg.[100]*

More research is needed to estimate CO_2 emissions and waste disposal aspects of konjac production, since it is still a relatively small industry.

**Based on comparable proxy data for yams*

CULTIVATION[101][102]

Konjac, which is also called Konnyaku potato, Porang, and Devil's Tongue, is cultivated in the warm climatic zones of East and Southeast Asia, from Japan and China to Indonesia. It is a perennial plant that produces a single leaf yearly, but the tuberous bulb or corm that is harvested takes three years to mature.[103][104]

Konjac is grown in deep, fertile, alluvial soils that are slightly acidic. The average yield is 9.07 tonnes per hectare[105] (or 4.53 - 5.44 tonnes per hectare when grown with teak forests within an agroforestry model, as has been done for Indonesian konjac[106][107]) and there is no evidence of GMO cultivation of this crop.

China is the world's leading producer of konjac, where it is distributed mainly in the mountainous and plateau regions south of the Qinling Mountains.[108][109][110]

As konjac production is still a small trade, it is not known how China's production compares with that of the rest of the world.

Special note: There are several edible variations of konjac within the same genus Amorphophallus*, including the elephant foot yam (*Amorphophallus paeoniifolius*). The elephant foot yam is mostly a wild crop, but is cultivated in some areas with the right conditions. It is currently sold in Japanese and Chinese markets.[111]*

TRADE[112]

Konjac has recently gained popularity as an export commodity in Indonesia, due to the high global prices it can command. It is often cultivated as an undercrop in forests. Top import markets include South Korea, China, and Japan.

Estimated pricing is not available for konjac, but export volume, which had historically been around 250 tonnes, is expected to rise to at least 400 tonnes by the end of 2020.

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

Konjac is primarily, though not exclusively, used as a component of foods to add stability or thickness to a formulation.[113] Konjac gum has very high viscosity, giving plant-based meats an elastic gelatinous quality that lends itself particularly well to alternative seafood products.[114] As a result, konjac currently accounts for roughly five percent of raw materials used in plant-based meat production in China.[115]

It is currently an ingredient in Sophie's Kitchen crab cakes, Whole Perfect Foods' seafood stewed meat, and is the primary ingredient in Malaysia-based SuXianZi's Vegetarian Chilli Fish Balls and Hong Kong-based Batata Greens' Vegan Squid Balls. London-based start-up company Ima has also produced plant-based salmon sushi that features konjac as its base.[116]

Konjac or konjac powder is also regularly used to mimic the fatty part of whole muscle plant-based meat products, for example in Whole Perfect Foods' Braised Pork Belly.[117] Konjac is widely recognized as beneficial for people who are looking to lose weight. It has been proven to lower cholesterol and boost metabolism, and as a soluble fiber, konjac can expand by absorbing massive volumes of water, promoting feelings of fullness. In many Asian markets, a key driving factor among consumers who choose to adopt a more plant-based diet is to lose weight, so a plant-based meat product based on or containing konjac has the potential to be very attractive.

Konjac
(CONTINUED)

Potato

CURRENT USES [118] [119]

- Consumed by humans in a myriad of ways, including skin-on or peeled, whole or cut up, and with seasonings or without
- Used to brew alcoholic beverages, such as vodka and akvavit
- Potato starch is used throughout the food industry as a thickener and binder for soups and sauces
- Potatoes considered too small or blemished for market sale are often fed to farmed animals

NUTRITION

Protein content: 2.05%[120]

An economical food, potatoes are a low-cost source of energy starch, Vitamins C and B1, and potassium.[121]

IMPACT

Water	287 liters per kg.[122]
CO_2 emissions	2.9 kg CO_2e per kg.[123]
Waste	Peels are a low-value byproduct of processing, accounting for up to 40 percent of a potato's mass, depending on the peeling method used.[124]

CULTIVATION [125][126]

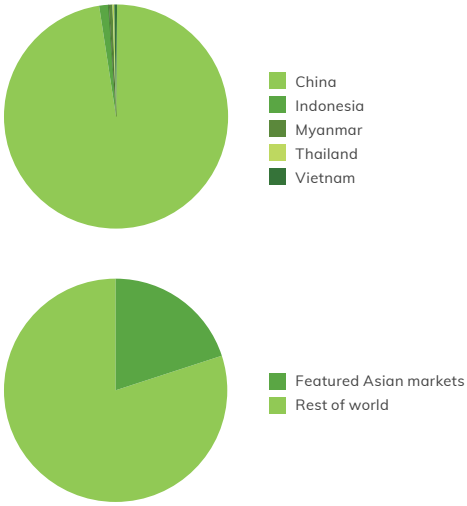
A root vegetable originating from the Americas, the potato is a starchy tuber of the plant *solanum tuberosum* and an essential staple in Europe—the region with the highest per-capita production. China, however, is the world's largest producer of potatoes, generating more than 22 percent of the global total. The Chinese government has prioritized cultivation of potatoes because they require 30 percent less water than rice, wheat, or corn, and provide more calories and vitamins per acre.

Potatoes grow best in cool, well-drained soil that is about 7°C to 13°C, with at least six hours of sunlight per day. They are traditionally grown as a summer crop in hilly areas and a winter crop in tropical and subtropical areas, and can be cultivated up to a height of 3,000 meters above sea level.

The average potato yield is 40.9 tonnes per hectare[127] and based on data provided by White Russet, about 0.06 percent of potatoes planted in the U.S. are genetically modified.[128]

About three-quarters of potatoes are grown outside of our featured Asian countries, but of those produced locally, almost all are in China.[129]

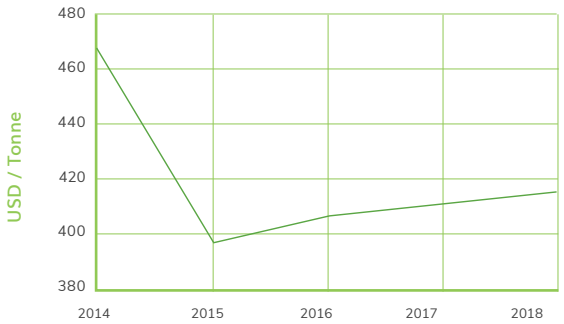
Production Across Featured Asian Markets and in Contrast to the Rest of the World



TRADE [130]

Top exporters: The Netherlands, France, Germany, Egypt, and Canada.
Top importers: Belgium-Luxembourg, the Netherlands, Germany, Spain, and the U.S.

Potato Commodity Pricing (2014-2018)



Average price: $417.96/tonne[131]

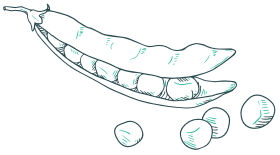
Potato
(CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

Potato protein, fiber, and starch frequently play a supporting role in plant-based meats in the U.S. and Australia, but seldom appear in comparable products created in Asia. Mainstream plant-based meats featuring potato-based ingredients include the Impossible Burger, Quorn's vegan nuggets, and Fry Family Food Co.'s Wood Smoked Breakfast Bangers.

Potatoes are not a particularly high-protein crop, but if their protein is isolated, it can become a useful formulation ingredient.[132] Consumers' universal familiarity with potatoes is also a big plus. When that familiarity is combined with their mild taste, high digestibility, high heat stability, and a complete amino acid profile, potato proteins become a compelling alternative protein choice.[133][134]

Field Pea



CURRENT USES

- Field peas, also known as yellow or dry peas, are widely consumed in soups, Indian dals, purees, and canned products, such as mushy peas
- Unlike conventional green peas, field peas are also used for protein extraction in plant-based meat applications,[135] due in part to their nuttier and comparatively less sweet taste

NUTRITION

Protein content: 24 - 25%[136][137]

Field peas are also low in fat,[138] high in fiber, and a good source of Vitamins C and K.[139]

Note: This nutritional data is based on publicly-available figures for split green peas, which are comparable to those of split yellow peas.

IMPACT[140]

Water	1,979 liters per kg.[141]
CO_2 emissions	0.188 kg CO_2e per kg of crop.[142]
Waste	Stems, leaves, pods, hulls, and other seed residues are left over from cleaning and splitting during processing. Some of this waste can be repurposed for farmed animal feed or biobutanol.[143]

CULTIVATION

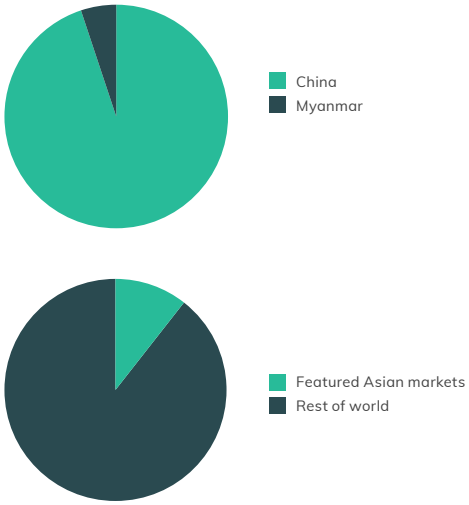
A cool-season vegetable similar to garden and sugar peas, field peas are left to dry on the vine before harvest and are therefore typically harvested in the warm summer months. They contain four to nine seeds and can be harvested once their pods have matured, dried, and turned yellow or brown. They thrive in a range of soil types; however, they grow best in well-drained soils.[144]

Canada is the top global producer of dry peas, where they have been harvested since the early twentieth century.[145]

The average yield of peas is 1.76 tonnes per hectare[146] and there is no known GMO cultivation.

The vast majority of field peas are grown outside of our featured countries, but within those countries, China produces almost all of them.

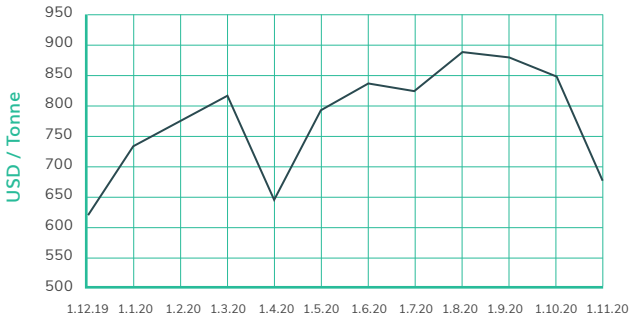
Production Across Featured Asian Markets and in Contrast to the Rest of the World



TRADE[147]

Top exporters: Canada, Russia, and Ukraine.
Top importers: China, India, and the U.S.

Field Pea Commodity Pricing
(Monthly)



Average price: $761.50/tonne[148]

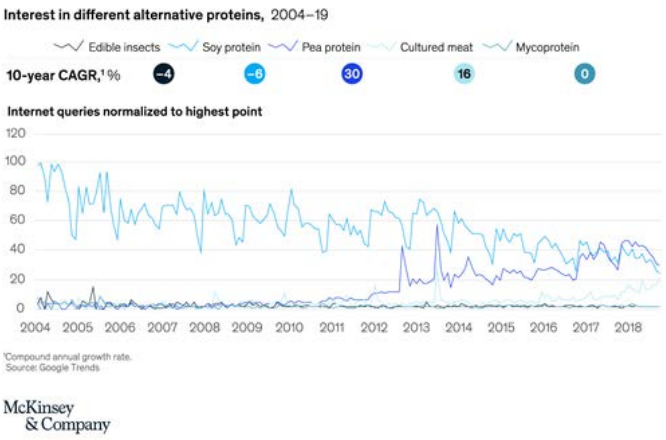
Note: Due to limited global data about field peas specifically, this pricing is based on proxy figures from Hungary and Poland.

Field Pea
(CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

Over the past several years, pea protein has asserted itself in the plant-based meat world, moving from a minor ingredient to a foundational component in many of the most popular 2.0 plant-based meat products, including the Beyond Burger, Beyond Sausage, and Field Roast plant-based nuggets. Even products like Bean Supreme's hemp burger are only six percent hemp protein and 43 percent pea. According to data from market research firm Mintel, pea protein product launches have more than doubled in the past five years leading up to 2020,[149] and research by McKinsey & Company shows that much of that rise is coming at the expense of soy.[150]

Customer interest in soy protein declined over a 15-year period, while interest in pea protein is growing.



[1]Compound annual growth rate.
Source: Google Trends

McKinsey & Company

Pea protein has a thicker mouthfeel and can impart earthy and savory flavors into plant-based meats. While formulating with pea protein can create issues of solubility and off-flavors that need to be masked, it remains a versatile and appealing protein option that also happens to be free of common allergens.[151] Tyler Lorenzen, president of the pea protein company PURIS, which received tens of millions of dollars in investment from agribusiness giant Cargill in 2019,[152] told *Food Navigator* that part of the reason pea-based protein is so popular is that it provides "the bite and bounciness that can mimic what people expect to find in animal meat."[153]

Chickpea

CURRENT USES

- Staple ingredient in Indian, Mediterranean, and Middle Eastern cuisine; consumed in salads, soups, stews, curry, hummus, falafel, and much more
- Farmed animal feed, in part because raw chickpeas have a lower trypsin and chymotrypsin inhibitor content than peas, common beans, and soybeans, leading to fewer digestive problems in non-ruminant animals, like birds and pigs[154]
- Byproducts of chickpea cultivation include low-grade and culled chickpeas, bran, crop residues (husks, straw), and chickpea hay

NUTRITION

Protein content: 20.47%[155]

Chickpeas are also a good natural source of fiber, iron, phosphorus, folic acid, and selenium.[156]

IMPACT

Water	4,177 liters per kg.[157]
CO_2 emissions	0.64 kg CO_2e per kg.[158]

CULTIVATION[159]

Chickpeas, also known as garbanzo beans, are believed to have been first cultivated more than 7,400 years ago, making it one of the earliest cultivated legumes.

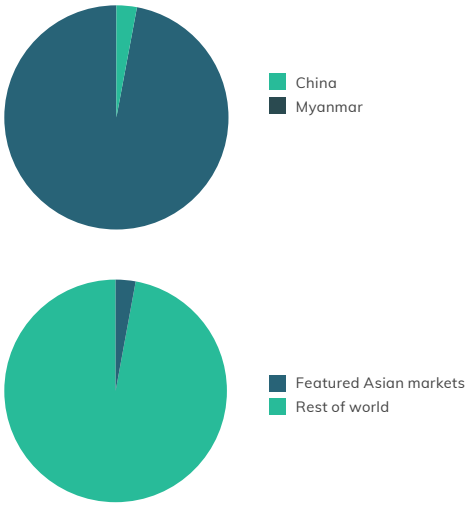
Grown as winter crops in the tropics and as summer or spring crops in temperate environments, chickpeas are associated with nitrogen-fixing bacteria and can be rotated with nitrogen-intensive crops, such as cereals, to improve soil conditions.

Chickpeas grow particularly well in locations with lighter and well-distributed rainfall patterns, and produce better yields in drier conditions. Loose, well-drained soil is ideal for growth, as chickpea roots and stems are vulnerable to waterlogging.

The average chickpea yield is approximately 1.64 tonnes per hectare[160] and there is no known GMO cultivation of this crop.

India is the world's top producer of chickpeas, accounting for approximately 65 percent of global production.[161] Among the Asian nations featured in this report, Myanmar accounts for 97 percent of local production. The vast majority of chickpeas are produced outside of our featured countries.[162]

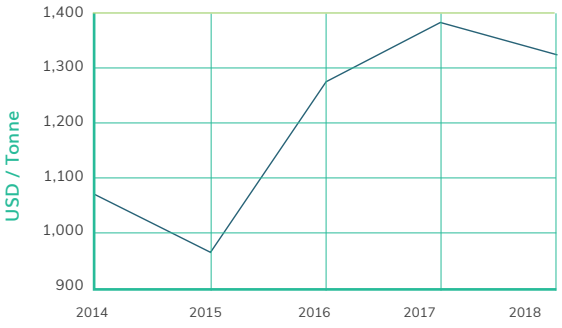
Production Across Featured Asian Markets and in Contrast to the Rest of the World



TRADE[163]

Top exporters: Australia, India, Mexico, Argentina, and Turkey.
Top importers: Pakistan, Bangladesh, Turkey, Algeria, and the United Arab Emirates.

Chickpea Commodity Pricing (2014-2018)



Average price: $1,196.12/tonne[164]

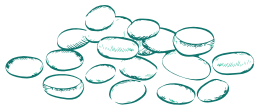
Chickpea (CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

With global production volumes comparable to peas,[165] and a starchy, buttery texture, chickpeas are a flexible protein choice that carry a subtle bean flavor (which is easy to mask) and a healthy dose of important nutrients.[166] Chickpea protein has a taste and mouthfeel that has been compared favorably to cow's milk and yogurt, so despite the fact that the crop is on the higher end of the plant protein cost scale, chickpeas have been named by the trend research analysts at FutureBridge as a logical next step from pea protein.[167]

Chickpea protein is currently featured in a small number of plant-based meat products, including Singapore-based PHUTURE Foods' "PHUTURE Mince" and Bean Supreme's hemp burgers (which are, in fact, 15 percent chickpea). Chickpea flour is more commonly found in alternative proteins, including Gardein's Mini Crispy Crabless Cakes, as well as Linda McCartney's vegetarian meatballs and Southern Style Chicken Fillet Burger.

Lentil



CURRENT USES

- Widely consumed around the globe, particularly in West Asia, Southeast Asia, and Mediterranean regions, where they are soaked, germinated, fried, baked, or the most common method, boiled
- Lentil flour is a byproduct of processing that is used for cooking and baking[168]
- Fed to cattle as a source of protein and energy[169]

NUTRITION

Protein content: 25%[170]

Lentils are an economical source of amino acids and antioxidants. They have also been associated with lowered risk of high cholesterol, cancer, and cardiovascular diseases.[171]

IMPACT

Water	5,874 liters per kg.[172]
CO_2 emissions	0.9 kg CO_2e per kg.[173]
Waste	Lentil crop waste is intentionally left in the soil, as it fixes significant quantities of atmospheric nitrogen and benefits rotated crops.[174]

CULTIVATION

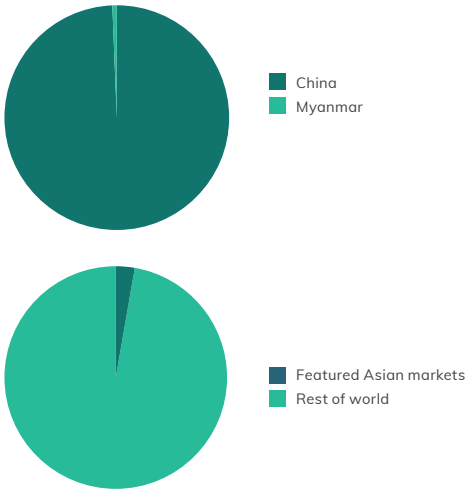
Lentils are an annual legume, best cultivated in cool conditions. They are largely grown in semi-arid locations and thrive in various soil types as long as there is good internal drainage. Excessive drought, high temperatures, and humidity are damaging to yields and seed quality.

Lentils are frequently rotated with other cereal crops, like wheat and barley, to capitalize on lentils' nitrogen-fixing properties.[175][176]

The average lentil yield is approximately one tonne per hectare[177] and there is no evidence of GMO cultivation.

The vast majority of lentils are produced outside of our featured Asian nations, but those that are produced locally are almost exclusively made in China.[178] Canada is the top global producer of lentils, cultivating an astonishing 2,092,136 tonnes in 2018 across more than 5,000 active farms.[179][180]

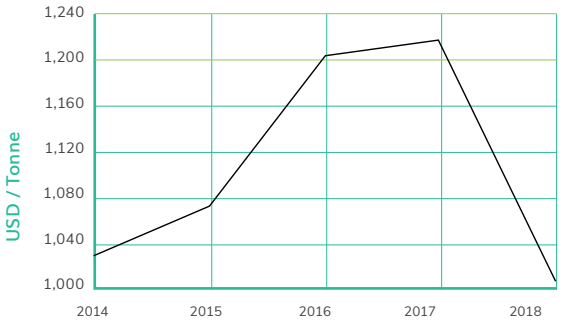
Production Across Featured Asian Markets and in Contrast to the Rest of the World



TRADE[181][182]

Top exporters: Canada, Turkey, Australia, the United Arab Emirates, and the U.S.
Top importers: Bangladesh, Turkey, the United Arab Emirates, India, and Mexico.

Lentil Commodity Pricing (2014-2018)



Average price: $1,110.23/tonne[183]

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

Lentils are a protein-packed economical ingredient that holds large potential for plant-based meat applications. While producers have to be careful to avoid a potentially mushy mouthfeel that can clash with the desired chewier texture,[184] lentils have shown good emulsifying and foaming properties, come in a variety of colors, and have

a naturally earthy, nutty flavor. They are also produced at a large scale that could soon equal that of peas.[185]

Despite their positive attributes, lentils are not currently found in many commercial plant-based meats, with the notable exception being Field Roast's holiday-focused Celebration Roast.

Mung Bean

CURRENT USES[186]

- Staple ingredient in both sweet and savory dishes throughout East Asia, Southeast Asia, and the Indian subcontinent, where they are consumed as whole beans or a paste, as well as made into flour, soups, porridge, snacks, bread, noodles, and even ice cream
- Mung bean starch is extracted from ground mung beans to produce transparent cellophane noodles
- Featured in plant-based egg alternatives, including the JUST Egg[187]
- Used by farmers before or after cereal crops, as a soil improver

NUTRITION

Protein content: 23.86%[188]

Mung beans are also naturally rich in fiber, folate, and antioxidants.[189]

IMPACT[190]

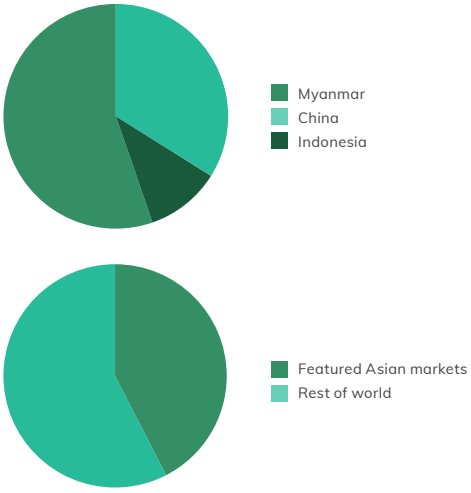
Water	5,053 liters per kg.
CO_2 emissions	2.0 kg CO_2e per kg.[191]
Waste	Mung beans produce very little waste, which makes them cost effective as an ingredient.

CULTIVATION[192][193][194]

Mung beans, also known as green grams, are mainly grown in East Asia, South Asia, and Southeast Asia. They are warm-season annuals that grow upright or on vines, with yellow flowers and fuzzy brown pods. They are often cultivated in a cereal-pulse cropping system, primarily to conserve soil nutrients and utilize the leftover soil moisture, particularly after rice cultivation.

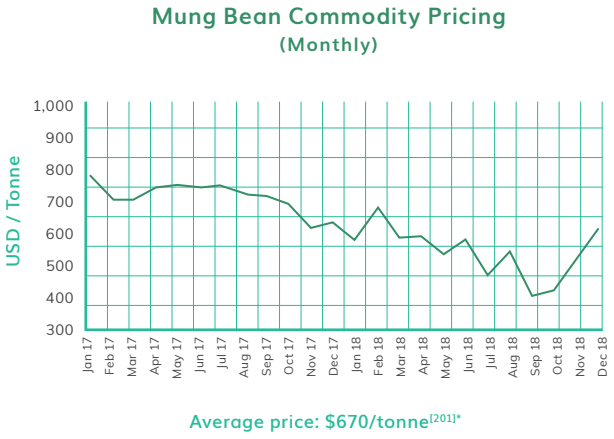
Mung beans do best on fertile, sandy loam soils with good internal drainage. The average yield for mung beans is between 0.34 - 2.24 tonnes per hectare[195] and there is no evidence of GMO cultivation.

Although mung beans can be grown in all the seasons, the majority of cultivation is sown in winter or late winter, particularly in India, which accounts for 60 percent of global production. Among the countries featured in this report, Myanmar accounts for the majority of local cultivation.[196][197][198][199]



TRADE[200]

Top exporters: Myanmar, China, and Australia
Top importers: India, China, and Japan



Average price: $670/tonne[201]*

**Estimate based on average price from 2017 to 2018 across featured countries where data was available. Note that this estimated price is reflective of both green gram (also known as mung bean) and black gram, as they are categorized together in agricultural data.*

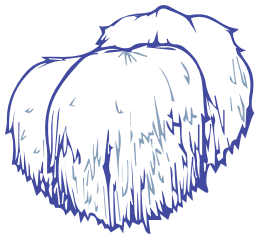
Mung Bean (CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

As a versatile but lesser-known ingredient, mung beans have only recently begun to appear in commercial-scale alternative protein products. One of the best attributes of mung beans is that they take on the flavor of whatever they are cooked in, which translates to high functionality and a clean base for producers to build on.[202] As a cousin of soy, mung beans may carry some allergen risk,[203] and their current cultivation volume trails significantly behind that of other comparable raw ingredients.[204] However, the cultivation that does exist is heavily centered in Asia, teeing up regional start-ups particularly well.

While mung bean protein is not yet a foundational ingredient in any commercial plant-based meats, it does play a minor role in Beyond Meat's burgers and crumbles.

Lion's Mane Mushroom



CURRENT USES[205][206]

- Prepared in Chinese cuisine—including stir fries, cooked in soups, or steeped as tea
- Sold fresh or dried to consumers enticed by the bioactive substances they contain, which have beneficial effects on the body, especially the brain, heart, and gut
- Featured in over-the-counter health supplements, with purported benefits including protection against dementia, reduced symptoms of depression and anxiety, and improved mood and focus

NUTRITION

Protein content: 2.4%,[207] but it rises to 20.8% when based on dry weight.[208]

Notably, lion's mane mushrooms contain all but one (Tryptophan) of the amino acids that are essential for human nutrition.[209]

IMPACT[210]

Water	Only 15 liters per kg of mushrooms.
CO_2 emissions	0.6 kg CO_2e per kg.
Waste	This ingredient does produce 5 kg of substrate material per kg of mushrooms, though the substrate can be used as a compost.

Note: These stats are for mushrooms in general, not specific to lion's mane.

CULTIVATION[211][212]

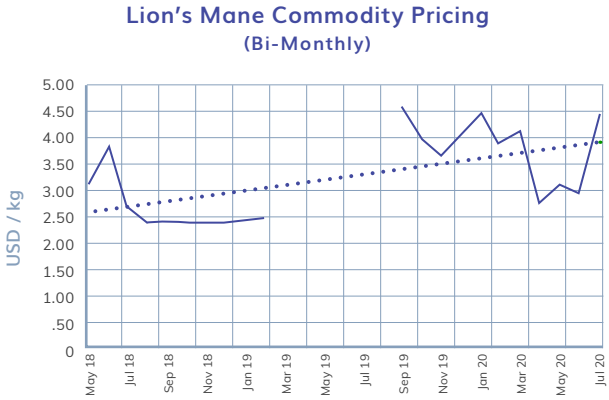
Lion's mane mushroom (*Hericium erinaceus*) is not widely cultivated for commercial purposes, though it is native to North America, Europe, and Asia. It is considered attractive to chefs as a specialty ingredient, due to its reported similarity of flavor and mouthfeel to lobster and chicken.

China is currently the largest global producer of lion's mane mushrooms. As it is native to temperate climates, lion's mane is not suitable for woodland agriculture in Asia. As an alternative crop in the tropics, it is more appropriately grown indoors, usually in a barn of some kind, where the environment can be controlled.

There are two ways of growing the crop: outdoor cultivation involves inoculating freshly felled timber; indoor cultivation involves inoculating bales of straw. Inoculating just two bales of straw per week (104 per year) would result in about 0.45 tonnes of mushroom per year, though it's clear that inside of a building, a multi-level format would enable this to be produced on much less than a hectare. There is no evidence of GMO cultivation for this ingredient.

TRADE

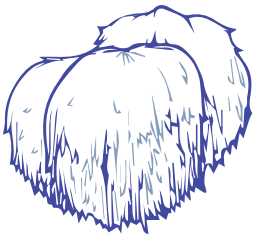
Little information about the import and export of lion's mane mushrooms is available. Reliable pricing is also not readily accessible, but limited data from Chinese wholesalers indicates that the crop sells for roughly $3.22 per kilo, or $3,220 per tonne.



CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT[213]

Currently, lion's mane mushroom is mostly used for health supplements or as an ingredient in traditional Chinese cuisine (not in an alternative protein context). There are some plant-based meats currently featuring the ingredient, but these are not widely available outside of the Chinese market.

Lion's Mane Mushroom



(CONTINUED)

Edible mushrooms have an extensive history in cultures around the world, so while lion's mane in particular is not widely known outside of certain communities, it is not hard to imagine a broad range of consumers being open-minded to an innovative mushroom-based product. Given its inherent meaty texture, lion's mane also has the additional benefit of requiring minimal processing, which is a growing preference among some consumer segments.

Lion's mane mushroom is a premium ingredient as compared to other raw materials featured in this report.

However, its nutritional benefits are well-recognized and the market is already accustomed to how much it costs in other contexts outside of alternative protein. Either using it as a primary ingredient, or incorporating it into a product that features another plant-based protein base, would likely garner interest because of the mushroom's proven and purported health benefits and the attractive textural mouthfeel; enough to demand a higher price point.

Source: Taiwan-based Ruyi's lion mane mushroom meat floss

Source: Taiwan-based VEGUE's marinated lion's mane mushroom

Source: China-based Qishan Foods' plant-based meatballs, made with soy isolate and lion's mane mushroom

Mycoprotein

CURRENT USES[214][215]

- A single-celled protein obtained from the filamentous fungus *Fusarium venenatum* strain PTA-2684, mycoprotein is grown by fermentation; when it has a similar appearance to bread dough, and is composed of a mass of very fine fibers
- Quorn is currently the only brand that is offering meat-alternative products containing mycoprotein—including crispy nuggets, burger patties, deli slices, vegan fillets, and garlic and mushroom escalopes

NUTRITION

Protein content: 17%*[216]

Mycoprotein also contains essential amino acids and fiber, but is low in fat, making it a desirable food source for consumers trying to limit their fat intake while maintaining a high-protein diet.[217]

**In optimal conditions, the* F.venenatum *biomass is able to achieve 42 percent protein content.*

IMPACT[218]

Water	500 liters per kg.
CO_2 emissions	1.14 kg CO_2e per kg.

Additional notes: According to Quorn, cultivating mycoprotein uses 90 percent less land than growing animal protein. The company is also seeking ways to repurpose some of the waste elements, such as the "broth" left over after fermentation.[219] These materials could have some potential market value and would further reduce the environmental impact of mycoprotein production.

CULTIVATION[220][221]

Mycoprotein fungus is grown in vats using glucose syrup as its food. A fermentation vat is filled with the growth medium and then inoculated with the fungal spores. The *F. venenatum* culture respires aerobically, so for it to grow at an optimum rate, it is supplied with oxygen, and carbon dioxide is drawn from the vat. To make protein, nitrogen (in the form of ammonia) is added, and vitamins and minerals are needed to support growth. The fungus can double its mass every five hours. Once the mycoprotein is separated and purified, it is a pale yellow solid with a faint taste of mushrooms, to which different flavors and tastes are added.

As Quorn is currently the only company mass-producing mycoprotein, the U.K. is the leading producer. The average yield per hectare is incalculable, as the ingredient is grown in vats. There is no evidence of GMO cultivation of mycoprotein.

Quorn products are available in Europe, North America, and Asia. Since the company's patents have now expired, a small number of other companies have started to produce mycoprotein products.

TRADE

As Quorn supplies only itself, it is not possible to accurately determine a commodity price estimate. There are no known mycoprotein producers in Asia.

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT[222]

Fermentation has quickly established itself as an important pillar of alternative protein production, and mycoprotein is among its biggest success stories to date. Traditional fermentation uses intact live microorganisms to modulate and process plant-derived ingredients, such as fermenting soybeans into tempeh. By contrast, the process of creating mycoprotein—known as biomass fermentation—leverages the fast growth and high protein content of microorganisms to efficiently produce large quantities of protein. The microbial biomass itself serves as an ingredient with the cells intact or minimally processed.

Producing protein through this method carries many advantages over traditional crop agriculture. For example, while crop plants typically require growing seasons of weeks or months, the doubling time of most microorganisms is hours or even minutes. Fermentation capitalizes on the fundamental biological property of exponential growth, meaning that every growth cycle can double the available biomass. When performed at the scale of hundreds of thousands of liters, these processes generate tens of tonnes of biomass every hour.

Quorn was the first company to commercialize microbial biomass fermentation for use in plant-based meat products, but new market entrants are also recognizing the industry's potential. Innovators are exploring unconventional species, as well as new feedstocks and

Mycoprotein
(CONTINUED)

bioprocess designs, to further improve the efficiency, sustainability, and economy of the process while pursuing consumer-relevant attributes, such as taste and texture.

The health benefits of mycoprotein have faced skepticism in some quarters. In response to concerns about allergies and adverse reactions from consumers, The Center for Science in the Public Interest (CSPI) filed a series of complaints with the Food and Drug Administration in the U.S., though the agency declined to take regulatory action. According to the CSPI, "in 2017, as part of a legal settlement, [Quorn] agreed to a package warning that 'Mycoprotein is a mold (member of the fungi family). There have been rare cases of allergic reactions to products that contain mycoprotein.'"[223] In response to such concerns, Quorn has said that "one person in 146,000 will have an adverse reaction to Quorn"—a reaction rate smaller than that of soy, which is about one in 350.[224]

Mycoprotein plays a central role in all of Quorn's current plant-based meat products, from vegan nuggets to their Smoky Ham Free Slices, though the percentage of a dish composed of mycoprotein can vary significantly. The company's sliced pepperoni, for example, is 53 percent mycoprotein, but their Ultimate Burger features only 10 percent.[225] The rest of those products are composed of other plant-based ingredients, including pea protein, wheat starch, potato protein, and sunflower oil. This fact further illustrates the compatibility of many of the featured raw materials from this report, which can either be elevated on their own, or combined into creative new formulations to stand out in an increasingly competitive space.

Wheat

CURRENT USES[226][227]

- One of the world's oldest and most important crops, as well as a leading source of carbohydrates and protein, it is used to make bread, muffins, noodles, biscuits, cereal bars, crackers, cakes, and much more
- Used in the creation of wheat starch, paste, alcohol, gluten, and other crop derivatives
- Farmed animal feed, either fed in association with other ingredients or mixed and processed into pellets

NUTRITION

Protein content: 13%[228]

Wheat is also a good source of dietary fiber, phytochemicals, and vitamins (notably B vitamins).[229]

IMPACT

Water	1,827 liters per kg.[230]
CO_2 emissions	1.0 kg CO_2e per kg.[231]
Waste	Wheat straw is a byproduct that is often left to rot on farms. Researchers are currently developing technologies to put straws to use as building blocks for greener biochemicals.[232]

CULTIVATION[233][234]

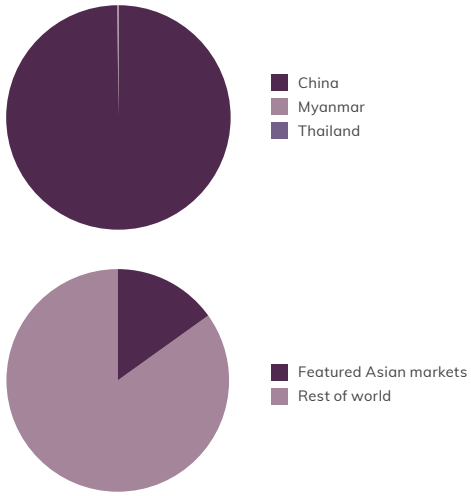
Wheat can easily be grown, handled, and stored. It yields a large amount of food for its weight and keeps so well that it can be shipped worldwide and stored for years.

Widely adaptable to a range of climates and soils, wheat grows best in temperate conditions with rainfall between 30 cm and 90 cm. The two major kinds of wheat are winter wheat and spring wheat.

The average wheat yield is approximately 4.49 tonnes per hectare[235][236] and there are currently no commercially-approved GMO varieties.

The top global producer of wheat is China, with over 133 million tonnes in 2019.[237][238] Still, cultivation within our featured regions remains a minority of global production.[239]

Production Across Featured Asian Markets and in Contrast to the Rest of the World

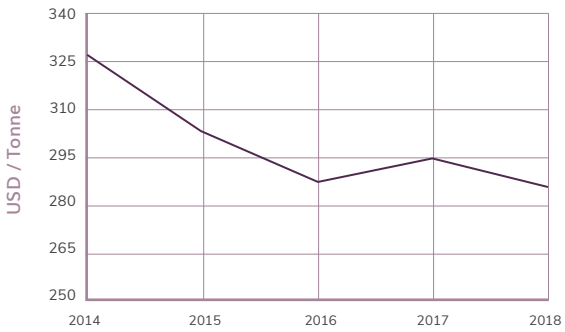


TRADE[240] [241]

Wheat is traded on an enormous scale, amounting to $41 billion in 2018 alone.

Top exporters: Russia, Canada, the U.S., France, and Australia.
Top importers: Egypt, Indonesia, Algeria, Italy, and Nigeria.

Wheat Commodity Pricing (2014-2018)



Average price: $289.47/tonne[242]

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

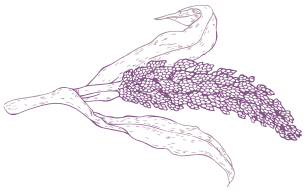
As a highly versatile protein source, wheat has been a staple ingredient of many plant-based meats for decades. In fact, wheat accounts for roughly 16 percent of all raw materials used in plant-based meat production in China.[243]

Wheat
(CONTINUED)

The chewiness of wheat gluten's texture naturally mimics that of conventional meat, but without the level of fat commonly associated with animal proteins.[244] Wheat also combines seamlessly with other types of plant-based proteins. However, it is avoided by people choosing to eat gluten-free, which is a potentially limiting factor.[245]

Wheat gluten and flour remain very common base ingredients in both traditional and modern plant-based meats, including Gardein's Beefless Burger, Tofurky's Plant-Based Chick'n, and Field Roast's FieldBurger.

Millet



CURRENT USES[246][247]

- A major food source in arid and semi-arid regions of the world and a feature in the traditional cuisine of many others
- Millet flour is often used to make local bread, but other products include millet porridge, stews, and even alcoholic beverages
- Fed to cattle to reduce overgrazing[248]

Note: Millet is an umbrella term for a number of small-seeded annual grasses that are cultivated as grain crops. For the purposes of this report, we focused primarily on pearl millet, which is the most widely cultivated variety and accounts for almost half of global millet production.[249]

NUTRITION

Protein content: 10 - 11.02%[250][251]

Millet is also rich in iron, magnesium, phosphorus, potassium, calcium, amino acids, B-complex vitamins, and fiber.[252]

IMPACT[253]

Water	4,478 liters of water per kg.[254]
CO_2 emissions	1.8 kg CO_2e per kg.

One major advantage of millet is that it is drought- and pest-resistant and able to survive in harsh environments with less fertile soil.

CULTIVATION[255][256]

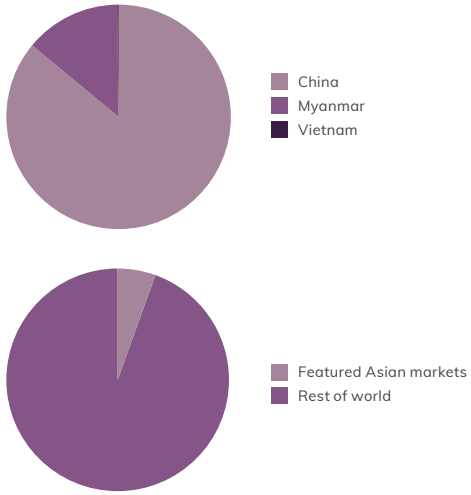
Millets are generally small-grained, annual, warm-weather cereals that thrive in warm temperatures. Optimal soil temperatures for germination range from 20°C to 30°C and well-drained loamy soils are preferred. Despite being highly tolerant of drought and other extreme weather conditions, millet does not fare well in waterlogged soils.

Millet is usually grown as a subsistence crop for local consumption and is most common in regions where food and nutritional security are major challenges. In developing countries, millet crops are usually grown without irrigation or chemical fertilizer, on light, well-drained soils that are poor in organic matter content.

India is the top producer of millet in the world, with more than 10,900,000 tonnes in 2017.[257] The average yield for millet is 0.78 tonnes per hectare[258] and there is no evidence of GMO cultivation for this crop.

Among the countries featured in this report, most millet cultivation takes place in China. Overall though, the vast majority of millet production currently takes place outside of our featured region.[259]

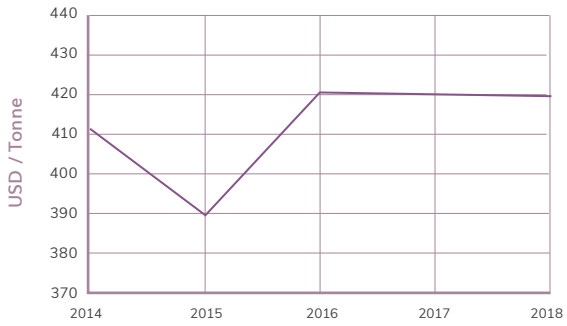
Production Across Featured Asian Markets and in Contrast to the Rest of the World



TRADE[260][261]

Top exporters: The U.S., India, France, China, and Russia.
Top importers: Indonesia, Germany, Belgium-Luxembourg, the U.K., and the Netherlands.

Millet Commodity Pricing (2014-2018)



Average price: $411.96/tonne[262]

Millet
(CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

Despite being less well-known in developed countries than wheat or rice, farmers in ancient China were growing millets ten thousand years ago, and the resilient crop still carries big potential for plant-based meat production today.[263] Millets come in a variety of colors, from white and gray to yellow and red, and can have either a creamy or fluffy consistency depending on preparation.[264] As a naturally gluten-free ingredient, it holds appeal as either a base ingredient or a nutrient-dense addition to other plant-based proteins. However, industrial methods of processing millets are not as developed as they are for wheat and other common raw materials, potentially slowing its scalability and current usefulness for protein extraction.[265]

Millet is not widely used in current plant-based meat dishes, and where it is, it is usually in the form of millet flour. Products that feature millet flour include Gardein's Seven Grain Crispy Tenders and Ultimate Beefless Burger.

Rice

CURRENT USES[266] [267] [268] [269]

- Arguably the most important food crop in the world, accounting for more than one-fifth of the calories consumed by humans, it is central to the food security of over half of the world's population, especially in Asia, Latin America, and Africa; crop varieties and culinary preparations vary regionally
- Often eaten alone or processed into side dishes, breakfast cereals, and alcoholic beverages
- Broken rice is used in brewing, distilling, and in the manufacture of starch and rice flour
- Rice byproducts, including finely-powdered bran and rice polish (a starch resulting from polishing) are sometimes used as feed for farmed animals
- Rice bran oil has both food and industrial applications

NUTRITION

Protein content: 6.61%[270]

Rice is also a reliable source of magnesium, phosphorus, manganese, iron, folic acid, and other important nutrients.[271]

IMPACT

Water	1,673 liters per kg.[272]
CO_2 emissions	3.6 kg CO_2e per kg of rice.[273]
Waste	For every tonne of rice produced, about a tonne of straw is grown. 770 million tonnes of rice are produced each year, which means that there is much more straw than can be repurposed as farmed-animal feed or fertilizer. Removing the straw is labor- and cost-intensive, which drives farmers to burn millions of tonnes of straw in rice fields each year.[274]

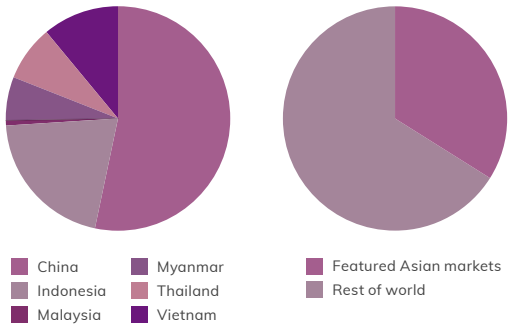
CULTIVATION[275] [276]

Rice is grown on submerged areas in coastal plains, deltas, or river basins of tropical, semi-tropical, or temperate regions. In hilly regions, rice farms are terraced to allow paddies to be flooded at various elevations. Depending on irrigation, quality of soil, and climate, rice yields may vary significantly. Sufficient irrigation is, however, a key requirement for productive land use. Following harvest, the rice grain is dried, stored, milled if necessary, processed, and packed before being exported to global markets.

The average rice yield is approximately 4.68 tonnes per hectare[277] and there is no evidence of GMO cultivation.

The majority of rice cultivation takes place in Asia, including significant production systems in Vietnam, Thailand, Myanmar, and Indonesia, but China is the world's largest producer, producing 212.13 million tonnes in 2018 and accounting for 30 percent of all rice cultivation globally.[278] [279]

Production Across Featured Asian Markets and in Contrast to the Rest of the World

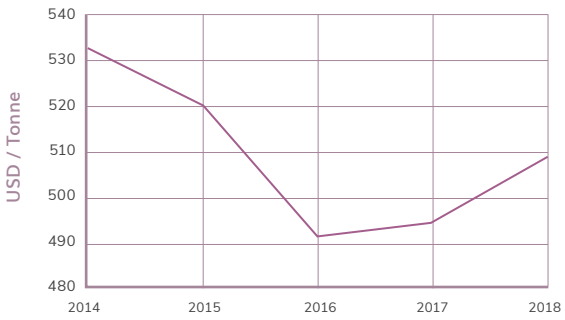


TRADE[280] [281]

The third-most produced agricultural commodity, global trade for rice amounted to $24.5 billion in 2018 alone.[282] [283]

Top exporters: India, Thailand, Vietnam, Pakistan, and the U.S.
Top importers: China, Iran, Saudi Arabia, Benin, and Indonesia.

Rice Commodity Pricing (2014-2018)



Average price: $509.44/tonne[284]

Rice (CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

One of the best arguments in favor of using rice to create plant-based meat is its sheer abundance. As a staple crop in every one of our featured countries, rice is already locally available at an affordable price, and manufacturing plant-based proteins in close proximity to the raw material source can help cut costs, providing a competitive advantage for producers.

Rice starch is a useful ingredient that delivers a fatty or creamy mouthfeel, while rice bran protein concentrates can be used in place of soy protein isolates in a formulation. Rice products are highly digestible and hypo-allergenic, making them easy to incorporate into plant-based meats of all varieties.

As a comparatively lower-protein crop, rice is often combined with pea, chickpea, or soy to balance out its nutritional profile when featured in current plant-based meats. Products that include rice protein, flakes, or flour include Omnipork, Sophie's Kitchen's plant-based shrimp, and Fry Family Food Co.'s Golden Crispy Fish-Style Fillets.

Jackfruit

CURRENT USES[285][286]

- A common ingredient in Indian curries and custards, and shipped internationally, canned, chilled, or frozen
- Jackfruit's fibrous texture has been likened to pulled pork and soaks up whatever seasoning is added, making it a popular vegetarian alternative—particularly for consumers seeking products that are "less processed"

NUTRITION

Protein content: 1.43 - 1.72%[287] [288]

While relatively low in protein, jackfruit is high in fiber and also contains many other nutrients, including Vitamin C, niacin, riboflavin, potassium, magnesium, manganese, and folic acid. It is one of the rare fruits that is rich in B-complex vitamins.[289][290]

IMPACT[291]

Water	967 liters per kg.[292]*
CO_2 emissions	0.9 kg CO_2e per kg.

**Note: Jackfruit does not require irrigation but generally only grows in tropical and subtropical regions where high levels of precipitation are common.*

CULTIVATION[293] [294]

Unlike other fruit-bearing trees, jackfruit trees are often not grown in orchards. In native countries, they are roadside flora, meant to provide shade or reduce wind, and growing jackfruit as an intercrop or shade crop can help promote biological diversity. They also grow in forests and are sometimes planted in woodlots. Jackfruit trees require very few resources to flourish, making them an important source of nutrition, timber, and animal fodder in local food systems. However, despite its usefulness, most jackfruit goes to waste in a given year and there is a huge amount of bioavailability growing naturally.[295]

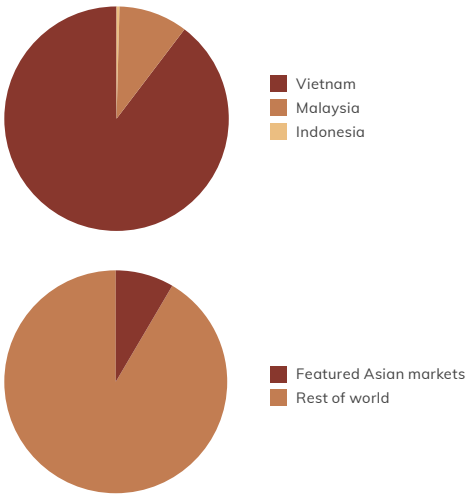
Jackfruit trees prefer full sun and well-drained soil, although the soil may be sandy, loamy, or rocky, and it will tolerate all of these conditions. It requires minimal irrigation but will not tolerate soaking roots. It grows best in humid tropical and near-tropical climates, as it is susceptible to frost and drought.

Cultivating jackfruit is often a long-term economic commitment for a farmer, as trees are unlikely to bear fruit in the first several years.[296] [297] The best yielding trees are 21 to 40 years old, and the average yield size is approximately 38.4 tonnes per hectare.[298] [299] There is no evidence of GMO cultivation of jackfruit.

India is the leading jackfruit producer, generating more than 1.8 million tonnes per year.[300] Within our featured Asian countries, Vietnam is the largest producer (nearly 90 percent), but the majority of jackfruit is currently grown outside of the featured region.[301] [302] [303] [304]

Note: While Thailand is also a significant producer of jackfruit, statistics for the crop are not available through Thailand's Office of Agricultural Economics, so the country is not represented in the below graphs.

Production Across Featured Asian Markets and in Contrast to the Rest of the World



TRADE

Commodity pricing is difficult to obtain, but farm gate prices range between $380 and $720 per tonne. In Vietnam, there have been reports of producers successfully commanding double this price, which has driven many local farmers to increase their emphasis on jackfruit.[305] In 2018, global exports were roughly 500 tonnes.[306] [307]

Jackfruit
(CONTINUED)

CHALLENGES AND HIGHLIGHTS FOR PLANT-BASED MEAT

The supply chain around jackfruit is fragmented and as a crop it is a big and laborious fruit to work with.[308] Obtaining a truly functional meat-like texture from jackfruit can be quite difficult, but companies like Singapore-based Karana (whose jackfruit dumplings are shown to the right) have managed to achieve this after extensive investment in innovative R&D.

Unlike many of our featured ingredients, jackfruit is most commonly consumed as a whole product, rather than one of many raw materials in a plant-based meat formulation. Bean Supreme's marinated chili and lime jackfruit—which is designed as an alternative to shredded pork—is an example of such an application. This usage works particularly well because the fruit has a natural slightly sweet flavor that can be easily overridden when braised with savory sauces.[309] However, given jackfruit's relatively low protein content, producers would be wise to explore ways to combine it with another raw material that could deliver a stronger protein punch.

Jackfruit dumplings from Karana, used with permission. Karana's products are currently rolling out through food service channels in Singapore.

FEATURED COUNTRY PROFILES

The seven countries we selected were chosen based on the availability of raw materials, existing infrastructure and manufacturing power, capacity to invest in scientific research or business development, influence over the regional and global food trade, and potential to shorten the distance between growers, processors, producers, distributors, and customers.

Some, like Myanmar, are developing agricultural economies that are seeking out new opportunities to modernize. Others are middle-income countries—like Vietnam, Thailand, and Indonesia—that are at a transformational stage, taking on a larger influence in supply chains and trade. No matter how industrialized a country is, there are raw materials that each can capitalize on right now to feed the growing regional demand for plant-based meat.

COUNTRIES

- China
- Singapore
- Thailand
- Vietnam
- Malaysia
- Indonesia
- Myanmar

China

CLIMATE AND GEOGRAPHY[310] [311]

China is a huge country with a great variety of climates. Winter is freezing cold in the north, in the mountains, and the plateaus, while it is mild in the south. Summer is hot everywhere, except in highlands and high mountains.

The nation's complex and varied climate results in a great variety of temperature belts, and dry and moist zones. There is little agriculture in the vast, western desert areas, where rainfall is scarce. Because of its varied topography and terrain conditions, China's climate differs from region to region. For instance, there is a long winter but no summer in the northernmost province, Heilongjiang, while there is a long summer but no winter in the southernmost, Hainan.

Temperature-wise, the nation can be sectioned from south to north into equatorial, tropical, subtropical, warm-temperate, temperate, and cold-temperate zones. In terms of moisture, it can be sectioned from southeast to northwest into humid (32 percent of land area), semi-humid (15 percent), semi-arid (22 percent), and arid zones (31 percent).

AGRICULTURAL CONTEXT

China is both the world's largest producer and consumer of agricultural produce.[312] The national government has also made a political decision to shift towards larger-scale farms, which—based on their track record of effectively achieving renewable and solar energy goals—is likely to be successful.[313]

As domestic agricultural industries have expanded, new businesses have emerged to service smaller-scale professional farmer operations, such as ploughing and threshing. Farms are also now using combine harvesters and drones for surveying and spraying.[314] China is in the vanguard of this kind of technological advancement within Asia, though it is also occurring on a smaller scale in other countries. The Chinese Academy of Agricultural Sciences has also expressed particular interest in crop diversification, though the country struggles with poorly-informed smallholder farmers.[315] This could potentially be improved by increased market information sharing, thus allowing farmers to make more educated crop decisions.

China is also battling public perception concerns, as their food manufacturing is often associated with lots of pesticides or food-safety concerns. Chinese agriculture is suffering twin challenges of groundwater depletion and groundwater pollution.[316] [317] [318] [319] 10 percent of farmland is polluted with heavy metals.[320] It has been speculated that it is because of the water shortages and pollution, as well as the agricultural sector's broader lack of awareness of pollution risks, that crop yields are lower in China than other markets.[321] Because of concerns over contamination and food safety, many U.S.-based plant-based protein manufacturers have indicated that they are wary of sourcing their plant-based protein ingredients from China.[322] In response to such concerns, direct command and control policies, such as standards and rules regulating agricultural pollution, have been gradually introduced by the Ministry of Ecology and Environment.

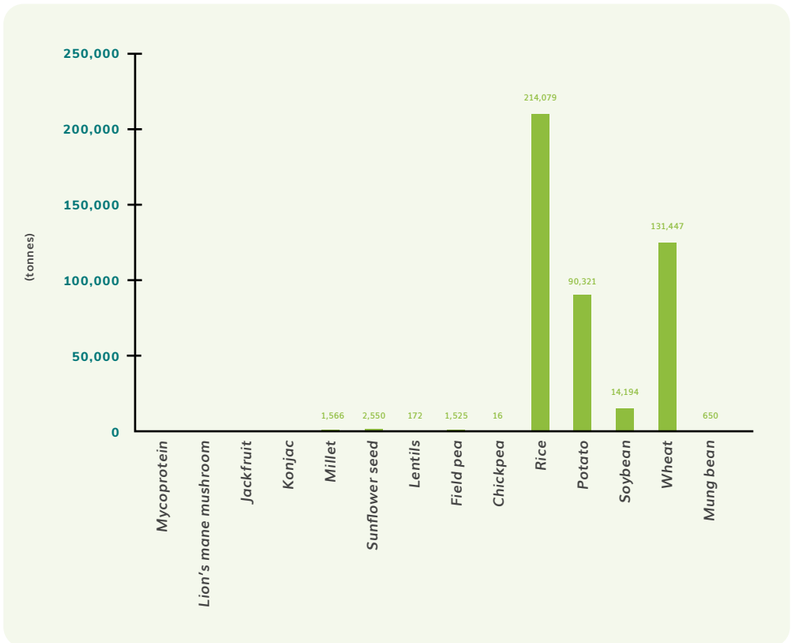
To further address such concerns, the country has developed a Green Food program, where produce is certified for low-pesticide input; this has been articulated as Green Food Grade A and Grade AA. The Green Food AA standard has been aligned with international standards for organic farming (established by The International Federation of Organic Agriculture Movements, or IFOAM) and has formed the basis of the rapid expansion of organic agriculture in China.[323]

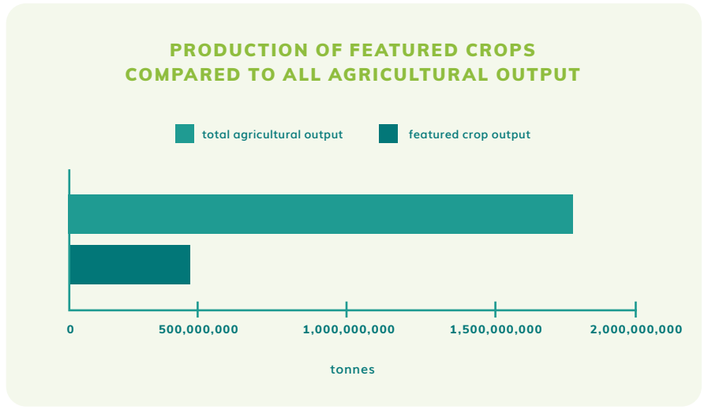
China has also recently experienced market shocks on both the supply and demand side. An outbreak of African swine fever resulted in the culling of millions of animals, which reduced demand for animal feed. The on-off trade war with the U.S. has also led to a temporary shift of soybean supplies to Brazil and other source nations. All imports and exports are controlled through government-owned corporations.[324]

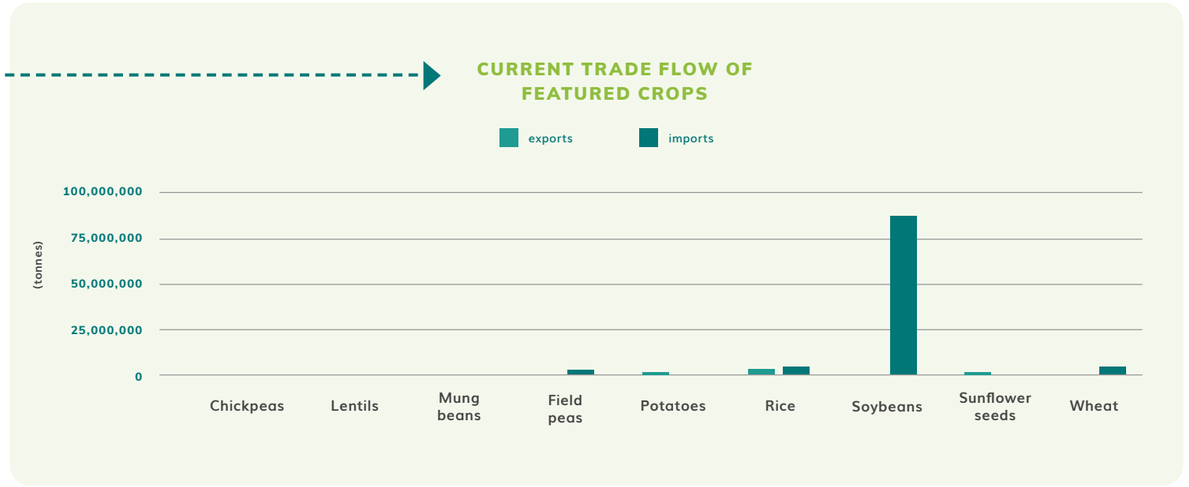
GMO stance: Licenses to import genetically modified (GM) crops have been granted for cotton, soybean, corn, sugar beet, and rapeseed. Imported agricultural GM crops are only approved for processing as raw materials and are not allowed to be grown domestically.[325] In 2011, imported GM soybeans constituted two-thirds of soybeans consumed domestically.[326] Along with corn, they have been used as feedstock for animals.[327] As to domestic cultivation, China has approved GM crops for cotton, corn, papaya, petunia, sweet pepper, tomato, and rice. In January 2020, China issued biosafety certificates for three new GM soybean and corn crop varieties, adding these to the list. Approval means that crops have been found to be safe, but still require clearance for production and commercialization. This last step for corn, rice, and soybean has been hindered by a lack of verification process and it is unclear how long this will take to resolve.[328] [329] [330] Meanwhile, cotton and papaya have been commercially grown since 1997 and 2006, respectively.[331] Foods that contain or use genetically modified ingredients during production must be labeled as GM.[332]

PRODUCTION OF FEATURED CROPS

Thanks to its diverse landscapes, China currently produces large volumes of several of our featured ingredients, including rice, wheat, and potatoes. And yet, cultivation of protein-rich pulses and grains, for either domestic consumption or export, continues to lag behind.[333] [334] [335]







CROPPORTUNITIES

RISKS

- China is a world unto itself with many unique driving forces and dynamics, leading many incoming companies to fail by forgetting to take domestic consumer preferences into account. There has been a sizable class shift over the past few decades, and the country is far more diverse than it once was.
- Intellectual property (IP) rights have historically been a difficult area, though recent reports suggest that this is improving.
- Operational costs are getting more expensive.

INCENTIVES[336][337]

- With scarce arable land and a large population, the pressure of food security is pressing.[338] This also presents an opportunity for those looking to produce resource-efficient alternative proteins.
- China offers a string of measures to support the development of agriculture and ecological protection. For example, China plans to accelerate the spread of advanced farming technologies by offering government subsidies to replace aged and highly polluting agricultural equipment, including tractors, combine harvesters, paddy transplanters, and threshers across the country.[339] [340]
- In 2008, China eliminated preferential tax rates for foreign-invested enterprises (FIEs) through the Enterprise Income Tax Law (EITL). However, the measure kept tax incentives for FIEs and domestic companies investing in agriculture, including growing vegetables, grains, potatoes, oil plants, beans, fruits, nuts, or new varieties of agricultural products. Additionally, China offers value-added tax (VAT) exemptions and reductions to FIEs and domestic companies investing in crop production.[341]

Millet and **lentil**, being less thirsty crops, would be sensible options for China, given its water scarcity; millet, in particular, could open up more arid regions to agriculture.

Lion's mane mushroom could also be expanded, as it doesn't require typical arable land and there is already a market awareness in China of the health benefits of this specialty mushroom with a naturally meat-like texture.

Lastly, but perhaps most notably for this report, China is a major exporter of **processed protein**. As of 2019, China accounted for 55 percent of the global soy protein isolate and 44 percent of the global soy protein concentrate trade. As of 2017, there were seven pea producers in China with a total processing capacity of 67,453 tonnes per year, rising to 146,313 tonnes per year by the end of 2019, according to expansion plans. Nearly all of the pea protein processed in China is raw material intended for export.[342] Analysis of General Administration of Customs China (GACC) records from 2020 indicates that the largest recipient nations of China's exported soy protein isolate are Russia, the Philippines, Japan, and the U.S.[343]

Singapore

CLIMATE AND GEOGRAPHY[344]

A small, island city-state, 128 km from the equator. Tropical climate, with uniformly high temperatures and humidity year-round. Rainfall averages 2,165.9 mm across 167 days of the year. No distinct wet or dry season.

AGRICULTURAL CONTEXT[345]

Singapore's stand-out factor is the city-state's governmental commitment to supporting agricultural innovation, and particularly the expansion of alternative protein and vertical farming (which increases land efficiency and protects crops from unpredictable weather patterns). The country has made a dynamic shift towards the development and use of climate-resilient, innovative, and sustainable technologies, as well as new biotech-based foods and ingredients. The country's future-ready food safety system also makes for efficient approvals of new ingredients.

While Singapore has no practical quantity of land that could be used to scale up crops to a large level, it does have a skilled workforce and, as one of the world's major financial hubs, has access to capital. Currently, a staggering 90 percent of the food consumed in Singapore is imported, but through investment and innovation, the country is aiming to increase food self-sufficiency to 30 percent by 2030.

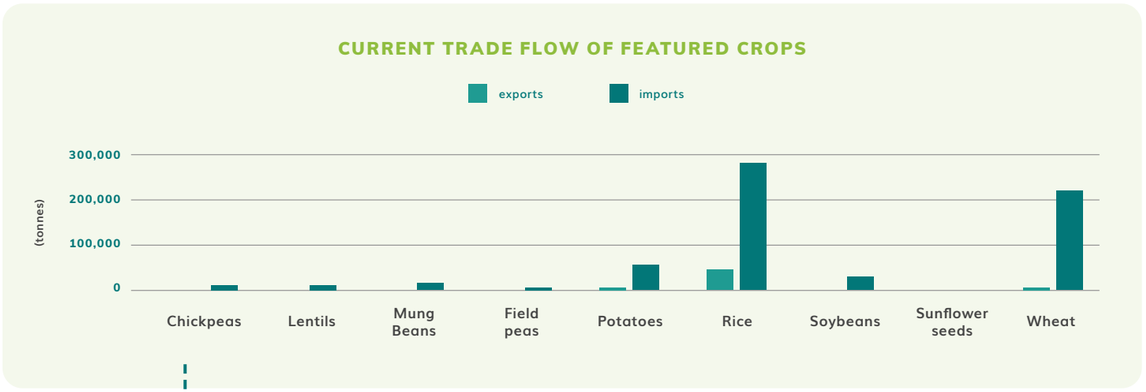
Singapore currently produces none of the crops featured in this report,[346] but it has drawn a lot of interest from start-ups and established multinational brands that look at food production through a nontraditional lens.

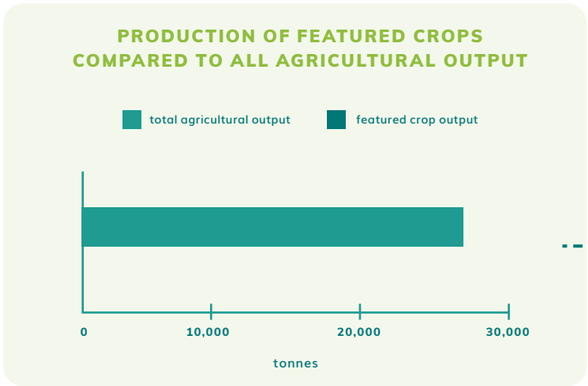
GMO stance: Before releasing any agriculture-related GMOs (genetically modified organisms) into Singapore, the proponent is required to submit a proposal to the Genetic Modification Advisory Committee. The proposal will then be reviewed and approved or rejected. Imports of food with GM-derived components are assessed to be safe based on the Agri-Food and Veterinary Authority's standards. There are not currently any pieces of legislation or guidelines regarding labeling, but GM foods have to meet standard food labeling requirements to facilitate tracing and recall. As of 8 April 2020, approved GM food ingredients include alfalfa, canola, cotton, corn, potato, soybean, and sugar beet.[347][348][349]

CURRENT TRADE FLOW OF FEATURED CROPS[350]

Note: As a regional shipping hub, Singapore also reships some imports, which is why exports far exceed domestic production.

Singapore currently imports many of our featured ingredients, including large volumes of rice, wheat, potatoes, and other staple crops, but is working to pivot to more locally-produced ingredients and alternative proteins.





RISKS

- Expensive real estate and high labor costs, which makes manufacturing domestically a challenge for start-ups that don't rely heavily on automation.
- Little arable land for traditional agriculture and heavy dependence on imports.

INCENTIVES

- According to the risk consultancy firm, PERC, Singapore enjoys the lowest political risk in Asia.[351] It also scores highly on ease of business and intellectual property (IP) protection, which are important factors for tech-forward food companies.[352]
- The largest commodity trading hub in Asia, which offers opportunities for partnership with companies sourcing raw materials. It is also a base for many global agri-food accelerators and financing firms.
- Ecosystem of more than 850 food manufacturers and a regional R&D and innovation base for major global brands, including Nestlé, Mead Johnson, and Bühler.
- A USD $107 million Singapore Food Story R&D Programme was initiated by the Singapore Food Agency (SFA) and the Agency for Science, Technology and Research (A*STAR) in 2019 to support the development of public research capabilities in the development and use of productive, climate-resilient, innovative, and sustainable technologies for agriculture and aquaculture.[353]
- Under FoodInnovate—a multi-agency government initiative—Enterprise Singapore collaborates with the Agency for Science, Technology and Research (A*STAR), Economic Development Board (EDB), Intellectual Property Intermediary (IPI), JTC Corporation (JTC), and the Singapore Food Agency (SFA) to bring a suite of resources to Singaporean food companies, enabling them to create and commercialize food products and access larger markets.[354]
- High interest in vertical farming of raw materials.[355]

CROPPORTUNITIES

The tech-forward nature of Singapore's urban ecosystem lends itself to investment in low land-use protein sources that could also assist national food-security efforts, such as **mycoprotein**. While imported products featuring mycoprotein are sold in Singapore, there are no local mycoprotein producers in Asia and perhaps no more than four producers in the world. As an ingredient that is grown in vats rather than fields, traditional agricultural land and labor needs are far less important than the availability of advanced R&D facilities and strong IP protection.

Another logical option for the "Lion City" would be **lion's mane mushroom**. As a crop that can be stacked vertically, mushrooms can maximize the value of any land footprint and allow companies to seize commercial opportunities without ever leaving an urban setting.

Lion's mane mushroom is currently viewed as a premium product, due to its known and theorized health benefits. However, it would have to be produced in larger quantities to bring the price down significantly.

> **"Key to [mycoprotein producer] Quorn's success was a lot of support from the government and given this is effectively a product made in a lab, there is reliance on the availability of technology and R&D facilities. In our list of countries, the strongest candidate for government and R&D support is Singapore—which is reflected by Monde Nissin's presence in Singapore—because it is able to provide a strong ecosystem."**
>
> ANDY KUSUMO, Director of Science and Technology, Monde Nissin/Quorn[356]

Bühler and Givaudan opens plant-based innovation centre in Singapore

Feb 13, 2020

Ian Robert, CTO of Bühler.

Bühler, a food technology provider, has teamed up with Givaudan to open a new innovation centre dedicated to plant-based food in Singapore.

Thailand

CLIMATE AND GEOGRAPHY[357]

Tropical, with three distinct seasons: a hot season from March to mid-May, a rainy season from mid-May to October, and a dry and relatively cool season from November to February. The relatively cool season is felt in the northern and inland areas, while on the coasts and in the south it's hot even in wintertime.

Most of the country receives a mean annual rainfall of 1,200 to 1,600 mm; however, certain areas on the windward sides of mountains receive more than 4,500 mm per year. The driest areas are the leeward sides of the central valleys and the northernmost portion of south Thailand, where mean annual rainfall is less than 1,200 mm.

AGRICULTURAL CONTEXT

Agriculture is a major economic sector in Thailand, employing 35 percent of the workforce.[358] Rice is the major export and, as such, rice prices are so intensely political that they have occasionally brought down prime ministers.[359]

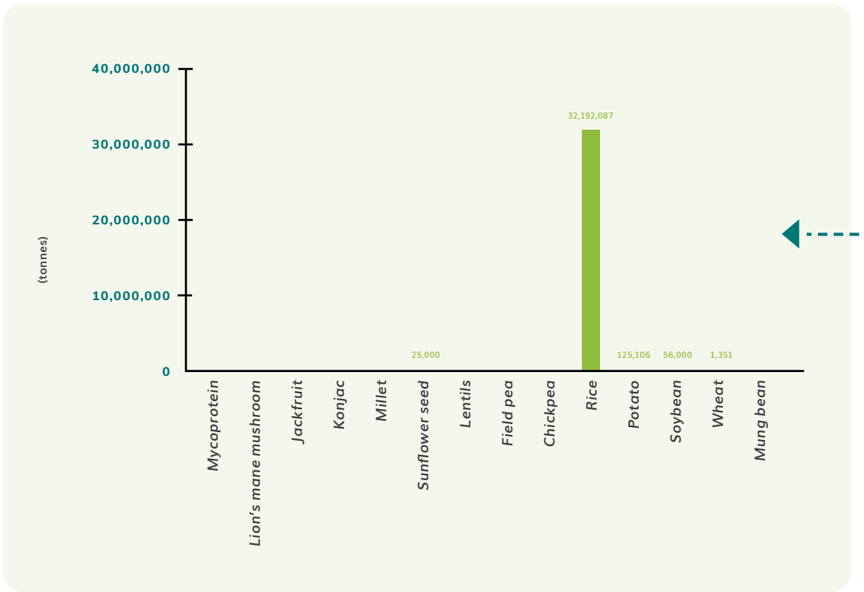
Periodic droughts, believed to be associated with climate change, regularly impact the wellbeing of Thai farmers, but improving agricultural productivity is a Thai government priority.[360]

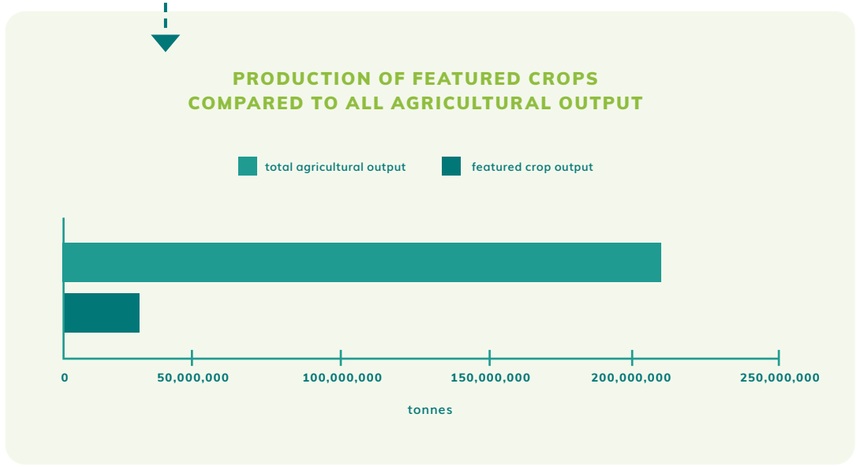
Domestic food and agriculture companies have also begun making significant moves towards alternative proteins. For example, Khaerai-based food exporters NR Instant Produce PCL have been investing in jackfruit as a plant-based pork. Danai Pathomvanich, the company's chief executive officer, told *Deal Street Asia* that "Consumer focus on health is a huge megatrend right now. The growth potential is massive." Mr. Pathomvanich said that plant-based products currently account for about seven percent of his company's revenue, but that he expected that to jump to 30 percent within four years.[361]

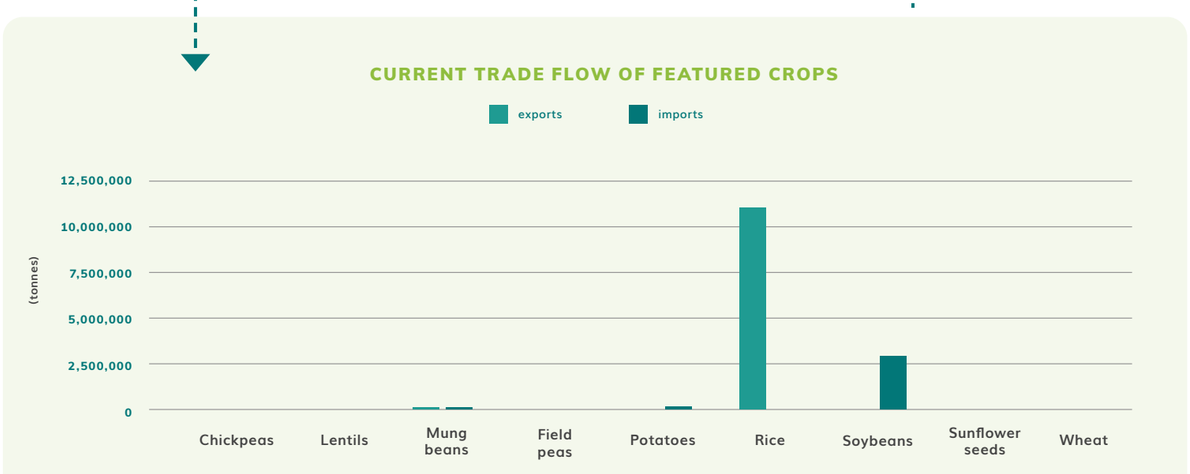
GMO stance: Thailand has not approved the commercial cultivation of any GM crops, and all open fields of GM crops were banned after 2001. Genetically modified foods have to be labeled with messages advising precaution before consumption. New genetically modified food regulations have been drafted, targeting food and food products containing or consisting of GMOs. The regulations cover the entire spectrum across plant, microorganism, and animal-based foods. Draft regulations have been submitted to the World Trade Organization by the Thai Food and Drug Administration. If passed, they will affect all regions and countries trading with Thailand.[362] [363] [364]

PRODUCTION OF FEATURED CROPS

While Thailand produces a variety of our featured crops, domestic cultivation is skewed very heavily towards rice, leaving significant room for growth in other raw materials.[365]







Note: Import figures for jackfruit were not available in Thailand, hence its exclusion. However, the nation reportedly exported around 40,000 tonnes of jackfruit in 2018.[366]

RISKS

- Perceptions of societal instability and a lack of government transparency have hampered growth and investment.[367]

INCENTIVES

- Substantial subsidies have been allocated by the government for rice farmers and others in the agricultural space to help them invest in more advanced machinery, processing, and logistics.[368][369]
- Funds have also been allocated for the development of 200,000 new farmers under the government's "smart farming" policy. Smart farming is the integration of modern information and communication technologies into agricultural management, and could be used to create more efficient systems, including those for alternative protein cultivation.[370]

CROPPORTUNITIES

Expanding the nation's **jackfruit** output could be beneficial, but would be dependent on an international harmonization of standards for the fruit; it could also require an investment in marketing materials to stimulate more local demand.

Konjac is also a logical option in Thailand, as there is evidence that it can be beneficially intercropped with rubber, which is already an important local resource.[371]

Bangkok, Thailand. Photo: Jakob Owens/unsplash

Vietnam

CLIMATE AND GEOGRAPHY[372]

Over a thousand miles from north to south, Vietnam's climate can be divided into a tropical and a temperate zone. The nation has a mostly tropical climate, which is dominated by the monsoon season. Regions located further north and in the mountainous regions have a slightly cooler, more temperate climate.

The annual average temperature ranges from 22°C to 27°C year-round. There are almost no significant differences in temperature in the southern parts of Vietnam, while the northern regions can get quite cold in the winter.

The diverse topography, wide range of latitudes, and influences from the South China Sea lead to climatic conditions varying significantly between regions. Mean annual rainfall in the country ranges from 700 to 5,000 mm, although most places in Vietnam receive between 1,400 to 2,400 mm.

AGRICULTURAL CONTEXT

Vietnam is a global leader in agriculture, in part because of a concerted effort by the national government to set clear targets and meet them. They supply a sizable amount of produce for the Chinese market across their northern border, and farmers are able to extract very high yields by comparison to neighboring countries. For example, Vietnamese coffee growers get as much as three times more yield out of their crops than do coffee growers in Indonesia. It is worth noting though that if a crop is not deemed important, the government may not support its widespread cultivation.[373]

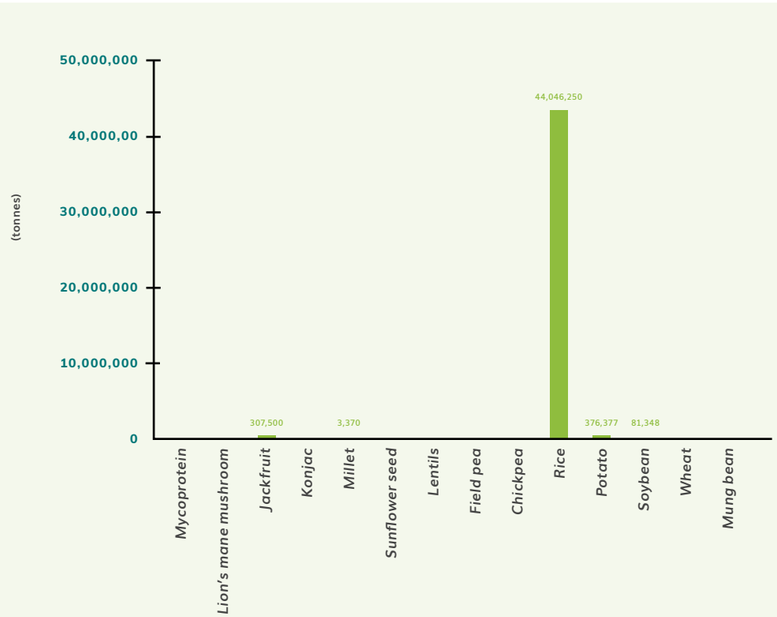
Moray McLeish, VP of Corporate Social Responsibility and Sustainability at raw-materials supply giant, Olam, believes Vietnam is very open to increased agricultural production and processing, with the ability to "make it happen."[374] This reputation has drawn interest and investment from food producers throughout the region. Nick Spencer, CEO of IBIS Rice, notes that much of Cambodia's rice is sent over the border into Vietnam because of the country's efficiency at processing the crop and extracting more from each harvest.[375]

However, despite having undergone decades of agricultural expansion driven by a focus on international trade, climate change is now a major challenge, particularly affecting rice cultivation. Saltwater intrusion in the Mekong Delta—Vietnam's "food bowl"—is a major issue that the government is currently trying to reconcile with additional infrastructure investment. Food safety is also a concern, with international demand driven by low prices pressing against the need for effective local regulation.[376] [377] [378]

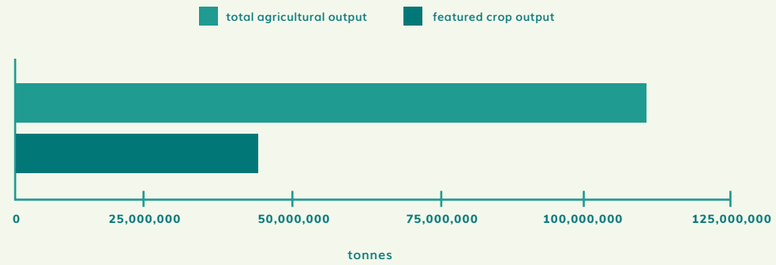
GMO stance: Beginning in January 2016, prepackaged GM foods traded in Vietnam have to be labeled "genetically modified." The rules apply to food products containing at least one GM ingredient, constituting over five percent of their total ingredients. Only GM corn has been approved for domestic cultivation.[379] [380] Vietnam does allow for import of GM foods, upon approval by the Ministry of Agriculture and Rural Development and other national authorities.[381]

PRODUCTION OF FEATURED CROPS[382]

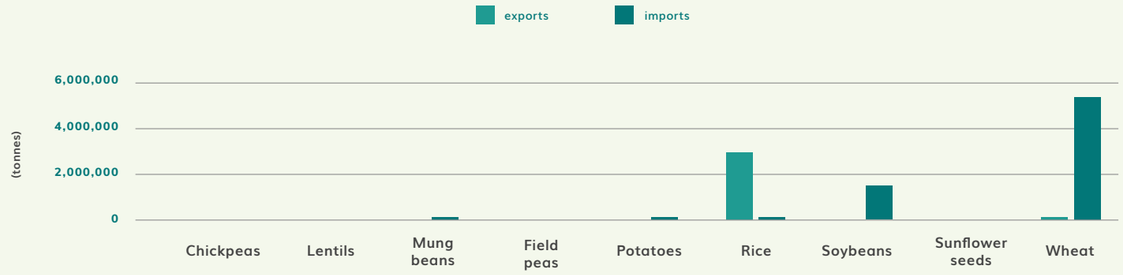
While Vietnam has a prolific agricultural sector, when looking specifically at our featured ingredients, only rice is currently produced on a massive scale. This has left a gap in the market that could be filled by raw materials that are resilient enough to be cultivated on degraded land, or can be seamlessly intercropped into existing plots.



PRODUCTION OF FEATURED CROPS COMPARED TO ALL AGRICULTURAL OUTPUT



CURRENT TRADE FLOW OF FEATURED CROPS



Note: Official statistics on the import and export of jackfruit as a separate category of fruit were not available for Vietnam, which is why it is not represented in this graph. However, the nation is believed to produce the crop primarily for export, particularly to China.[383]

RISKS[384][385]

- Inefficiency and mismanagement undermine state enterprises.

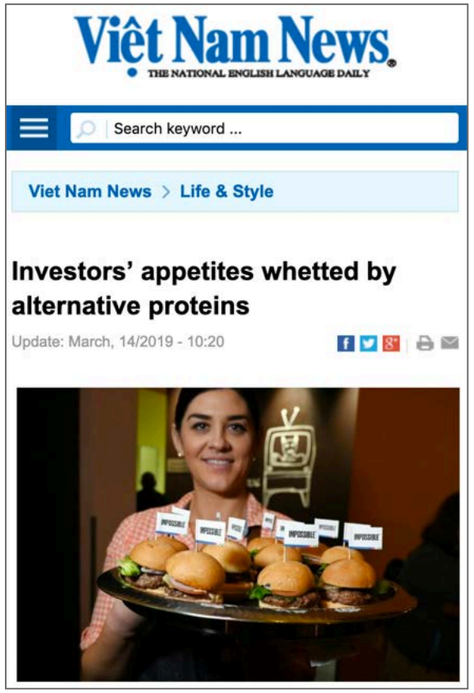
INCENTIVES

- The government is aiming to attract USD $8 billion in foreign direct investment in Vietnam's farming, forestry, and fishery sectors by 2030, with the goal of funding more advanced technologies for cultivation of rice, cassava, and other crops. The government also offers additional tax incentives if an entity is focused on "clean, high-tech, and eco-friendly agriculture."[386] [387]

CROPPORTUNITIES

Konjac is an option for intercropping on Vietnamese rubber plantations, though demand would have to be stimulated; furthermore, it is not a core protein crop, but it does have other nutritional benefits. With more stable demand, **jackfruit** is also an option for expansion.

For a high-protein crop, **peas** could offer Vietnam an option for restoring degraded land, due to their nitrogen-fixing properties and ability to use plant waste as a green manure.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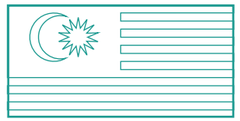
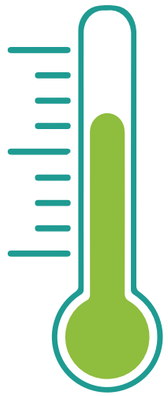
Investors' appetites whetted by alternative proteins

Update: March, 14/2019 - 10:20



Malaysia



CLIMATE AND GEOGRAPHY[388]

Malaysia enjoys tropical weather year-round. Despite this, the weather is never too hot and temperatures range from 20°C to 30°C on average throughout the year, though the highlands experience cooler temperatures.

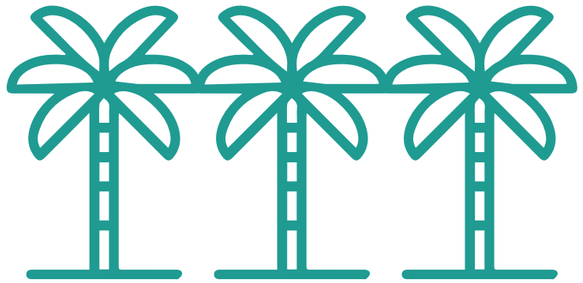
Local climates are affected by the presence of mountain ranges throughout Malaysia, and climate can be divided into that of the highlands, the lowlands, and coastal regions. Malaysia experiences a monsoon season, however the season's timing varies by region. The peninsular region generally receives an average annual rainfall of 2,500 mm, while East Malaysia experiences 5,080 mm.

AGRICULTURAL CONTEXT

Some of the companies and experts we interviewed for this report told us that while their corporate headquarters may be in Singapore, that they have chosen to base their manufacturing operations in Malaysia, because of its large and low-cost agricultural labor pool.[389] As neighboring countries, that close proximity to all aspects of the supply chain is beneficial. It is worth noting though that Malaysia is rapidly industrializing, which means that the number of people involved in its agricultural sector is shrinking.[390]

As of 2018, the agriculture sector represents 7.3 percent of Malaysian GDP, nearly 40 percent of which is exclusively related to palm oil cultivation. Palm oil production accounts for an astonishing 75 percent of all cultivated land in Malaysia, leading to deforestation, land degradation, and the replacement of food crops with non-food crops. The Malaysian government maintains that it has policy objectives to increase self-sufficiency and increase food production, but it is unclear whether they are willing to do this at the expense of palm oil production.[391][392][393]

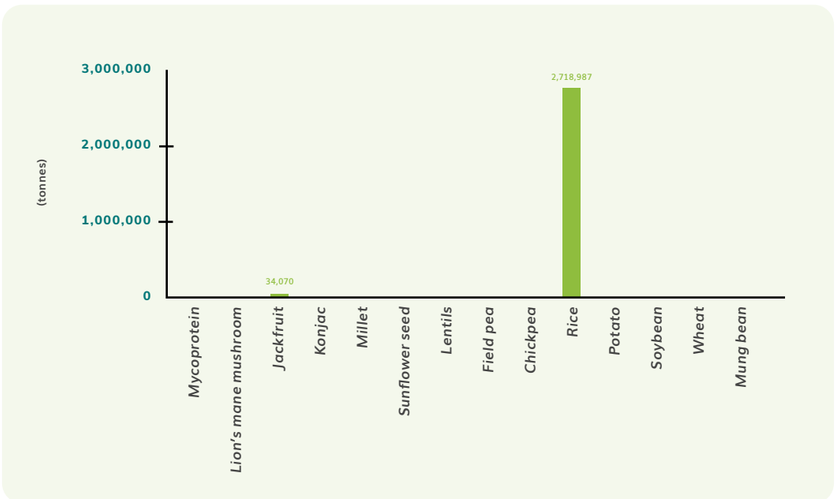
Malaysian rice paddy yields are on a par with those of Thailand, though they lag behind Philippine, Indonesian, and Vietnamese yields, in part because farmers often don't own mechanical equipment and must hire an array of contractors through the production process.[394]

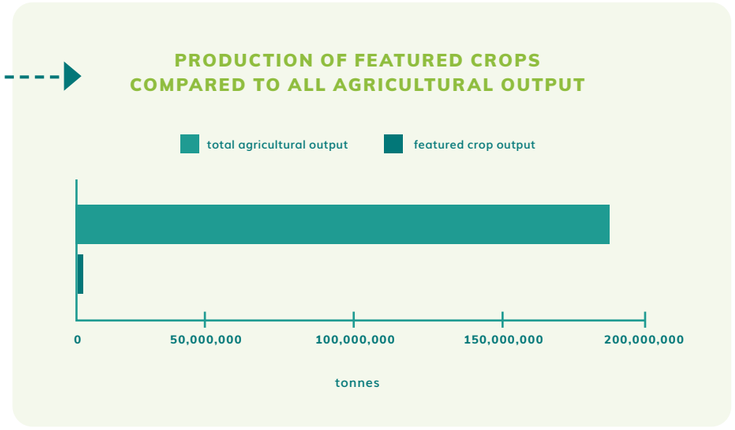


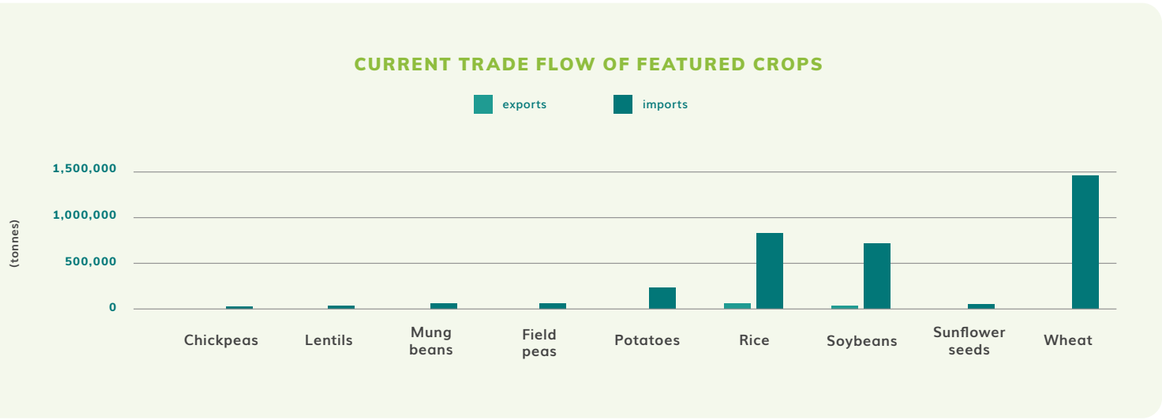
GMO stance: No GM food crops have been approved for cultivation to date. All GMOs or products derived thereof are required to be identified and labeled, and only GM soybeans and corn have been approved for human consumption. Almost all animal feed in Malaysia is genetically modified. In 2015, eight GM corn products and six GM soybean products for food, animal feed, and processing purposes were approved. Approvals were also given for field trials of GM mosquitoes, papaya, and the release of GM products for use as pesticides and fertilizers.[395] [396] [397] [398] [399] [400]

PRODUCTION OF FEATURED CROPS

Malaysia's production of our featured crops is limited to just rice and jackfruit. Meanwhile, the country is importing vast quantities of wheat, soy, potatoes, and other raw materials, rather than cultivating homegrown alternative proteins domestically.[401] This imbalance presents an opportunity for market diversification.







CROPPORTUNITIES

RISKS[402] [403] [404]

- Erosion of price competitiveness due to increasing labor costs.
- Somewhat volatile economic environment.

INCENTIVES

- Ranked highly by the World Bank for ease of business.[405]
- The current strategic priorities of the Malaysian government include modernizing and increasing agricultural production, particularly for "young agropreneurs."[406] Integrating and empowering a younger generation within agriculture could ultimately be beneficial for the alternative protein sector, as it is most popular with upwardly-mobile young people.

While the statements from the Malaysian government about food and crop diversification are encouraging, the country's addiction to palm oil revenues is also creating monoculture wastelands out of biodiverse peatlands. Furthermore, the oil industry deeply objects to intercropping due to its long-term negative impact on oil yields.[407]

As a result, land-hungry alternatives to palm oil may simply not be sufficiently profitable to entice farmers to switch. By contrast, **lion's mane mushroom** may be a useful side-crop, as it uses little land if grown vertically and offers farmers a year-round income.

Malaysian plant-based alternative-pork startup scouting for food technology talent

By RJ Whitehead
18-Sep-2019 - Last updated on 18-Sep-2019 at 22:54 GMT

The start-up is expanding and recruiting talent ©Phuture Foods

Indonesia

CLIMATE AND GEOGRAPHY[408]

The climate of Indonesia is almost entirely tropical. The uniformly warm waters that make up 81 percent of the nation's area ensure that temperatures on land remain fairly constant, with the coastal plains averaging 28°C, the inland and mountain areas averaging 26°C, and the higher mountain regions, 23°C. Temperature varies little from season to season, and, straddling the equator, Indonesia experiences relatively little change in the length of daylight hours from one season to the next.

Extreme variations in rainfall are linked with the monsoons; generally speaking, there is a dry season (June to October) and a rainy season (November to March).

AGRICULTURAL CONTEXT[409]

Long-term trade and subsidy policies in Indonesia mean that there is an overreliance on rice and noodles, to the detriment of more nutritious staples, in a nation where nutrition is a challenge.

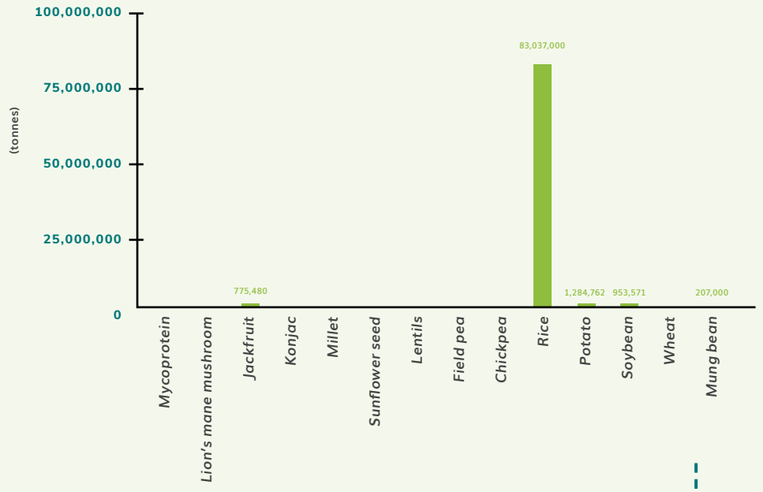
Indonesia is the world's largest producer of palm oil, leading to perennial forest burning issues. Agriculture is also affected by climate-related droughts and floods.

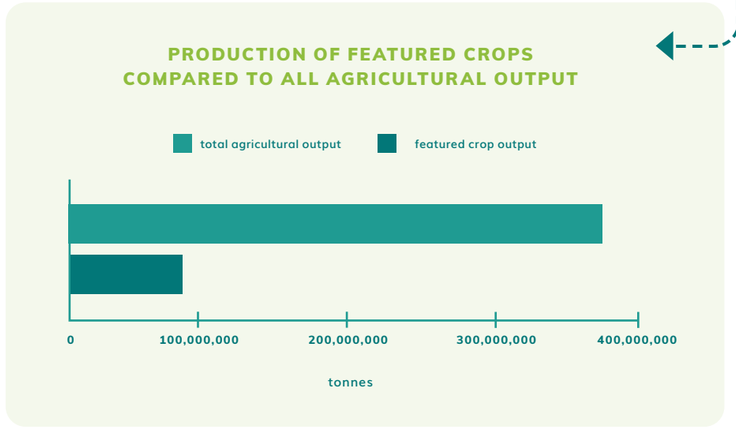
Furthermore, interviews with regional producers showed concerns about lower yields and productivity among the Indonesian agriculture sector compared to others in the region. Some of this is attributed to a lower availability of skilled workers and poor infrastructure.[410]

GMO stance: All GM foods must have authorization from the Government before being released or distributed. The country also requires mandatory labeling of GM foods and has so far provided authorization of GM varieties of soybean, corn, potato, and sugarcane.[411] [412] If a food product contains GMO ingredients or is a derivative of a GMO product, it must be labeled as such. However, if such derivatives have undergone further refining processes to the extent that GM materials cannot be identified, or if a food product contains less than five percent content derived from GM processes, then no GMO statement is required. For imports, labeled information on the GMO raw material is required unless the product derivatives have undergone multiple refining processes in high temperatures, such as fat or oil.[413]

PRODUCTION OF FEATURED CROPS

While Indonesia has a climate that lends itself to cultivation of several of the featured crops on our list, only rice is currently produced at a massive volume.[414] This leaves the potential for skilled agricultural workers to scale up several other ingredients that could be useful for plant-based meat production.





CROPPORTUNITIES

RISKS[415][416][417]

- Prone to natural disasters and struggling with biodiversity loss.
- Comparatively high logistics costs and a fragmented market due to the nation's layout over an extensive archipelago.
- Exposure to shifts in Chinese demand; though this could be less of a challenge if crops are aligned with Chinese market shifts towards alternative protein.

INCENTIVES

- The national government is working with the Food and Agriculture Organization of the United Nations (FAO) to increase agricultural resilience and sustainable crop production.[418]
- The government is providing and distributing subsidized fertilizers to food farmers in an effort to boost production of certain crops, including rice, corn, and soybeans.[419]

The sheer size of Indonesia provides many options for alternative protein crops. Already, the country produces thousands of tonnes of **rice**, **potatoes**, and **mung beans**, so farmers' familiarity with these crops suggests they could be ripe for expansion.

Furthermore, Indonesia's extensive teak forestry is an excellent ground on which to plant **konjac** as an undercrop.


A sustainable solution for Indonesia's love of beef: Jakarta Post contributor

In the article, the writer says that plant-based meat in Indonesia can be a unique business opportunity in itself, with some start-ups already driving down this road.

Myanmar

CLIMATE AND GEOGRAPHY[420]

Myanmar features a wide variety of microclimates, but is generally considered subtropical/tropical, with cool weather from November to February, heat in March and April, and a rainy season from May to October. Northern Myanmar is cooler, averaging around 21°C.

The country follows a monsoonal weather pattern, with coastal regions receiving over 5,000 mm of rain annually, about 2,500 mm in the delta region, and less than 1,000 mm in the dry zone of central Myanmar.

AGRICULTURAL CONTEXT [421] [422]

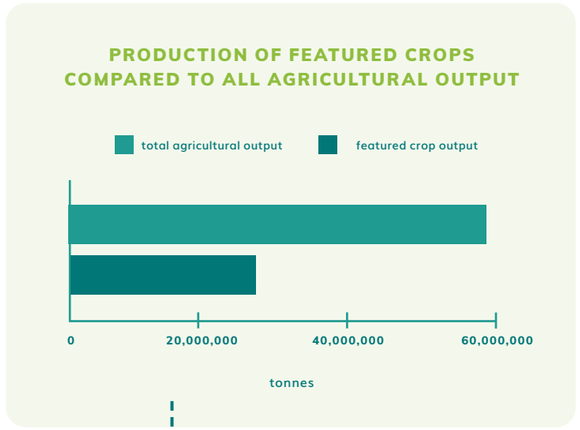
Myanmar is rich in natural resources and is currently one of the world's largest exporters of pulses. Its close proximity to China is also a geographic advantage and has triggered a large amount of incoming infrastructure investment as part of the Belt and Road Initiative.[423] Grow Asia, a multi-stakeholder partnership platform in Southeast Asia, notes that large volumes of pulses are being cultivated in the center of the country, where the climate is drier but there is still access to irrigation.

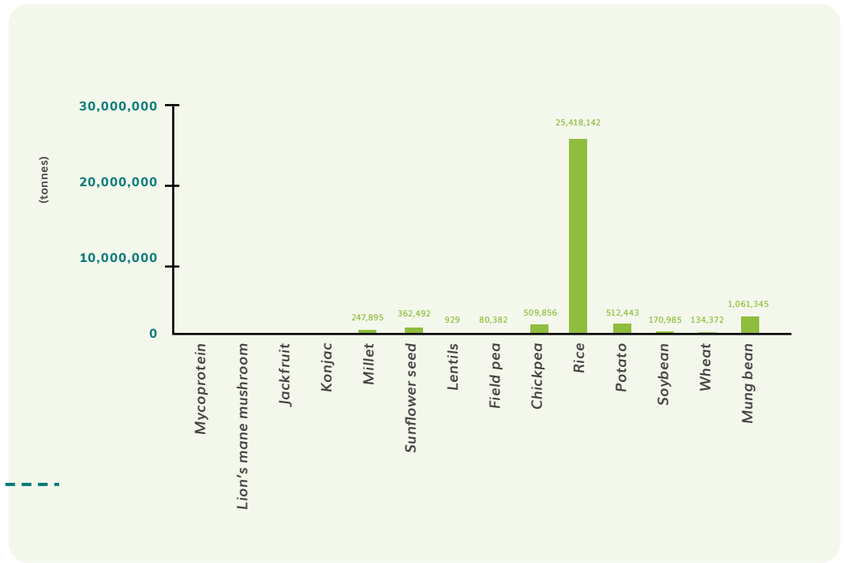
The agricultural sector accounts for 38 percent of Myanmar's economy and employs a remarkable 70 percent of the workforce. 53 percent of its production is rice, though beans and pulses now exceed rice in terms of export value. Extensive river systems substitute for road infrastructure to bring exports to ports overseas.

The agricultural sector suffers from poor productivity, driven by a lack of financing and infrastructure, inadequate access to high-quality seeds, and a lack of knowledge in terms of modern agricultural methods. As a result, Myanmar's produce is often perceived as low quality and priced accordingly.

GMO stance: Myanmar is still in the process of establishing a regulatory framework, developing regulations, and drafting a biosafety law. It does not currently conduct any safety assessment of GMO food or field testing, largely due to there being no current law and capacity constraints. Myanmar does not currently produce any GMO food or feed. A genetically modified crop of cotton was approved under the Seed Law, but this seemed to be a one-time administrative decision rather than a formal application approval.

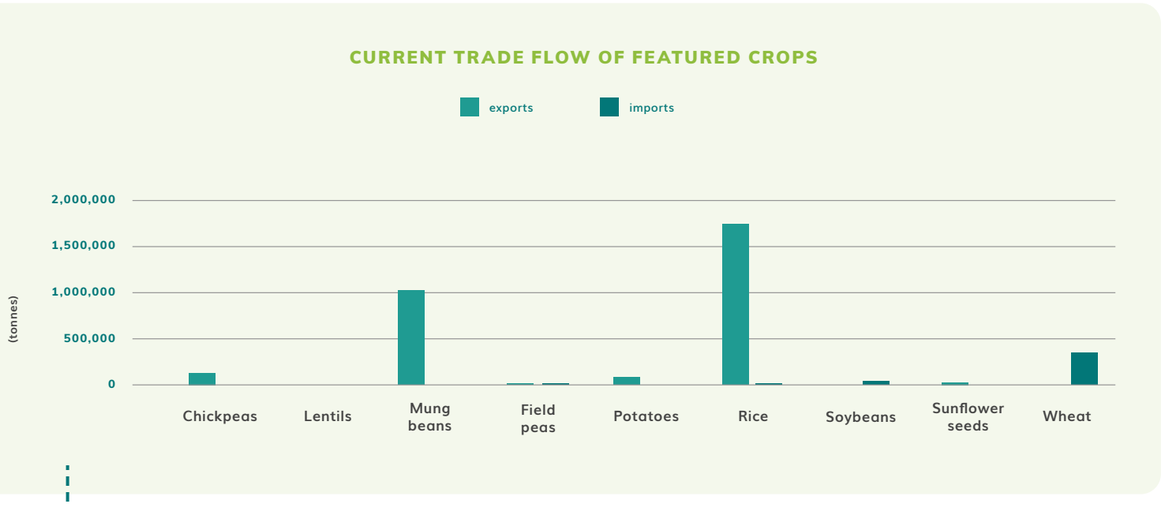
There are no labeling regulations or policies in place for GMO products. The import of GMO food and feed is allowed. Imported seeds must come with a non-GMO certificate to gain import approval, but this does not have to be listed on the label. Other than this, there is no authorization process in place and no policy regarding testing of imported or exported products for genetically engineered content. Some government agencies may, however, conduct random testing and general surveys.[424] [425]





PRODUCTION OF FEATURED CROPS[426]

Myanmar's extensive agricultural sector includes cultivation of several of the most promising raw materials for diversified plant-based meat production. The country is among the best positioned to be a supplier country, if the infrastructure can be built to capitalize on the opportunity.



CROPPORTUNITIES

Myanmar faces many infrastructural challenges, but is nevertheless an agricultural powerhouse with large potential as a supply source.

Low levels of farmer knowledge mitigate against early adoption of novel crops; however, **chickpeas**, **mung beans**, **potatoes**, and **sunflower seeds** are already established and could be prioritized for expansion.

Agri-Tech Asia: These 9 Sustainable Startups Are Fixing Our Food Systems

Village Link (Myanmar)

Source: Village Link

Founding date: 2017

Headquarters: Yangon, Myanmar

Founder: U Thadoe Hein

RISKS[427] [428]

- High vulnerability to natural hazards and economic instability.
- Weak track record of contract enforcement, which presents legal risks.
- Underdeveloped infrastructure and financial sector.

INCENTIVES

- The majority of goods exempted from commercial taxes are agricultural goods.[429]
- The national government is working to develop internationally comparable regulations on food, agriculture, and biosafety.[430]
- The Myanmar Agriculture Development Strategy and Investment Plan focuses on crop diversification and infrastructure development.[431]

Potential Constraints on Plant-Based Meat Growth

As with any emerging industry, the speed with which it accelerates depends in large part on the buy-in of the various stakeholders. Demand for plant-based meat shows no signs of slowing down, but whether suppliers are prepared to fill that demand, and whether the infrastructure to source a diverse range of raw materials is operating at full capacity or not will make a difference in how quickly the industry can scale up to its full market potential.

GOVERNMENT EXTENSION SERVICES AND REGULATORY HARMONIZATION

One potential pitfall is that, too often, political leaders view agriculture as an antiquated industry, or worse yet, a hurdle to economic growth. Nothing could be further from the truth, but nonetheless, the perception persists that as a country becomes wealthier, agriculture fades. There are notable exceptions to this rule, including Vietnam and Thailand, whose leaders see that agriculture has the potential to be an economic engine and opportunity for growth. Similarly, leaders of innovation hubs like Singapore are re-thinking what agriculture and food production looks like entirely, which injects an essential boost of technology into an industry that is staring down a sharply-inclining demand curve.

One way that proactive governmental leaders can support a shift towards alternative proteins is by offering government extension schemes or programs to help farmers diversify and extract higher yields. These include training and provision of inputs and seeds, and helping farmers in their production, storage, and processing. Agricultural extensions could either focus on a single crop or take a "whole farm" approach, depending on a country's requirements and agenda. Extension services can also address land and water management, pest and disease control, and improved crop varieties, as well as build up organizations, collectives, and farmers' groups to help farmers benefit from the programs. If programs are successful in helping farmers increase their productivity yield, it also has the ancillary benefit of reducing the likelihood that they will illegally extend their farmlands into protected forest areas in order to hit their harvest goals.

Historically, oversight of food production and food security has been primarily the responsibility of governments, but recently it has been the private sector that is leading the charge towards growth and innovation, driven, in part, by consumer concerns about nutrition and the environmental impacts of food production. There is still an open opportunity though for governments to engage with the private sector for mutual gain at all stages of the supply chain—particularly in manufacturing and processing, where many new jobs could be created.

On a larger scale, there is also a need for governments across Asia to work together to harmonize their regulatory structures (e.g. harmonizing regulations on the adoption of biotechnology in agriculture, aligning the use of pesticides and fungicides with international standards, or ensuring consistency in labeling for standards like halal certification of pork substitutes), which could allow the region to compete more aggressively as an integrated system against Australia, Brazil, and the U.S. This absence of clear harmonization slows the development and proliferation of processes and technologies that could be used to accelerate alternative proteins.

CONCERNS WITH SMALLHOLDER FARMERS

Two primary concerns that emerged over the course of our industry-expert interviews were that 1) smallholder farmers are often concerned that they will not have an offtaker for a given commodity, and 2) processors who source from smallholder farmers often find quality inconsistencies or safety concerns associated with the crops, compared with those sources from larger farms. In short, there is distrust on both sides of the relationship that the other is going to fall short of expectations.

On the plus side, a positive attribute about a shift towards plant-based protein is that unless the crop is being eaten in its original unprocessed form (such as jackfruit), the crop is likely to be used as a feedstock for protein isolate extraction. This can be a blessing for many farmers because crops used for isolates are not as reliant on the absolute or cosmetic qualities of the raw materials, as they will not be consumed in whole form. Rather, what matters to an agribusiness processor is consistency, food safety, and unit cost. As long as a smallholder farmer can meet those basic requirements, providing raw materials for plant-based protein remains an option for them.

EFFECTIVE KNOWLEDGE OF HOW TO USE LESS-COMMON INGREDIENTS TO CREATE GREAT-TASTING PLANT-BASED MEAT PRODUCTS

It is understandable that both start-ups and corporations do not want to invest a lot of resources on R&D to

reinvent the wheel, when soy and wheat are working "perfectly fine" as is. In terms of baseline functionalities and nutritional value, maturity of the supply chain, and decades of knowledge built on how to work and utilize them, these common raw materials are currently more accessible options compared to other plant proteins.

An example of learning and adapting to new raw materials is dealing with the distinct built-in bitter or "beany" flavor notes that each type of legume and pulse carries. If, for example, a company is trying to produce an innovative new plant-based chicken alternative using mung beans, presumably it is important to first mask any off-notes from the mung beans, and then add the "taste of chicken" to create the desired end taste of the product. In reality, however, the process is anything but a straightforward subtraction and addition exercise. Typically, years of R&D have gone into creating and optimizing formulations using different ingredients, and when, for example, soy isolate is replaced with mung bean protein isolate, everything changes.

> **"Alternative plant proteins need a competitive value proposition to bring about growth. To compete directly with wheat and soy a major question is how well they texturize."**
>
> CHRIS GREGSON, independent research consultant for The Good Food Institute

Thankfully, there are innovation centers and co-manufacturing companies in Asia advancing product formulation solutions. As an example, in early 2021, the Swiss food-processing giants Bühler and Givaudan are joining forces to open The Protein Innovation Center in Singapore.[432] This new full-service innovation hub aims to build out the ecosystem for Asia-specific alternative proteins by using Asian experts and insights; and they're actively seeking local start-ups and researchers to collaborate with.

For those companies with a product already on the market, the Center can bring in their chefs, flavorists, sensory experts, and consumer feedback panels, to determine how it could be enhanced. If someone doesn't yet have a physical product but has a rough concept in mind, or perhaps produces a local crop that they want to find a way to monetize in the plant-based meat market, the Center will help them to create an entire end-to-end game plan to conceptualize, manufacture, and export a finished product to consumers.

Innovator Spotlight: WhatIF Foods

Food technology companies like Singapore-based **NamZ**, and their brand **WhatIF Foods**, believe that diversification of protein sources—with a preference towards plants that can grow on degraded land—will be essential to building a smarter food system. That belief, which may initially seem like a limitation, could actually provide a competitive advantage to their business during a time of increasingly unstable climate conditions.

WhatIF Foods does not believe that any single crop will be the answer to satisfying global protein demand. On the contrary, an overreliance on a small number of crops has brought the food system to the fragile and unhealthy state it is in. Instead, Christopher Langwallner, founder and CEO of WhatIF Foods, believes the questions that suppliers and producers should be asking about their raw materials include: "Can it grow and produce good yields under changing climate conditions, with hotter microclimates and less water availability?"; "Can it be used for intercropping at scale, so that prices can be reduced?"; and "Can growing the crop benefit the farming community that grows it, so that they have meaningful livelihoods?" If so, he believes that's a winning combination.

Mr. Langwallner's strategy comes with one big advantage that he believes will translate to economic success: many of his ingredients grow where others cannot. According to Langwallner, 17 percent of peninsular Malaysia's land, for example, is occupied by palm oil plantations, of which 50 percent is degrading and becoming largely unviable for cultivation; unless you're growing future fit crops. That means that WhatIF Foods has less competition for the land they need, and they don't have to pay the high supply costs that they would to obtain more conventional raw materials.

"Mr. Langwallner's strategy comes with one big advantage that he believes will translate to economic success: many of his ingredients grow where others cannot."

That strategy has allowed the company to create a healthier version of instant noodles, featuring climate-resilient, future fit crops. Wheat continues to be the core base ingredient in their noodles, but they beef up the noodles' nutritional value by using Bambara groundnuts (an African nut similar to a peanut) and lupins (a flowering plant in the legume family that is highly adaptable to different soils and climates). Lupins have high protein content (roughly 45 percent) and the groundnuts are rich in fiber, calcium, iron, potassium, and the essential amino acid, methionine.[433] Together, they create a more complete nutrition and flavor profile and help WhatIF Foods' brand stand out.

The WhatIF Foods story is representative of a larger shift taking place among forward-thinking food businesses, and their strategic approach can also apply to the production of plant-based meat. By diversifying a product's ingredient list, and combining high-impact raw materials from throughout the local region, producers can formulate nutrient-dense proteins that stand out among the crowd.

Cutting Edge Case Study: Feeder Materials in Fermentation

In addition to looking at raw materials that naturally lend themselves to plant-based meats, or those that could be beneficial as a protein isolate, there are other applications of local raw materials that may fly completely under the radar.

One such example is in the fermentation space, which is one of the fastest-growing sub-sectors of the alternative protein space.[434] Many people may think of fermentation as just letting mushrooms and fungi grow, but at a more fundamental level, creating something like Quorn's mycoprotein is really a matter of turning carbohydrates into protein. In Quorn's case, the company feeds glucose, sourced from wheat and corn, into their base ingredient, to help it grow. In other words, they are feeding plants to a fungus, and as a result, turning carbs into protein.

Currently, Quorn sources the wheat and corn they use as mycoprotein feed from the U.K.,[435] but as more companies—particularly those with products made through fermentation—eye an expansion in Asia, growing crops to be used as fermentation feed could soon become an industry unto itself.

Food Industry Giants Pivoting to Plant-Based Meat[436]

Recognizable start-up brands that distribute plant-based end-products may garner most of the headlines, but as

we've shown throughout this report, it is often those working with raw materials on the upper end of the value chain who bring together the signature textures, flavors, and nutritional values that keep consumers coming back. Legacy food-industry titans, such as Cargill and Nestlé, have increasingly seen the writing on the wall and pivoted towards producing plant-based foods;[437] [438] but when it comes to the critical task of taking crops and turning them into building blocks of plant-based flavor, like value-added oils and fats, AAK (formerly AarhusKarlshamn) is in a league of its own.

Oils and fats may not be the first things consumers think of when fantasizing about their favorite foods, but both elements play a central role in crafting the unique flavor profiles we love. "Fat is the protagonist in terms of flavor delivery," according to Lucas Hardy, AAK's Customer Innovation Director for South Latin America, and that's as true for plant-based foods as it is for animal meat.

AAK's company roots stretch back about 140 years, but the Swedish-Danish corporation now has nearly 4,000 employees and operates in more than 100 countries.[439] The multibillion-dollar publicly traded company commands huge influence over the shape of the food system, so when they decided to create a new global plant-based food platform—called AkoPlanet™—to help other businesses create animal-free meats "without sacrificing taste and texture," it sent a clear signal to their industry peers that the shift away from animal protein was here to stay. The company has since begun working closely with the China Plant Based Foods Alliance and Centre for a Responsible Future (based in Singapore) to further accelerate innovation throughout the fastest-growing region of the world.

As Dheeraj Talreja, President of AAK Kamani (an affiliate located in India), astutely points out, "animal farms will not be sufficient to meet the [protein] demand from Asia Pacific. The demand is going to exceed the supply." He believes that this presents an enormous opportunity for homegrown Asian producers to satisfy that demand by using locally-grown crops to create convincing meat alternatives, and AAK stands ready to help them do it. According to Talreja, "the global food industry is growing at a rate of two to three percent growth, but plant-based food is growing at five to six times that rate."

Heavyweights like AAK have the financial resources and industry clout necessary to accelerate broader changes within the global food system by directing their decades of experience in the upper end of the value chain towards the goal of elevating plant-based meat. Their decision to do so will benefit the entire Asian food production ecosystem, from raw material suppliers to manufacturers and businesses further downstream.

The Potential for Growth

As the plant-based meat sector grows, in order to calculate the potential impact on various raw materials that serve as alternative sources of protein, it is necessary to know the expected growth of the plant-based meat sector in terms of *volume*. Unfortunately, as Figure 1 below shows, most growth projections currently in the market have estimated this growth in terms of the sector's market *value*.

As can be seen, estimates for both current and future market size and the respective compound annual growth rates (CAGR) vary significantly. In addition, such

Figure 1: Market size and growth estimates for plant-based meat

SOURCE	PLANT-BASED MARKET SIZE (USD BILLION) (2018/2019)	FUTURE MARKET SIZE (USD BILLION)	ENDING PERIOD	IMPLIED CAGR
A.T. Kearney	4.6	450	2040	23.2%
Barclays	14	140	2029	25.9%
FAIRR	19.5	100	2034	11.5%
Jefferies' Base Case	14	240	2040	12.0%
Jefferies' Best Case	14	470	2040	15.0%
Jefferies' Worst Case	14	90	2040	7.0%
UBS	4.5	85	2030	27.7%

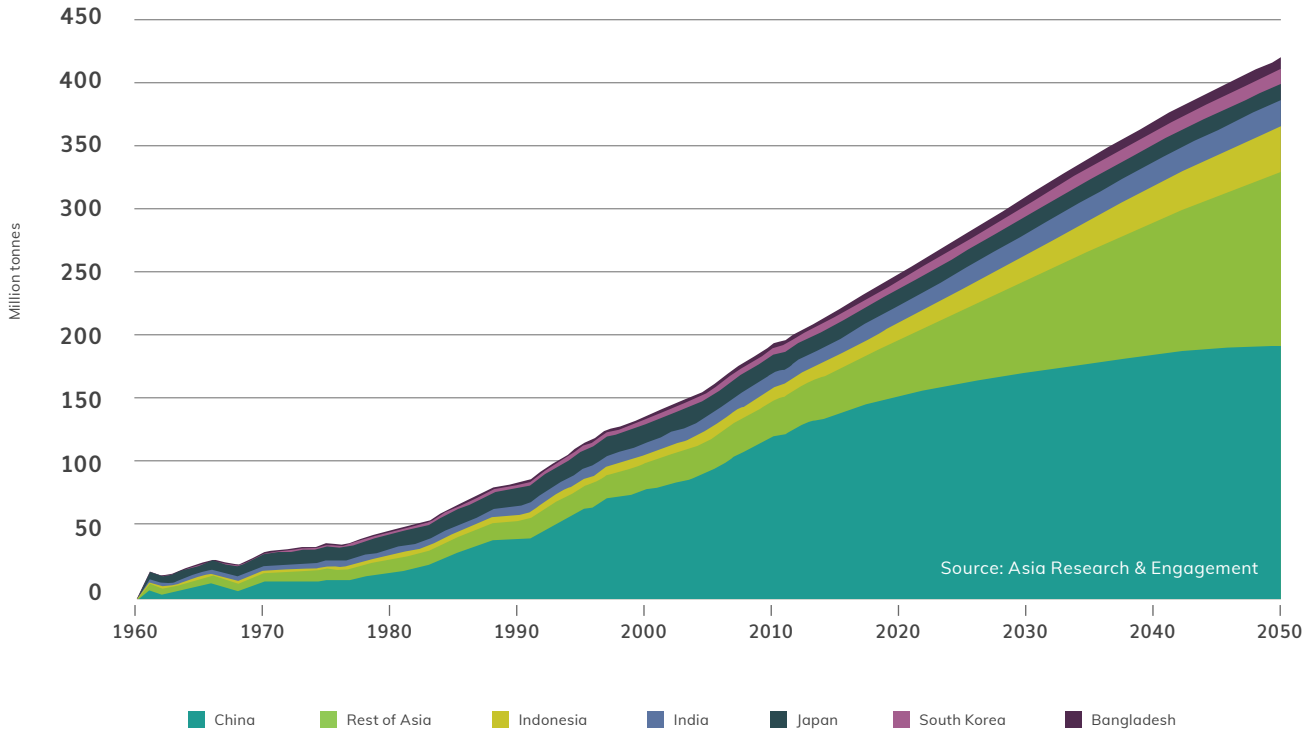
Source: Asia Research & Engagement (ARE)[440]

projections typically refer to global market size, not specifically to Asia.

ARE has modeled the projected growth of meat consumption volumes across Asia. In a business as usual scenario, economic growth and rising incomes are expected to drive Asia's appetite for traditional meat and seafood to increase by 33 percent and 78 percent from 2017 to 2030 and 2050, respectively.[441]

If plant-based meat volumes were to increase fast enough to meet Asia's protein demand, this would represent enormous growth for the sector and reduce intense environmental and social pressures. But this cannot happen without plant-based meat prices falling to price parity with traditional meats in each market. Given the diversity and heterogeneous nature of the Asian region, more in-depth research is necessary to provide feasible scenarios for the overall growth in the market in terms of volumes.

Figure 2: Asia's projected meat and seafood consumption growth, 1961 - 2050



APPENDIX 1

	OILSEEDS		PULSES				GRAINS			VEGETABLES		FRUITS	FUNGI			
	Soybean	Sunflower seed	Field pea	Chickpea	Lentil	Mung bean	Wheat	Millet	Rice	Konjac	Potato	Jackfruit	Lion's mane mushroom	Mycoprotein	Pork	Beef
Protein content (%)	34.3-36.3	19.33	24 - 25	20.47	25	23.86	13	10-11.02	6.61	1.2	2.05	1.43-1.72	2.4-20.8#	17	10.5***	13.8***
Water use (L/kg)	2,145	3,366	1,979	4,177	5,874	5,053	1,827	4,478	1,673	343	287	967	15	500	6,000***	15,400***
CO_2 emissions (kg/kg)	0.45	0.88	0.188	0.64	0.90	2.00	1.00	1.80	3.60	Unavailable	2.90	0.90	0.60	1.14	7.00****	60.00****
Yield (tonne/hectare)	2.81	2.5	1.76	1.64	1	1.29 (midpoint)	4.49	0.78	4.68	9.07	40.9	38.4	0.45##	N/A		
Commodity pricing (USD/tonne)	558.26	607.22	761.50	1,196.12	1,110	670	289.47	411.96	509.44	Unavailable	417.96	380-720	3,220	Unavailable		
Featured Asian countries production/global production	4%/96%	5%/95%	11%/89%	3%/97%	3%/97%	42%/58%	15%/85%	6%/94%	34%/66%	Unavailable	20%/80%	23%/77%	Unavailable	Unavailable		
GMO status (Yes/No)	Yes*	No	No	No	No	No	No	No	No###	No	Some**	No	No	No		
Use in plant-based meat	Very common	Uncommon (except in the form of oil)	Common	Uncommon	Uncommon	Uncommon	Very common	Uncommon	Uncommon (except in the form of rice flour)	Uncommon	Uncommon (except in the form of potato starch)	Uncommon	Uncommon	Common - but limited to one brand		

* 94 percent of soybeans in the U.S. are genetically modified
** About 0.06 percent of potatoes planted in the U.S. are genetically modified
*** Source: **https://waterfootprint.org/media/downloads/Report-48-WaterFootprint-AnimalProducts-Vol1_1.pdf**
**** Source: **https://ourworldindata.org/environmental-impacts-of-food**

Rises to 20.8% when based on dry weight
Can be cultivated vertically, in multi-level format, thereby yielding manyfold more per hectare
While GMO rice has not been released commercially, China has an experimental field testing it out. **https://asia.nikkei.com/Economy/China-s-record-rice-yield-a-blessing-for-global-grain-consumers**

APPENDIX 2

BRAND	PRODUCT NAME	MEAT SUBSTITUTE	PRIMARY INGREDIENTS	BRAND ORIGIN
Gardein	**Golden Fishless Filet**	Fish	Water, **Soy** Protein Concentrate, Expeller Pressed Canola Oil, **Potato** Starch, Modified Vegetable Gum, **Soy** Protein Isolate, Vital **Wheat** Gluten, Sea Salt, Natural Flavors (from Plant Sources), Yeast Extract, Organic Cane Sugar, Citric Acid, Algal Oil (Plant Source Of Omega 3 DHA and EPA), Onion Powder, **Pea** Protein, Carrot Fiber, Color Added, Paprika, Rosemary And Turmeric Extracts, Breading: **Wheat** Flour, Modified Corn Starch, Tapioca Starch, Yellow Corn Flour, Onion Powder, Salt, Garlic Powder, **Wheat** Gluten, Baking Powder, Canola Oil, **Soy** Flour, Spices, Sugar, Paprika, Citric Acid, Turmeric, Xanthan Gum	North America
Gardein	**Mini Crabless Cakes**	Crab	Water, Textured **Wheat** Protein, **Wheat** Gluten, **Wheat** Protein, Expeller Pressed Canola Oil, Vegetables, Red Bell Pepper, Green Onion, **Soy** Protein Isolate, Vital **Wheat** Gluten, **Potato** Starch, Natural Flavors (from Plant Sources), Modified Vegetable Gum, Roasted Garlic Puree, Organic Cane Sugar, Sea Salt, Yeast Extract, Lemon Juice Concentrate, Tapioca Starch, Vinegar, Color Added, **Chickpea** Flour, Spice, Chia Seed Oil (Plant Source Of ALA), Gum Arabic, Algal Oil (Plant Source Of Omega 3 DHA and EPA), Citric Acid, Modified Corn Starch, Breading: Water, **Wheat** Flour, Modified Corn Starch, Tapioca Starch, Yellow Corn Flour, Onion Powder, Garlic Powder, Leavening, Canola Oil, Cane Sugar, Yeast, Salt, **Soy** Flour, Spice, Xanthan Gum	North America
Gardein	**Seven Grain Crispy Tenders**	Chicken	Water, **Soy** Protein Isolate, Vital **Wheat** Gluten, Expeller Pressed/Canola Oil, Organic Ancient Grain Flour, Organic KAMUT® Khorasan **Wheat** Flour, Organic Amaranth Flour, Organic **Millet** Flour, Organic Quinoa Flour, Natural Flavor (from Plant Sources), Modified Vegetable Gum, Yeast Extract, Sea Salt, Organic Cane Sugar, **Potato** Starch, Onion Powder, Garlic Powder, **Pea** Protein, Vinegar, Carrot Fiber, Beetroot Fiber, Extractives Of Paprika And Turmeric, Seven Grain Breading: **Wheat** Flour, Water, **Rice** Flour, Oat Bran, Oats, Salt, Sugar, Spices, **Millet** Flour, Amaranth Flour, Quinoa Flour, KAMUT® Khorasan **Wheat**, Leavening, Sodium Bicarbonate, Cream Of Tartar, Yeast, Extractives Of Paprika	North America
Gardein	**Ultimate Beefless Burger**	Beef	Water, Textured **Wheat** Protein, **Wheat** Gluten, **Wheat** Flour, Malted Barley Extract, Vital **Wheat** Gluten, **Soy** Protein Concentrate, Onions, Expeller Pressed/Canola Oil, **Soy** Protein Isolate*, Organic Ancient Grain Flour, Organic KAMUT® Khorasan **Wheat** Flour, Organic Amaranth Flour, Organic **Millet** Flour, Organic Quinoa Flour, Modified Vegetable Gum, Yeast Extract, Dehydrated Garlic, Onion Powder, Malted Barley Extract, Organic Cane Sugar, Sea Salt, Natural Flavors (from Plant Sources), **Potato** Starch, Spices, Vinegar, **Pea** Protein, Carrot Fiber, Beetroot Fiber	North America
Gardein	**Beefless Ground**	Beef	Water, **Soy** Protein Concentrate, Expeller Pressed Canola Oil, Organic Cane Sugar, Sea Salt, Yeast Extract, Onion Powder, Garlic Powder, Caramel Color, Natural Flavors (from Plant Sources), Spices	North America
Impossible Foods	**Impossible Burger**	Beef	Water, **Soy** Protein Concentrate, Coconut Oil, **Sunflower** Oil, Natural Flavors, 2% Or Less Of: **Potato** Protein, Methylcellulose, Yeast Extract, Cultured Dextrose, Food Starch Modified, **Soy** Leghemoglobin, Salt, Mixed Tocopherols (Antioxidant), **Soy** Protein Isolate	North America
Beyond Meat	**Beyond Meatballs**	Beef	Water, **Pea** Protein*, Expeller-Pressed Canola Oil, Refined Coconut Oil, Natural Flavors, **Rice** Protein, Yeast, Methylcellulose, **Potato** Starch, Spices, Salt, Potassium Chloride, Apple Extract, Garlic Powder, Vinegar, Lemon Juice Concentrate, Onion Powder, Pomegranate Extract, **Sunflower** Lecithin, Beet Powder (for color), Carrot	North America
Beyond Meat	**Beyond Breakfast Sausage Classic**	Beef	Water, **Pea** Protein*, Expeller-Pressed Canola Oil, Refined Coconut Oil, Natural Flavors, Inactivated Yeast, **Rice** Protein, Methylcellulose, Yeast Extract [niacin (Vitamin B3), pyridoxine hydrochloride (Vitamin B6), thiamin hydrochloride (Vitamin B1), riboflavin (Vitamin B2), folic acid (Vitamin B9), cyanocobalamin (Vitamin B12)], Apple Extract, Salt, Pomegranate Extract, Vinegar, Lemon Juice Concentrate, **Sunflower** Lecithin, Beet Juice Extract (for color), Carrot	North America
Beyond Meat	**Beyond Burger**	Beef	Water, **Pea** Protein*, Expeller-Pressed Canola Oil, Refined Coconut Oil, **Rice** Protein, Natural Flavors, Cocoa Butter, **Mung Bean** Protein, Methylcellulose, **Potato** Starch, Apple Extract, Pomegranate Extract, Salt, Potassium Chloride, Vinegar, Lemon Juice Concentrate, **Sunflower** Lecithin, Beet Juice Extract (for color)	North America
Beyond Meat	**Beyond Beef**	Beef	Water, **Pea** Protein*, Expeller-Pressed Canola Oil, Refined Coconut Oil, **Rice** Protein, Natural Flavors, Cocoa Butter, **Mung Bean** Protein, Methylcellulose, **Potato** Starch, Apple Extract, Pomegranate Extract, Salt, Potassium Chloride, Vinegar, Lemon Juice Concentrate, **Sunflower** Lecithin, Beet Juice Extract (for color)	North America

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Beyond Meat	**Beyond Sausage Brat Original**	Pork	Water, **Pea** Protein*, Refined Coconut Oil, **Sunflower** Oil, Natural Flavor, Contains 2% or less of: **Rice** Protein, Faba Bean Protein, **Potato** Starch, Salt, Fruit Juice (For Color), Vegetable Juice (For Color), Apple Fiber, Methylcellulose, Citrus Extract (To Protect Quality), Calcium Alginate Casing	North America
Tofurky	**Plant-Based Chick'n Lightly Seasoned**	Chicken	Water, vital **wheat** gluten, expeller pressed canola oil, organic tofu (water, organic **soybeans**, magnesium chloride, calcium chloride), natural flavors, contains less than 2% of cornstarch, oat fiber, cane sugar, garlic puree, granulated garlic, onion powder, sea salt, spices, **soy** sauce (water, **soybeans**, **wheat**, salt), natural smoke flavor, **sunflower** oil, sesame oil, celery seed oil, citric acid, calcium lactate, potassium chloride, titanium dioxide (for color), gum arabic, xanthan gum	North America
Tofurky	**Smoked Ham Plant-Based Deli Slices**	Pork	Water, vital **wheat** gluten, organic tofu (water, organic **soybeans**, magnesium chloride, calcium chloride), expeller pressed canola oil, contains less than 2% of granulated garlic, sea salt, spices, cane sugar, natural flavors, natural smoke flavor, color (lycopene, purple carrot juice), oat fiber, carrageenan, dextrose, **konjac**, potassium chloride, xanthan gum	North America
Tofurky	**Plant-Based Burger**	Beef	Water, **soy** protein concentrate, structured vegetable protein (**soy** protein isolate, **wheat** gluten, **wheat** starch), canola oil, **wheat** gluten, coconut oil, **soy** protein isolate, fermented corn sugar, natural flavor, modified cellulose, sea salt, natural colors, onion powder, granulated garlic, black pepper.	North America
Tofurky	**Plant-Based Original Sausage Italian**	Pork	Organic tofu (water, organic **soybeans**, magnesium chloride, calcium chloride), vital **wheat** gluten, expeller pressed canola oil, water, **soy** sauce (water, **soybeans**, **wheat**, salt), **soy** flour and/or concentrate, sun dried tomatoes, contains less than 2% of basil, granulated garlic, sea salt, spices, **sunflower** oil, potassium chloride.	North America
Tofurky	**Plant-Based Crumbles Chorizo Style**	Beef	Water, **soy** flour, expeller pressed canola oil, apple cider vinegar, spices, contains less than 2% of sea salt, granulated garlic, paprika oleoresin (for color), natural flavor, potassium chloride, xanthan gum.	North America
Sophie's Kitchen	**Plant-Based Shrimp**	Shrimp	Water, **pea** protein, **potato** starch, canola oil, konjac powder, **pea** starch, seaweed powder, **rice** flakes (from brown **rice**), sea salt, organic agave nectar, organic apple cider vinegar, celery powder, fenugreek, alginate (from seaweed), black pepper, dry mustard, bay leaf, nutmeg, ginger, paprika, cloves, calcium hydroxide.	North America
Sophie's Kitchen	**Plant-Based Fish Fillets**	Fish	Textured vegetable protein (**pea** protein, **pea** starch), canola oil, **rice** flakes (from brown **rice**), **konjac** powder, seaweed powder, **potato** starch, powdered cellulose, organic agave nectar, turmeric, white pepper, sea salt, ginger.	North America
Sophie's Kitchen	**Plant-Based Crab Cakes**	Crab	Water, **pea** protein, **potato** starch, canola oil, **konjac** powder, **pea** starch, seaweed powder, **rice** flakes (from brown **rice**), sea salt, organic agave nectar, organic apple cider vinegar, celery powder, fenugreek, alginate (from seaweed), black pepper, dry mustard, bay leaf, nutmeg, ginger, paprika, cloves, calcium hydroxide.	North America
Sophie's Kitchen	**Toona Black Pepper**	Tuna	Water, **Pea** Protein, Safflower Oil (Expeller Pressed High Oleic), Vegan Spice Mix (**Potato** Starch, Sea Salt, Vinegar Powder, Umami Flavor (Yeast Extract, Natural Flavor), Kombu Powder, Beet Powder, Torula Yeats, Black Pepper, Canola Oil, with no more than 2% Silicon Dioxide as Anti-Caking Agent).	North America
Field Roast	**Plant-Based Nuggets**	Chicken	Water, canola oil, **pea** protein, **wheat** gluten, fava bean protein isolate, tapioca starch, methylcellulose, salt, yeast extract, citrus fiber, maltodextrin, granulated roasted garlic, dextrose, cultured sugar, spices, vinegar, flavor. Coated with: enriched **wheat** flour (**wheat** flour, niacin, reduced iron, thiamine mononitrate, riboflavin, folic acid), water, modified corn starch, modified **wheat** starch, **rice** starch, **rice** flour, dextrose, sugar, salt, guar gum, dried roasted barley malt extract, extractives of paprika (color), yeast, spice extractives. Partially fried in: **soybean** oil.	North America
Field Roast	**Frankfurters**	Pork	Filtered water, vital **wheat** gluten, expeller pressed safflower oil, organic expeller pressed palm fruit oil, barley malt, naturally flavored yeast extract, tomato paste, apple cider vinegar, paprika, sea salt, onions, spices, whole **wheat** flour, garlic, natural liquid smoke, caraway, celery seed, ground yellow mustard, paprika oleoresin.	North America
Field Roast	**FieldBurger**	Beef	Vital **wheat** gluten, filtered water, organic expeller pressed palm fruit oil, barley, garlic, expeller pressed safflower oil, onions, tomato paste, celery, carrots, naturally flavored yeast extract, onion powder, mushrooms, barley malt, sea salt, spices, celery seed, balsamic vinegar, black pepper, shiitake mushrooms, porcini mushroom powder and yellow **pea** flour.	North America
Field Roast	**Celebration Roast**	Turkey	Filtered water, vital **wheat** gluten, expeller pressed safflower oil, naturally flavored yeast extract, barley malt, whole **wheat** flour, granulated garlic, butternut squash, organic **wheat** flakes, onion powder, apples, garlic, mushrooms, yellow **pea** flour, **lentils**, lemon juice, irish moss (sea vegetable) extract, sea salt, tomato paste, red wine, black pepper, rubbed sage, spices, rosemary, paprika, natural liquid smoke and carrots.	North America

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MorningStar Farms	**Meat Lovers Vegan Burgers**	Beef	Water, vegetable oil (corn, canola, and/or **sunflower** oil), **wheat** gluten, **soy** protein isolate, **soy** flour. Contains 2% or less of natural flavor, methylcellulose, cornstarch, salt, cooked onion and carrot juice concentrate, **sunflower** oil, spices, garlic powder, onion powder, yeast extract, tomato paste (tomatoes), xanthan gum.	North America
MorningStar Farms	**Veggie Lovers Vegan Burgers**	Beef	Water, onions, carrots, mushrooms, cooked brown **rice** (water, brown **rice**), celery, vegetable oil (corn, canola, and/or **sunflower** oil), brown **lentils** (water, **lentils**), spinach, **soy** flour, cooked **millet** (water, **millet**), **soy** protein isolate. Contains 2% or less of pumpkin seeds, **sunflower seeds**, spices, methylcellulose, sweet potato powder, salt, red bell peppers, sugar, green bell peppers, **potato** starch, dried garlic, yeast extract, **konjac** flour, xanthan gum, tomato powder, natural flavor, garlic powder.	North America
MorningStar Farms	**Chik'n Nuggets**	Chicken	Water, **wheat** flour, **soy** flour, vegetable oil (corn, canola and/or **sunflower** oil), **soy** protein isolate. Contains 2% or less of **wheat** gluten, **wheat** starch, yellow corn flour, methylcellulose, **potato** starch, cornstarch, yeast extract, sugar, salt, natural flavors, dextrose, spices, onion powder, yeast, potassium chloride, glutamic acid, paprika (color), leavening (sodium acid pyrophosphate, sodium bicarbonate), garlic powder, citric acid, xanthan gum, barley malt extract.	North America
MorningStar Farms	**Meatballs**	Beef	Water, **wheat** gluten, vegetable oil (corn, canola and/or **sunflower** oil), **soy** flour, **soy** protein concentrate, **wheat** flour, spice. Contains 2% or less of methylcellulose, cooked onion and carrot juice concentrate, garlic powder, onion powder, salt, yeast extract, natural flavor, **potato** starch, **konjac** flour, sugar, dextrose, **soybean** oil.	North America
MorningStar Farms	**Vegan Grillers Crumbles**	Beef	Water, **soy** flour, corn oil, yeast extract, cooked onion and carrot juice concentrate. Contains 2% or less of reduced sodium tamari **soy** sauce (water, **soybeans**, salt, alcohol), natural flavor, salt, garlic powder, onion powder, gum acacia, sugar, spices.	North America
Lightlife	**Plant-Based Burgers**	Beef	Water, **Pea** Protein, Canola Oil, Coconut Oil, Natural Flavors, Less Than 2% Modified Cellulose (from Plant Fiber), Sea Salt, Vinegar, Beet Powder (Color), Cane Sugar, Cherry Powder (to promote color retention).	North America
Lightlife	**Smart Dogs**	Pork	Water, **Soy** Protein Isolate, **Soybean** Oil, Evaporated Cane Sugar, **Pea** Protein Isolate, Tapioca Starch, Salt, Potassium Chloride, Yeast Extract, Carrageenan, Dehydrated Garlic, Natural Flavor, Natural Smoke Flavor, Xanthan Gum, Fermented **Rice** Flour, Guar Gum, Oleoresin Paprika (Color), Vital **Wheat** Gluten.	North America
Lightlife	**Plant-Based Ground**	Beef	Water, **Pea** Protein, Canola Oil, Coconut Oil, Natural Flavors, Less Than 2% Of Modified Cellulose (From Plant Fiber), Sea Salt, Vinegar, Beet Powder (Color), Cane Sugar, Cherry Powder (To Promote Color Retention).	North America
Lightlife	**Smart Tenders® Plant-Based Chicken**	Chicken	Tender: Water, **Wheat** Gluten, **Soy** Protein Concentrate, Tapioca Starch, **Wheat** Starch, Less Than 2% of: Sea Salt, Yeast Extract, Methylcellulose, Natural Flavor, Salt, Sodium Alginate, Calcium Sulphate, **Potato** Starch. Savory Rub: Dehydrated Mustard, Sea Salt, Evaporated Cane Sugar, Onion, Spices, Garlic, Dehydrated Lemon Peel, Paprika, Natural Flavor.	North America
Lightlife	**Plant-Based Bratwurst Sausages**	Pork	Water, **Pea** Protein, Canola Oil, Modified Cellulose (From Plant Fiber), Less Than 2% of Natural Flavors, Cane Sugar, Salt, Tapioca Starch, Citrus Fiber, Fava Bean Protein, Brown **Rice** Protein, Beet Powder (Color), Yeast Extract, Dried Torula Yeast, Dehydrated Lemon Peel, Smoked Sugar.	North America
Alpha Foods	**Chik'n Nuggets**	Chicken	Chik'n (Water, **Soy** Protein Concentrate, Textured **Wheat** Protein [**Wheat** Gluten, **Wheat** Starch, Vitamin E (Tocopherols)], Canola Oil, Vegan Chik'n Seasoning [Maltodextrin, Yeast Extract, Salt, Gum Arabic, Natural Flavors, Citric Acid], Methylcellulose, Yeast Extract, Natural Vegan Flavor), Breading (**Wheat** Flour, **Wheat** Gluten, Corn Starch, Canola Oil, Sugar, Yeast, Dextrose, Leavening [Sodium Acid Pyrophosphate, Sodium Bicarbonate], Garlic Powder, Onion Powder, Salt, **Sunflower** Oil	North America
Alpha Foods	**Meatless Sausage Patty**	Pork	Filtered Water, **Soy** Protein Concentrate, Structured Vegetable Protein (Isolated **Soy** Protein, **Wheat** Gluten, **Wheat** Starch), Seasoning (Sugar, Yeast Extract, Salt, Spices, Torula Yeast, Garlic Powder, Onion Powder, Citric Acid, Spice Extractive), **Soybean** Oil, **Soy** Sauce (Water, **Soybeans**, Salt, Alcohol, **Wheat**), Methylcellulose, **Wheat** Gluten, Malt Extract, Cellulose Fiber, Beet Juice	North America
Alpha Foods	**Original Beefy Burger**	Beef	Filtered Water, **Soy** Protein Concentrate, Structured Vegetable Protein (Isolated **Soy** Protein, **Wheat** Gluten, **Wheat** Starch), Onions, Onion Seasoning (Sea Salt Blend [Potassium Chloride, Sea Salt], Sugar, Tapioca Dextrin, Yeast Extract, Garlic Powder, Onion Powder, Dehydrated Onion, Grill Flavor [From **Sunflower** Oil], Spices [Including Celery Seed], Dehydrated Red And Green Bell Pepper, Salt, Tomato Powder, Molasses, Spice Extractive, Citric Acid), **Soybean** Oil, **Wheat** Gluten, Less Than 2% **Soy** Sauce (Water, **Soybeans**, Salt, Alcohol, **Wheat**), Methylcellulose, Yeast Extract, Malt Extract, Seasoning (Yeast Extract, Salt)	North America

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Quorn	**Quorn Ultimate Burger**	Beef	Water, Textured Proteins (**Wheat** Gluten, **Pea** Protein, **Wheat** Starch, **Wheat** Flour, **Pea** Protein Isolate), Vegetable Oils (**Sunflower**, Palm, Coconut), **Mycoprotein** (10%), Natural Flavouring, Red Beet Juice (4%) (Red Beet, Lemon Juice Concentrate), Stabiliser: Methylcellulose; **Potato** Protein, Barley Malt Extract	United Kingdom
Quorn	**Quorn Battered Fishless Fillets**	Fish	**Rice** Flake (**Rice**, Emulsifier: Sodium Alginate), **Wheat** Flour (**Wheat** Flour, Calcium Carbonate, Iron, Niacin, Thiamine), Water, **Mycoprotein** (10%), Vegetable Oils (**Sunflower**, Rapeseed), Natural Flavouring, **Rice** Flour, Maize Flour, **Wheat** Starch, Malt Vinegar Powder (0.7%) (Barley), Thickener: Methyl Cellulose; **Wheat** Dextrose, Sea Salt (0.28%), Salt, Citric Acid, Sugar, Yeast Extract, Garlic Powder, Onion Powder, Black Pepper	United Kingdom
Quorn	**Quorn Vegan Nuggets**	Chicken	**Mycoprotein** (54%), **Wheat** Flour (**Wheat** Flour, Calcium Carbonate, Iron, Niacin, Thiamine), Vegetable Oils (**Sunflower**, Rapeseed), Water, **Wheat** Starch, Firming Agents: Calcium Chloride, Calcium Acetate; **Pea** Protein, **Potato** Protein, Salt, Natural Flavouring, **Wheat** Gluten, **Pea** Fibre, **Wheat** Semolina, Yeast, Stabilisers: Carrageenan, Sodium Alginate; Sage & Sage Extract, Onion Powder, Garlic Powder, White Pepper, Onion Extract, Colour: Paprika Extract; Raising Agent: Ammonium Bicarbonate	United Kingdom
Quorn	**Quorn Vegan Pepperoni Slices**	Pork	**Mycoprotein** (53%), Vegetable Oils (Palm, Rapeseed), Water, Natural Flavouring, **Potato** Protein, **Pea** Fibre, Tapioca Starch, Firming Agent: Calcium Chloride; Stabiliser: Carrageenan; Colours: Paprika Extract, Iron Oxide; Preservative: Potassium Sorbate; Ground Cayenne Chilli, Smoke Flavouring	United Kingdom
Quorn	**Quorn Vegan Smoky Ham Free Slices**	Pork	**Mycoprotein** (78%), Water, Natural Flavourings (contain Smoke Flavourings, Colour: Iron Oxide), Gelling Agents: Agar and Locust Bean Gum, **Potato** Protein, Salt, **Pea** Fibre, Preservative: Potassium Sorbate	United Kingdom
Linda McCartney	**Vegetarian Sausages**	Pork	**Soya** Rehydrated textured protein (70%), water, rapeseed oil, **Soya** protein concentrate, seasoning (sulphites) (dextrose, salt, flavouring, onion powder, yeast extract, colour: red iron oxide), fortified **wheat** flour (**wheat** flour, calcium carbonate, iron, niacin, thiamin), stabiliser: methyl cellulose; tomato purée, salt, raising agent: ammonium carbonates	United Kingdom
Linda McCartney	**Vegetarian Meatballs**	Beef	Rehydrated textured **soya** protein (53%) (water, textured **soya** protein), water, onion purée (10%), rapeseed oil, basil, tomato purée, **soya** protein concentrate (2.7%), **chickpea** flour, stabiliser: methyl cellulose; yeast extract, salt, parsley, oregano, onion powder, malted barley extract, maltodextrin, garlic powder, dextrose, black pepper, tomato powder, flavouring, white pepper	United Kingdom
Linda McCartney	**Vegetarian Southern Style Chicken Fillet Burger**	Chicken	Filling (78%) [rehydrated textured **soya** and **wheat** protein (65%) (water, **soya** protein, **wheat** gluten, salt, **soya** bean oil, natural flavouring), water, rapeseed oil, **chickpea** flour, **soya** protein concentrate, stabiliser: methyl cellulose, **rice** flour, yeast extract, onion powder, natural flavouring, garlic powder], southern fried coating (17%) [fortified **wheat** flour (**wheat** flour, calcium carbonate, iron, niacin, thiamin), water, maize starch, maize flour, **wheat** starch, black pepper, dextrose, **rice** flour, salt, **wheat** gluten, yeast, yeast extract, fennel, black pepper extract, paprika, thyme extract, colour: paprika extract, turmeric extract, rapeseed oil], rapeseed oil	United Kingdom
Moving Mountains	**Plant-Based Hot Dog**	Pork	Water, Vegetables (Onion, Carrot), Coconut Oil, **Sunflower Seeds**, Thickeners (Carrageenan, Methyl Cellulose, **Konjac**), Salt, Natural Flavoring, Spice Extract, Dextrose Monhydrate, Spices, Acidity Regulator (Vegan Lactic Acid), Yeast extract, Natural Colour (Iron Oxide), Natural Smoke Flavoring	United Kingdom
Rügenwalder Mühle	**Vegan Beef Steak**	Beef	Water, 13% **soy** protein concentrate, **wheat** gluten, rapeseed oil, flavouring, thickener: methyl cellulose, 2% **soy** protein isolate, colouring foodstuffs: concentrate made from beetroot, carrot, radish; starch, salt, distilled vinegar, **wheat** flour, **pea** fibre, spices, glucose	Germany
Rügenwalder Mühle	**Vegan Chicken Fillet**	Chicken	Water, 10% **wheat** gluten, **soy** protein concentrate, rapeseed oil, starch, thickener: methyl cellulose, **soy** protein isolate, salt, natural flavouring, distilled vinegar, 1% **wheat** flour, sugar, **pea** fibre, spices	Germany
Rügenwalder Mühle	**Vegan Nuggets**	Chicken	Drinking water, **wheat** flour, 11% **soya** protein concentrate, **wheat** gluten, rapeseed oil, 4% **soya** protein isolate, table salt, thickening agent: methylcellulose, distilled vinegar, maize flour, natural flavouring, **wheat** starch, sugar, spices, dextrose, yeast	Germany
Rügenwalder Mühle	**Vegan Mincemeat**	Beef	Water, 26% **soya** protein concentrate, distilled vinegar, rapeseed oil, table salt, natural flavouring, spices, caramel	Germany
Rügenwalder Mühle	**Vegan Salami Classic**	Pork	Drinking water, rapeseed oil, 6% **wheat** gluten, flavouring, thickening agent: carrageenan, **konjac**, methylcellulose; table salt, **potato** protein, 1,6% **wheat** flour, spices, dextrose, citrus fibers, colouring agents: iron oxide, carotene	Germany

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Vantastic Foods	**Vantastic Burger**	Beef	Drinking water, textured **soy** protein mixture (12%), (**soy** protein isolate (76%), corn starch), textured **soy** protein concentrate (10%), coconut oil, natural flavors, thickener: methyl cellulose; Table salt, dextrose, psyllium husks, inulin, beetroot extract, natural paprika flavor	Germany
Vantastic Foods	**Vantastic Mock Duck**	Duck	**Wheat** protein (74%), **soy** oil, **wheat** starch, sesame oil, **soy** sauce (black **soybeans**, salt), sugar, salt, ginger, chili pepper, hydrolyzed **soy** protein	Germany
Vantastic Foods	**Vantastic Nuggets**	Chicken	Drinking water, **wheat** flour, rapeseed oil, textured **soy** protein concentrate (10%), textured **wheat** protein mixture (4%) (**wheat** protein (75%), **wheat** flour), **wheat** protein (3%), natural flavors, thickener: methyl cellulose; iodized table salt (table salt, potassium iodate), **soy** protein isolate (1%), corn flour, **wheat** starch, spices, table salt, dextrose, yeast, **potato** starch	Germany
Veggyness	**Vegan Bacon**	Pork	Seitan (water, **wheat** protein) (87%), onions, coconut fat, aroma, smoke aroma, rock salt, oat fiber, yeast extract, **pea** protein, psyllium powder, thickener: locust bean gum; Dye: iron oxide; Beech wood smoke.	Germany
Wheaty	**Vegan Slices Chorizo**	Pork	Seitan (water, **wheat** protein) 78%, coconut fat, onion, yeast extract, **soy** sauce (water, **soybeans**, sea salt), red bell pepper, garlic, rock salt, spices, paprika extract, acidifying agent: vegan lactic acid	Germany
Wheaty	**Salami**	Pork	Seitan (water, **wheat** protein) 84%, high oleic **sunflower** oil, spices (contains celery and mustard), rock salt, yeast extract, onion, thickening agent locust bean gum and guar gum, paprika extract, natural beech wood smoke	Germany
Wheaty	**Vegan Superhero Burger**	Beef	Seitan (water, **wheat** protein) (54%), textured **wheat** protein (**wheat** protein, **wheat** flour) high oleic **sunflower** oil, onion, **soy** sauce (water, **soybeans**, sea salt), yeast extract, spices, rice flour, thickening agent locust bean gum	Germany
Heura Foods	**Chicken Bites**	Chicken	Water, concentrated **soy** protein, olive oil, salt, flavorings, spices (paprika, pepper, ginger, nutmeg, mace, cardamom)	Spain
Heura Foods	**Burger**	Beef	Water, rehydrated **soy** protein 17.81%, **sunflower** oil 10.21%, **rice** flour, contains 2% or less of: onion, maltodextrin, sugar, beet extract, vegetable fiber, methylcellulose, salt, black pepper, natural aroma, iron and vitamin B12	Spain
Heura Foods	**Meatballs**	Beef	Water, rehydrated **soy** protein 13.71%, **sunflower** oil 10.57%, **rice** flour, contains 2% or less of: onion, maltodextrin, sugar, beet extract, vegetable fiber, methylcellulose, salt, black pepper, natural aroma, iron and vitamin B12	Spain
The Alternative Meat Co.	**The Alternative Mince**	Beef	Water, Vegetable Protein (29%) (**Soy**, **Wheat**, **Pea**), Vegetable Oil, Stock Powder, **Pea** Fibre, Tapioca Starch, Vegetable Gums (Xanthan, Carrageenan, Guar), Thickener (Methyl Cellulose), Natural Colours (Beet, Caramel I, Paprika Extract), Salt, Parsley, Pepper, Natural Flavour, Vegetable Extract	Australia
The Alternative Meat Co.	**The Alternative Sausage**	Pork	Water, Vegetable Protein (19%)(**Soy**, **Wheat**, **Pea**), Vegetable Oil, Casing (Calcium Alginate), Sautéed Onions, Thickeners (Methyl Cellulose, Guar Gum, Xanthan Gum, Carrageenan Gum), Stock Powder, **Pea** Fibre, Tapioca Starch, Herbs and Spices (Pepper), Natural Colours (Beet, Caramel I, Paprika Extract), Natural Flavours, Salt, Vegetable Extract	Australia
Vegie Delights	**Vegie Roast**	Beef	Water, Vegetable Protein (25%) (**Wheat**, **Soy**, **Wheat** Gluten), Onion, Canola Oil, Starch (Tapioca, **Potato**), Flavour [Sugar, Maltodextrin, Salt, Yeast Extract, Flavour, Antioxidant (Vitamin E)], Oats, Crumb (**Wheat**), Garlic, Thickener (Carrageenan Gum), Minerals (Zinc, Iron), Vitamin (B12), Acidity Regulator (Citric Acid), Potassium Chloride, Chilli	Australia
Vegie Delights	**Tender Fillets**	Chicken	Water, Vegetable Protein (22%) (**Soy**, **Pea**, **Wheat** Gluten), Canola Oil, Starch (Tapioca), Flavours (**Wheat**, **Soy**), Sugar, **Wheat** Fibre, Thickener (Carrageenan Gum), Salt, Yeast Extract, Potassium Chloride, Acidity Regulator (Citric Acid), Minerals (Zinc, Iron), Vitamin (B12)	Australia
Vegie Delights	**Vegie Sausages**	Pork	Water, Vegetable Protein (22%) (**Wheat** Gluten, **Soy**), Canola Oil, Starch (Tapioca, **Potato**), Seasoning [**Soy**, Salt, Vegetable Protein (Maize), **Rice** Bran Oil, Onion, Tomato Powder, **Wheat** Protein, Maltodextrin, Flavour, Garlic, Sugar, Spices, Thickeners (Guar Gum, Carrageenan Gum), Dextrose, Potassium Chloride, **Rice** Flour, **Wheat** Flour, Vegetable Powder, Yeast Extract (Barley)], Oats, Crumb (**Wheat**), Minerals (Zinc, Iron), Vitamin (B12), Fermented **Rice**	Australia

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Coles Nature's Kitchen	**Original Meat Free Sausages**	Pork	Water, Textured **Wheat** Protein (**Wheat** Protein, **Wheat** Flour), Textured **Soy** Protein (Defatted **Soy** Flour, Colour (Caramel 1), Coconut Powder, Canola Oil, Emulsifier (461) Maltodextrin, Maize Starch, Natural Flavouring, Yeast Extract, Thickener (461, 412) **Wheat** Protein, Lipoflex (Potato Powder), **Pea** Protein, Salt, Dehydrated Onion, Dehydrated Garlic, Flavour Enhancer (L-Cysteine) **Potato** Fibre, Parsley, Pepper, Dried Yeast, Stabiliser (401) Rosemary, Garlic, **Rice** Flour, Firming Agent (509)	Australia
Coles Nature's Kitchen	**Meat Free Smokey Grill Burgers**	Beef	Water, Defatted **Soy** Flour, **Wheat** Protein, Coconut Oil, Canola Oil, Thickener (461) Maltodextrin, **Wheat** Flour, Smoke Grill Flavor (1.0%) (Maltodextrin, Natural Flavouring, Natural Smoke Flavour), Natural Flavouring, Yeast Extract, Lipoflex (**Potato** Fibre), Dehydrated Vegetables (Dehydrated Onion, Dehydrated Garlic), Salt, Herbs & Spices (Parsley, Pepper, Rosemary), Colour (Caramelised Sugar, Caramel 1) Flavour Enhancer (L-Cysteine) Dried Yeast, **Rice** Flour	Australia
Coles Nature's Kitchen	**Meat Free Chicken Style Tenders**	Chicken	Water, Textured **Wheat** Protein (**Wheat** Protein, **Wheat** Flour), Vegan Chicken Flavour (Coconut Oil, Maltodextrin, Natural Flavouring, Yeast Extract, Salt, Flavour Enhancer (L-Cysteine) Dehydrated Garlic, Rosemary), Canola Oil, Thickener (Maize Starch, **Wheat** Protein, Thickener (461) **Pea** Protein, **Potato** Fibre, Dried Yeast), **Potato** Starch	Australia
V2	**V2 Mince**	Beef	Water, **soy** protein, vegetable oils, thickeners (methyl cellulose, modified starch, carrageenan), flavours (contains Glutamic Acid), Colours (caramelized sugar, beetroot powder), salt, yeast extract, minerals (zinc, iron), vitamins (B3, B6, B12), antioxidant (ascorbic acid)	Australia
V2	**V2 Burger**	Beef	Water, **soy** protein, vegetable oils, thickeners (methyl cellulose, modified starch, carrageenan), flavours (contains Glutamic Acid), Colours (caramelized sugar, beetroot powder), onion, salt, yeast extract, herbs (parsley, thyme), minerals (zinc, iron), vitamins (B3, B6, B12), antioxidant (ascorbic acid)	Australia
Made with Plants	**Meat-free Premium Mince**	Beef	Water, Vegetable Protein (**Soy**) (19%), Vegetable Oil, Cocoa Butter, Thickeners (Methylcellulose, Guar Gum), Vegetable Protein Powder, Vegetable Protein Extract (**Soy**), Smoke Flavour, Yeast Extract, Beetroot Powder, Sea Salt, Natural Colour (Caramel I)	Australia
Fable	**Plant-Based Braised Beef**	Beef	Shiitake Mushroom (62%), Coconut Oil, Isolated **Soy** Protein, Sugar, Tapioca Flour, Gluten free **Soy** Sauce, Yeast Extract, Salt, White Pepper, Black Pepper	Australia
Eaty	**BBQ Beef Style Burger**	Beef	Water, Textured Vegetable Protein (**Wheat**, **Soy**), Plant Proteins (**Wheat**, **Pea**), Methylcellulose, Maltodextrin (from Maize), Vegetable Oil (Canola), Maize Starch, Coconut Oil, Yeast & Yeast Extracts, Natural Flavourings, Vegetable Fibre, Salt, Dehydrated Vegetables, Mushroom Extract, Fermented Sugars, Spices & Spice Extracts (Paprika Extract), Herb & Herb Extracts, Natural Smoke Flavour, Fermented **Rice** Powder, Vitamin B12	Australia
Unreal Co	**Beef Brat Vegan Sausages**	Beef	Water, Protein [**Soy**, **Rice**], Starches [**Potato**, Corn], Natural Vegan Brat Spice Mix, Vegan Egg Replacer, Fat [Coconut Oil, Canola Oil], Plant Based Sausage Skin, Potassium Sorbate, Citric Acid	Australia
Unreal Co	**Chick'n Schnitzel**	Chicken	Water, Protein [**Soy**, **Pea**, **Rice**], Starches [Corn, **Potato**], Fats [Canola, Coconut], Vegan Chicken flavoring, Sugar, Vegan Egg Replacer, Inactive Yeast, Herbs and Spices, Citric Acid, Potassium Sorbate	Australia
Bean Supreme	**Beetroot Burgers**	Beef	Black Beans (49%), Beetroot (23%), Onion, Pumpkin Seeds (3.5%), Caramelised Onion, Buckwheat (3.2%), Quinoa (2.6%), Gelling Agents (Methylcellulose, Carrageenan, Locust Bean Gum), Sea Salt, Spices, Yeast Extract	New Zealand
Bean Supreme	**Hemp Burgers**	Beef	Green **Peas** (43%), Onion, **Chickpeas** (15%), Vegetable Oil, Hemp (6%) (seeds, protein), Spinach (4%), Kale (2%), Coriander, Gelling Agents (Methylcellulose – from plant fibre, Locust Bean Gum – from carob seeds, Carrageenan – from red seaweed), Sweetcorn, Salt, Potato Fibre, Lemon Juice Concentrate, Parsley, Paprika, Garlic, Cumin, Black Pepper	New Zealand
Bean Supreme	**Gourmet Burgers**	Beef	Tofu (40%) (Water, **Soy** Beans, Firming Agent (Calcium Sulphate)), Onion, Vegetable Oil, Vegetable Protein (**Soy**, Colour (150d)), **Soy** Protein, Gluten (**Wheat**), Tapioca Starch, **Soy** Sauce (**Soy**, **Wheat**), Yeast Extract, Gelling Agents (Methylcellulose – from plant fibre, Carrageenan – from red seaweed, Locust Bean Gum – from carob seeds), Parsley, Yeast, Sugar, Garlic, Tomato, Paprika, Black Pepper, Salt, Caramelised Sugar, Acidity Regulator (Citric Acid)	New Zealand
Bean Supreme	**Gluten Free Roast Garlic Sausages**	Pork	Tofu (43%) [Water, **Soy** Beans, Firming Agent (Calcium Sulphate)], Onions, Water, Vegetable Fat (Coconut), **Potato** Fibre, **Potato** Starch, Salt, Gelling Agents (Methyl Cellulose, Carrageenan), Egg White, Sugar, Yeast, Herbs & Spices, Parsley, Yeast Extract, Garlic, Onion Flakes, Caramelised Sugar, Roasted Garlic (0.3%), Food Acid (Citric)	New Zealand

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Bean Supreme	**Marinated Chili and Lime Jackfruit**	Pork	**Jackfruit** (52%). Water, Onion, Coconut Sugar, **Sunflower** Oil, Red Thai Chilli Pepper (3%), Lime Juice (3%), Garlic, Herbs and Spices, Vinegar, Salt, Chilli	New Zealand
Sunfed Foods	**Boar Free Bacon**	Pork	Water, **Pea** Protein, Cold Pressed Extra Virgin Olive Oil, Yeast Extract, **Pea** Fibre, Hickory Liquid Smoke, Smoked Salt (Beech, Hickory), Fermented Red **Rice** Powder, Citric Acid	New Zealand
Sunfed Foods	**Chicken Free Chicken**	Chicken	Water, **Pea** Protein, **Rice** Bran Oil, **Pea** Fibre, NZ Pumpkin, Natural Yeast Extract, NZ Maize Starch	New Zealand
Starfield	A01 Ground Burger Meat	Beef	Non-GMO **soy** protein, yeast extract, coconut oil, cocoa spices, sugar, salt, beetroot red	China
Zhenmeat	**Plant-based beef flavored ground meat**	Beef	Water, **soy** protein isolate, vegetable oil, fermented vegetable oil (caramel color), starch, sugar, salt, monosodium glutamate, food flavoring, beet powder, spice	China
Z-Rou	**Z-Rou Plant-based meat**	Pork	Water, textured **soy** protein, coconut oil, protein isolate powder, distarch phosphate, corn starch, yeast extract, **konjac** powder, carageenan, mushroom powder, salt, baking soda, sorghum red	China
Whole Perfect Food / Qishan Foods	**Vegetarian Chicken Wing Stewed**	Chicken	**Soybean** fibre, isolated **soy** protein, salt, sugar, vegetarian spices	Shenzhen/Hong Kong SAR
Whole Perfect Food / Qishan Foods	**Vegan Zi Zi Spareribs**	Pork	Isolated **soy** protein, food starch, vegetable oil, water, salt, sugar, fermented **soy** sauce, vegetarian seasonings	Shenzhen/Hong Kong SAR
Whole Perfect Food / Qishan Foods	**Vegetarian Mac Chicken Nugget**	Chicken	Textured **Soy** protein, isolated **soy** protein, bread crumb, **soybean** salad oil, salt	Shenzhen/Hong Kong SAR
Whole Perfect Food / Qishan Foods	**Vegan Seafood Stewed Meat**	Fish	Water, **konjac** powder, food starch, mushroom, celery, vegetable oil, salt, sugar, fermented **soy** sauce, white pepper and vegetarian seasonings	Shenzhen/Hong Kong SAR
Whole Perfect Food / Qishan Foods	**Vegetarian Mini Sausage (Hot Dog)**	Pork	**Wheat** protein, **soy** protein, salt, mushroom, taro, vegetarian spices, **soybean** salad oil, salt	Shenzhen/Hong Kong SAR
Omnipork	**Omnipork**	Pork	Water, Protein Blend (**Soy** Protein Concentrate, **Soy** Protein Isolate, Shiitake Fermented **Pea** & **Rice** Protein), Thickeners (Methylcellulose, Maltodextrin), Yeast Extract, **Potato** Starch, Cane Sugar, Salt, Natural Flavour (Contains Canola and **Sunflower** Oil), Barley Malt Extract, Colour (Beet Red), Dextrose	Hong Kong SAR
Omnipork	**Omnipork Luncheon**	Pork	Water, Protein Blend (**Soy** Protein Concentrate, Vital **Wheat** Gluten, **Soy** Protein Isolate), Coconut Oil, Thickeners (Methylcellulose, Maltodextrin), Yeast Extract, Natural Flavour, **Potato** Starch, Salt, Natural Colour (Beet Red).	Hong Kong SAR
Omnipork	**Omnipork Strip**	Pork	Water, **Soy** Protein Concentrate, **Sunflower** Oil, Yeast Extract, Salt, Sugar, Wheat Starch, Acidity Regulator (Sodium Hydrogen Carbonate), Thickener (Maltodextrin), Natural Flavour, Natural Colour (Beet Red), White Pepper, Barley Malt Extract	Hong Kong SAR
Vegelink	**Cantonese Style BBQ**	Pork	Flour, Sugar, Chinese Herbs (Licorice, Angelica, Chinese Cinnamon), Salt, Vegetarian Seasoning (Sugar, Salt, Non-GMO **Soy** Sauce), Colour (Sunset Yellow FCF, Ponceau 4R)	Hong Kong SAR
Vegelink	**Vegan Stewed Mutton**	Lamb	Water, Mushroom, **Soya** Protein, **Wheat** Starch, Palm Oil, Sugar, Salt, Vegetarian Spices, Texture Modifier (Transglutaminase)	Hong Kong SAR
Batata Greens	**Vegan Mini Wonton**	Pork	Flour, Dried Mushroom, Vegetarian Meat Shreds (**Wheat** Flour, **Soybean** Oil), Vegetarian Meatloaf (**Wheat** Protein, **Soy** Protein, **Wheat** Starch, Calcium Carbonate, Calcium Sulphate), Cabbage, Yam Bean, Carrot, **Soybean** Oil, **Soy** Sauce (Water, **Soybean**, **Wheat**, Salt), Vegetarian Mushroom Oyster Sauce (Water, Sugar, **Soybean**, Salt, **Wheat**, Mushroom Power), Chinese Toon, Sugar, Salt, **Potato** Starch, Five-Spice Powder	Hong Kong SAR
Batata Greens	**Veggie Squid Balls**	Squid	Water, Thickener (Curdlan Gum), **Konjac** Powder, **Potato** Starch, **Wheat** Fibre, **Soy** Protein Powder, Sea Tangle Extract, Sugar, Salt	Hong Kong SAR
Ji Hong Xiang	**Ji Hong Xiang Veg. Frost Steak**	Beef	**Soybean** fiber, **wheat** protein condense, vegetable oil, salt, vegetarian seasonings, vegan binder	Taiwan
San Yang Food 三陽食品	**Vegetarian Jerky**	Beef	Texturized Vegetable Protein (**Wheat** Protein, Corn Starch, **Soy** Oil), Sugar, Sweetener (Sorbitol), **Soy** Sauce, Salt, Yeast Extract, Licorice Powder, Caramel Color, Black Pepper, Chili Powder, Flavoring (Citric Acid), Prickly Ash Powder, Flavoring (Disodium Succinate), Flavorings	Taiwan

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Vegefarm	**Vegan Shrimp**	Shrimp	Water, Glucomannan, Sweetener (D-Sorbitol), Starch, Pasting Agent (Curdlan), Salt, Sugar, Flavoring Agent (Glycine), Spices (Contains Sesame), Paprika Colors, Quality Improvement Agent (Calcium Oxide)	Taiwan
Vegefarm	**Vegan Shiitake Steak**	Beef	**Soy** Protein NON-GMO (Contains **Soy**, **Wheat**), Shiitake Fungus, **Wheat** Protein (Contains **Wheat**), Canola Oil, Starch, Curdlan, Salt, Sugar, Black Pepper, Brew **Soy** Sauce (Contains **Soy**, **Wheat**, Sugar, Salt), Vegetarian Seasoning, Vegetarian Essence.	Taiwan
Vegefarm	**Vegan Half Chicken**	Chicken	Water, NON-GMO **Soy** Protein (Contains **Soy**, **Wheat**), **Wheat** Starch (Contains **Wheat**), Plant Fibres, Canola Oil, **Wheat** Protein (Contains **Wheat**), Starch, Salt, Sugar, White Pepper, Flavoring Agent (Glycine), Bean Skin (Contains **Soy**), Spices (Contains **Soy**, Peanut, Sesame)	Taiwan
Vegefarm	**Vegan Lamb Chunk**	Beef	Water, NON-GMO **Soy** Protein (Contains **Soy**, **Wheat**), **Wheat** Starch (Contains **Wheat**), Plant Fibres, Mushroom, Canola Oil, **Wheat** Protein (Contains **Wheat**), Starch, Sugar, Brew **Soy** Sauce (Contains **Soy**, **Wheat**), Salt, Flavoring Agent (Glycine), Cinnamon, Anise, Cumin, Tangerine Peel, Peppercorns, Angelica powder, White Pepper, Vegetarian Essence	Taiwan
Vegefarm	**Vegan Fish Steak**	Fish	Water, NON-GMO **Soy** Protein (Contains **Soy**, **Wheat**), **Wheat** Starch (Contains **Wheat**), Plant Fibres, **Wheat** Protein (Contains **Wheat**), Corn Starch, High-gluten Flour (Contains **Wheat**), **Potato** Starch, Canola Oil, Starch, Salt, Yeast Powder, Flavoring Agent (Glycine), Laver, Spices (Contains Sesame, **Sunflower Seeds**)	Taiwan
Unlimeat	**Unlimeat Sliced Beef (BBQ)**	Beef	BBQ Sauce [Cocoa Butter, Yeast Extract Powder, Dextrose Monohydrate, Dried **Potato** Powder, Acidity Regulator (Potassium Pyrophosphate)], **Wheat** Protein, **Sunflower** Oil, **Soy** Protein Isolate, Roasted **Lentil** Bean Powder, Roasted **Chickpea** Powder, **Rice** Powder, Roasted Quinoa Powder, Salt, Cacao Powder	South Korea
Phuture Meat	**Phuture Minced**	Pork	Water, **Soy** Protein Concentrate, Natural Flavours, **Soy** Flour, Methylcellulose, Extra Virgin Olive Oil, Protein Blend (**Chickpea**, **Rice**, **Pea**, Mushroom), **Potato** Starch, Chicory Root Fiber, Natural Colours (Red Beet, Lycopene), Dextrose, Calcium Carbonate, Vitamins (B6, B9, B12, E)	Singapore
OKK	**OKK Veg. Slice Fish**	Fish	**Soya** protein, vegetable oil (palm oil, **soya** oil), spices, salt, sugar, whey protein, **wheat** flour, water, **soya** bean curd sheet, seaweed sheet, **soya** sauce	Malaysia
OKK	**OKK Vegan Smoked Black Pepper Sausage**	Pork	Isolated **soy** protein, carrageenan, salt, sugar, **soya** bean oil, flavour enhancer (E639, E627), black pepper, water, smoked process	Malaysia
OKK	**OKK Vegan Original Sausage**	Pork	Isolated **soy** protein, carrageenan, salt, **soya** bean oil, flavour enhancer (E639, E627), natural color (monascus, malt extract), water	Malaysia
OKK	**OKK Veg. Medium Prawn**	Prawn	**Konjac**, curdlan, salt, sugar, acidity regulator (E526, E452(i)), flavour enhancer (E639, E627), water, natural colour (E160c)	Malaysia
Fry Family Food	**The Big Fry Burger**	Beef	Vegetable Protein (**Soya**, **Wheat** (Gluten)), Onions, Vegetable Oil (**Sunflower Seed**), Dijon Mustard, Corn Flour, Salt, Coriander Seeds, Thickener (Methylcellulose), Onion Powder, Beetroot Powder, Paprika, Smoke Flavour, Garlic Powder, Flavourings (0.1%), Cilantro, White Pepper, Black Pepper, Parsley, Turmeric, Colourant: Caramel IV	South Africa
Fry Family Food	**Wood Smoked Breakfast Bangers**	Pork	Vegetable Protein (12%) (**Soy**, **Wheat** [Gluten]), Vegetable Oil (**Sunflower Seed**), **Wheat** [Gluten] Flour, **Potato** Starch, Salt, Modified Starch, Flavourings (2%) (Smoky Savoury Flavour, Corn Starch, Salt, Onion, Pepper, Anti-caking Agent [E551]), Maize Starch, Thickener (Methylcellulose), Ground Coriander, Paprika, Mustard	South Africa
Fry Family Food	**Chicken-style Nuggets**	Chicken	Crumb: **Wheat** Flour, Yeast, Improving Agent (Vitamin C), **Sunflower** Oil. Nugget: Vegetable Protein (11%) (**Soy**, **Wheat**), **Wheat** Flour, Flavourings, Maize Starch, Yeast Extract, Plant Fibre, Thickener (Methyl Cellulose), Salt, Rosemary, Marjoram, Sage, Mustard Seeds, Anti-caking Agent (E551), Garlic	South Africa
Fry Family Food	**Meat Free Mince**	Beef	Vegetable Protein (**Soya**, Wheat (Gluten)), Flavourings (Onion, Pepper, Maize Starch, Anti-caking Agent (E551), Savory Flavour), Vegetable Oil (**Sunflower Seed**), **Wheat** (Gluten) Flour, **Potato** Starch, Plant Fibre, Maize Starch, Thickener (Methyl Cellulose), Ground Coriander (Sulphites), Salt, Onion, Mustard, Colourant: Caramel IV	South Africa
Fry Family Food	**Golden Crispy Fish-Style Fillets**	Fish	Tempura: **Rice** Flour, **Wheat** Flour, **Potato** Starch, Maize Flour, Salt, Raising Agents (Sodium Carbonate, Diphosphates), Dextrose, **Sunflower** Oil. Fish Fillet: Vegetable Protein (22%) (**Soya**, **Wheat**), **Wheat** Fibre, Thickener (Methyl Cellulose, Gum Arabic), **Pea** Fibre, Flaxseed Oil (6%), **Wheat** Flour, Flavourings, Smoke Flavour, Maltodextrin, Emulsifier (E1518), Garlic	South Africa

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