

EXECUTIVE SUMMARY

Plant Proteins: Present and Future

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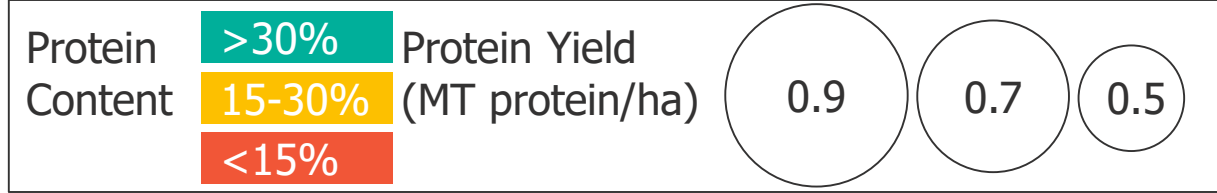
Executive Summary

Since 2015, the plant protein space has experienced an unprecedented level of commercial activity, much of it just since Beyond Meat went public in May 2019.

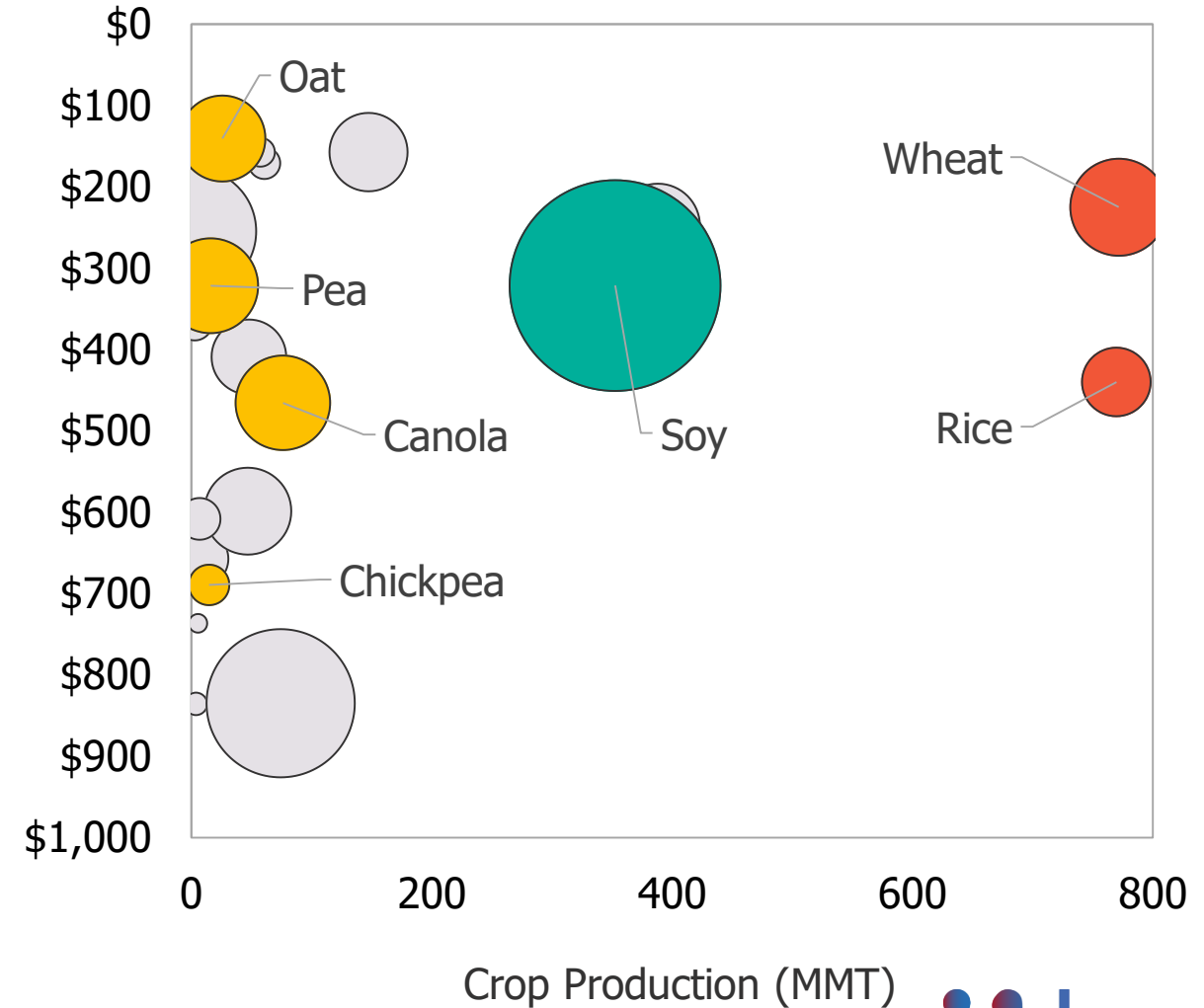
The nature of the activity alongside ongoing trade affairs is signaling the need for three attributes, which hinge on crop production factors: **1) protein source diversity, 2) scalability, and 3) regional resiliency.**

In the full report we analyze 24 different plant protein sources on crop production factors (shown to the right) at global and regional levels. **We identify soy, wheat, and rice as top three “staple” crops for plant protein, with pea, canola, oat and chickpea as the “alternative” up-and-comers.**

Ingredient companies and CPGs should collaborate (e.g., through joint development agreements) on those that are relatively immature as protein sources but present favorable crop production factors – with canola and oat as two prime candidates.



Plant Protein Sources: Global
Crop Value (\$/MT)



Plant proteins have appeal, but with a caveat

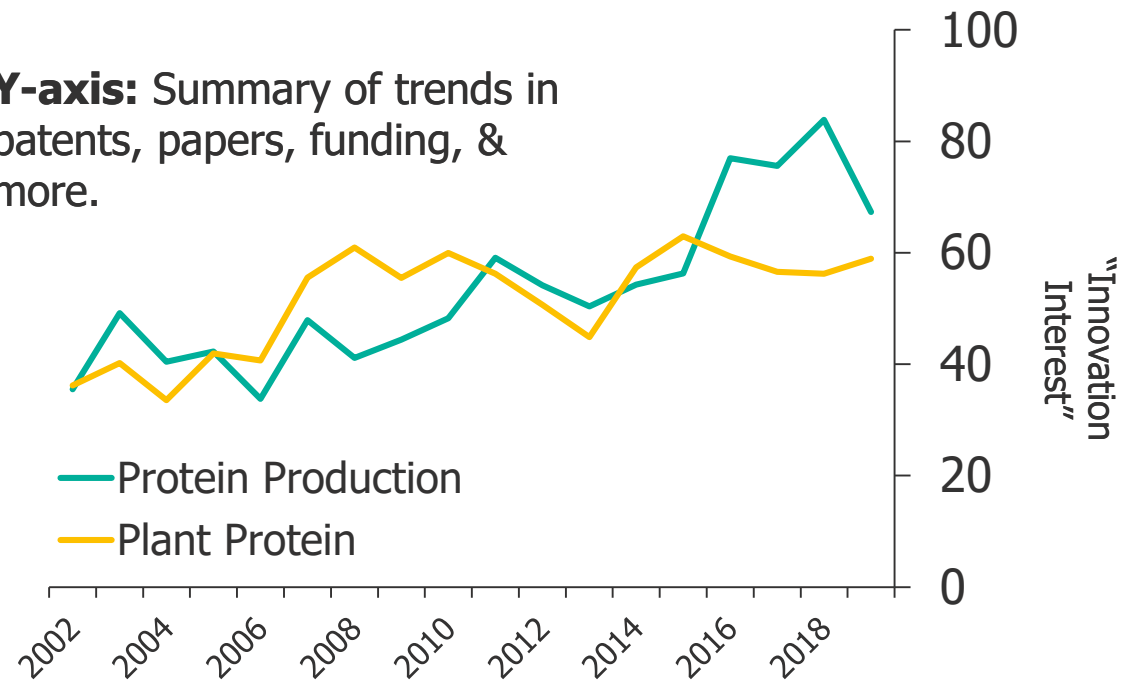
Conventional meat, fish, and poultry are insufficient to sustainably satisfy protein demand. The global population is swelling toward 10 billion, with more demand for animal protein as more countries grow richer.

This has given rise to next-generation methods for protein production, including plant proteins, insect proteins, algae, and cellular agriculture.

While “innovation interest” in plant proteins has leveled off in the past decade, this should not be misconstrued as a lack of momentum in the space. Rather, it is experiencing increasing commercial maturity as product launches, market expansions, and manufacturing facility constructions – events not detected by the Lux Tech Signal – accelerate. **There are, however, regional differences complicating the space that must be considered.**



Y-axis: Summary of trends in patents, papers, funding, & more.



Three storylines are shaping the future of plant protein for human nutrition

RISING INSURGENTS

Three plant-based food companies, all hailing from California, are asserting their dominance in the U.S. and abroad (number of retail and food service locations with products present):

- [Beyond Meat](#) (35,000+)
- [Impossible Foods](#) (17,000+)
- [Just](#) (5,100+)

Each has also raised several hundred million dollars and achieved “unicorn” status, highlighted by Beyond Meat’s \$241 million IPO in May 2019.

MNCs TAKING ACTION

Large multinational corporations (MNCs), namely ingredient manufacturers and packaged food producers, are moving beyond just making minority investments into plant-based startups through venture arms.

Since 2018, there has been a flurry of notable acquisitions, joint ventures, and product launches from MNCs. There has especially been an uptick in product launches, with major meat companies JBS, Tyson, and Smithfield Foods all introducing plant-based brands since May 2019.

TRADE TURMOIL

Inter- and intraregional trade relations have become particularly volatile of late. Three recent events exemplifying this are the U.S.-China trade war, the U.K. Brexit, and the Asia-Pacific Regional Comprehensive Economic Partnership (RCEP).

Events like these are currently affecting, or have future implications for, the trade of agricultural commodities (e.g., soybean). Future events will have additional impacts. With such volatility, the need for regional considerations in plant protein source selection is elevated.

The storylines signal the need for three protein source attributes that hinge on crop production

PROTEIN SOURCE DIVERSITY

The diversification of plant protein sources beyond soy is only quickening. Pea protein from Beyond Meat and others is rising in popularity, while more exotic sources like mung beans from Just are entering the landscape too.

This isn't just from the efforts of rising insurgents; large MNCs like Cargill are also playing roles in this diversification process.

SCALABILITY

Scalability is essential for supply to meet demand. As plant-based alternatives proliferate, affordable, accessible, and abundant protein sources are required for large-scale impacts, especially with MNCs entering the fray.

There have already been instances where demand outstripped supply – highlighted by shortages of Beyond Meat and Impossible Foods products.

REGIONAL RESILIENCE

Geopolitical factors are warranting the need for regionally resilient supply chains.

The unreliability of trade agreements is placing an emphasis on regional self-sufficiency; companies will need to hone in on crops suitable for their region(s) of interest.

GLOBAL Three groups emerge

Three groups emerge among plant protein sources:

“Staple” sources (<\$1,000/MT, >100MMT)

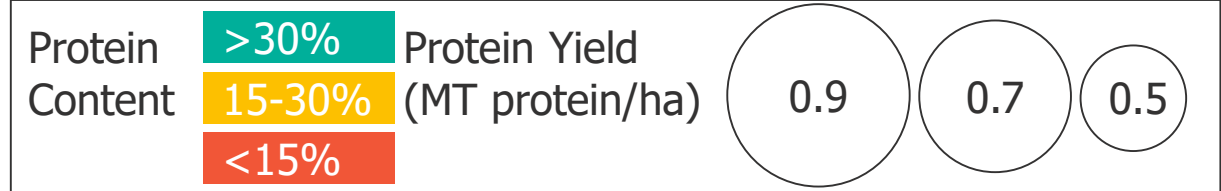
- Although only comprising six crops, in aggregate, these are produced about 8× more than the remaining 18 crops. Not surprisingly, soy remains the leading plant protein source given its high protein content and good production metrics.

“Premium” sources (>\$1,000/MT, <100 MMT)

- On a global level, almond is the only crop positioned within this group and a distant outlier but a notable one given its prevalence within plant-based dairy alternatives.

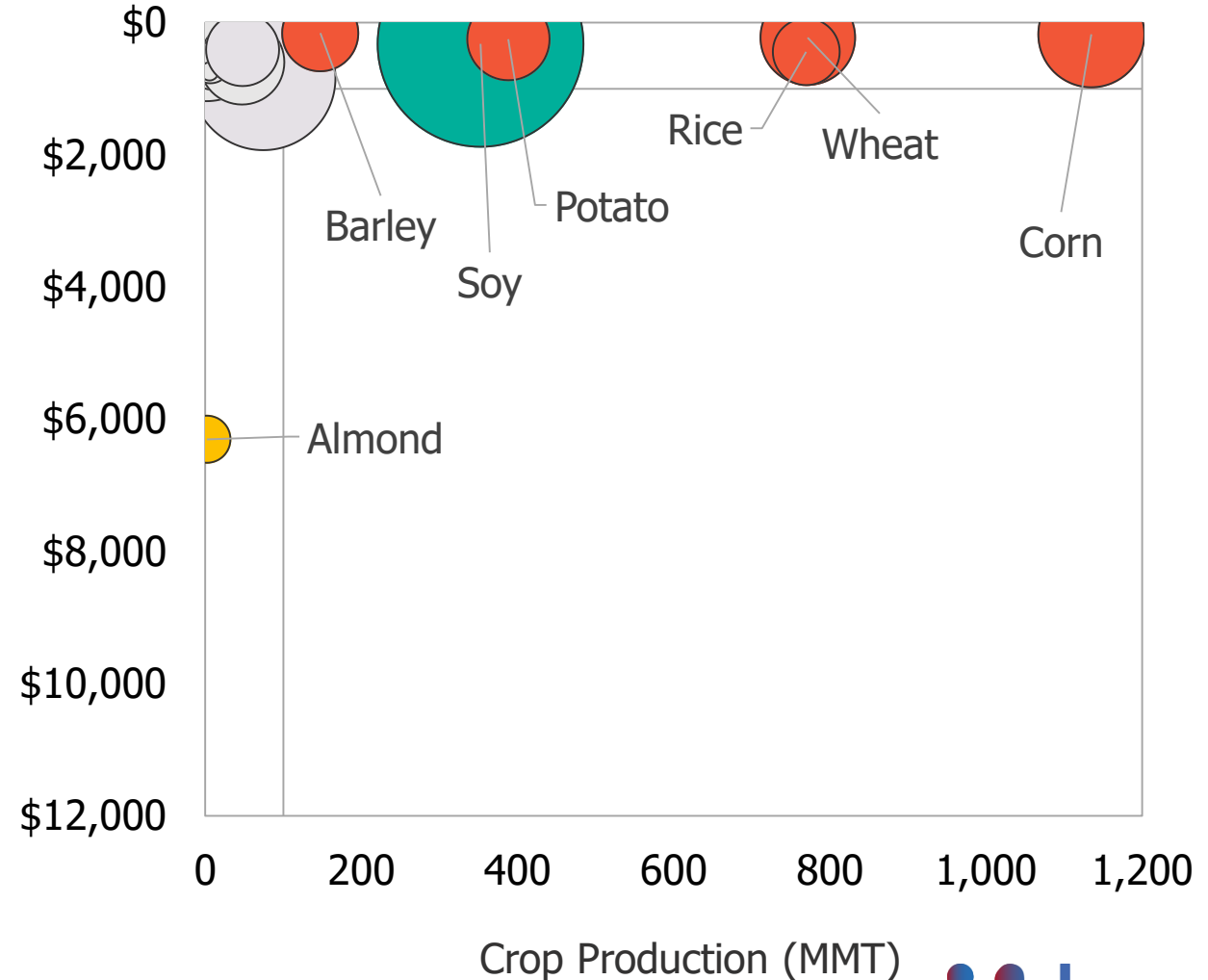
“Alternative” sources (<\$1,000/MT, <100 MMT)

- Most protein sources fall within this group (and are grayed out here). An inset view of this group is shown on the next slide and for each regional-level analysis.



Plant Protein Sources: Global

Crop Value (\$/MT)



NORTH AMERICA

Notable production of soy and corn

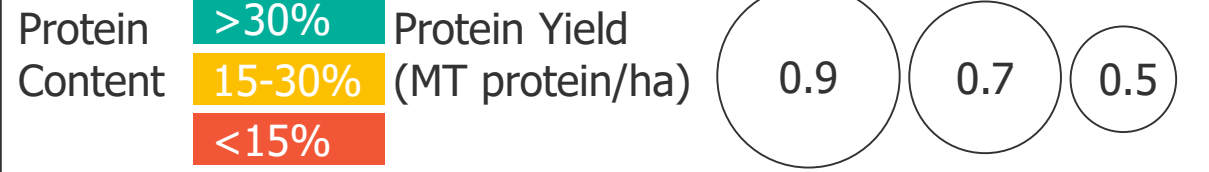
There is significant output of soy and corn in North America, but there is a pull for these crops toward feed and fuel. For example, in the U.S., roughly [75%](#) of soy and [80%](#) of corn goes to these uses.

Corn is not traditionally thought of as a protein source but interestingly enough boasts a protein yield comparable to soy in North America.

There is also notable production of almond, but at an expense, with the regional crop value about 2× higher than the global crop value.

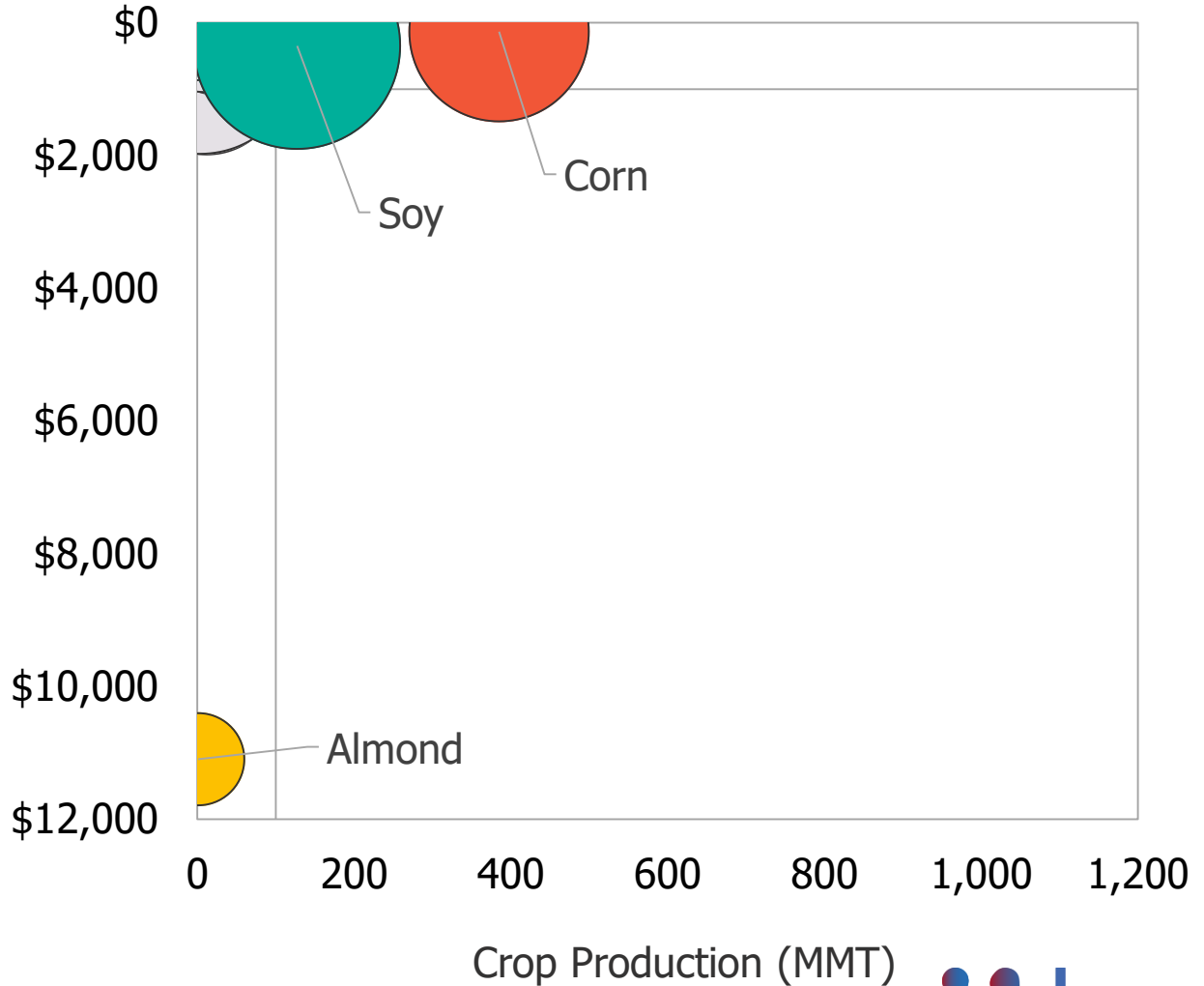
LUX TAKE

Soy from North America will remain a key protein source, but the pull toward nonfood uses indicates that less-produced crops have a competitive position and should be exploited. Separately, corn should only be considered if within your existing supply chain.



Plant Protein Sources: North America

Crop Value (\$/MT)

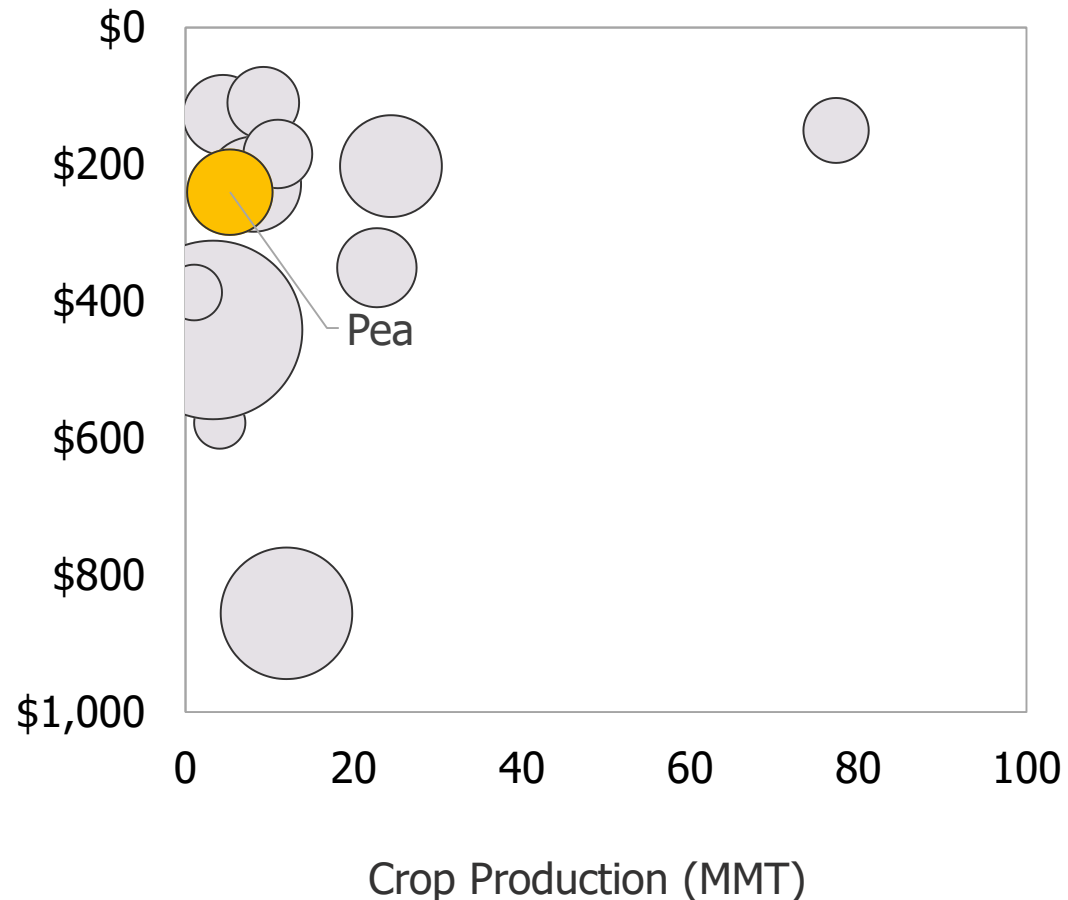


NORTH AMERICA: CASE STUDY

Cargill is betting \$100 million on pea protein through its joint venture with Puris

Plant Protein Sources: North America

Crop Value (\$/MT)



INTRODUCTION

Cargill formed a JV with U.S.-based pea protein manufacturer Puris in 2018, initially [investing \\$25 million](#). In 2019, Cargill invested an [additional \\$75 million](#). Commercial operations are scheduled to begin in late 2020.

BUSINESS IMPACT

Although the exact capacity has not been publicized, Puris expects to double its pea protein production (within an existing 200,000 ft² facility) thanks to the additional \$75 million investment from Cargill.

LUX TAKE

Cargill is wisely diversifying its plant protein feedstock beyond soy, and by partnering with Puris, it is gaining access to the company's proprietary non-GMO pea varieties.

NORTH AMERICA

Pea protein is looking to usurp soy, but oat and canola are the opportunity going forward

WHAT THE DATA SAY

North America plays a prominent role in producing the world's No. 1 source of plant protein, soy, owning 36% of the crop's global output.

Pea, canola, and oat exhibit favorable sourcing factors – affordability (<\$500/MT) and good protein content (15% to 30%). North America's production of pea and canola outpaces that of oat, with a third of total output for each.

Smaller in production (<5 MMT), North America accounts for the highest lentil production (54%).

HOW INDUSTRY PLAYERS ARE TAKING ACTION

The emphasis has been on pea protein, with Roquette, Cargill, and Burcon investing nearly half a billion dollars in total in facility construction since 2017.

The demand is there, with Beyond Meat and others dependent on the ingredient. In fact, Beyond Meat secured a three-year [supply agreement with Roquette](#) and Burcon inked a [joint development deal with Nestlé](#) within weeks of each other in January 2020.

WHAT WE THINK

2020 will be a major inflection point for the pea protein supply chain, which is good for ingredient companies that already have manufacturing facilities underway, but others should shy away.

Instead, newcomers should focus on oat and canola, which are largely untapped as protein sources for human nutrition.

CPGs shouldn't wait until these ingredients become mature; test for application suitability now to gain early-mover advantage.

CONCLUSIONS

Soy, wheat, and rice will lead among “staple” crops, with pea, canola, oat, and chickpea as the rising “alternative” crops

NORTH AMERICA

Soy will remain the No. 1 plant protein source for at least the next five years, with North America as a major driving force.

As the supply chain for pea protein rapidly matures and looks to compete with soy, newcomers should place their attention on oat and canola for the North American market.

EUROPE

Wheat is and will be Europe’s No. 1 resource for plant protein.

In the grand scheme of things, Europe appears to be lagging behind North America in creating manufacturing infrastructure for pea, canola, and oat proteins. Ingredient companies and CPGs should be proactive and set up joint development agreements as a first step.

ASIA

Although rice protein is not as ubiquitous as soy and wheat protein, this only highlights an opportunity that companies, either Asia-based or foreign, should seize.

The region also has a plethora of other protein sources that allow for differentiation, with chickpea as one such candidate. The immediate action to take here is to assess technical and market feasibility.

Other regions like South America will also contribute to production of plant protein sources, but these three regions are the ones with the strongest observed levels of market activity and interest in recent years.

OUTLOOK

Technology will be a mainstay for the future of plant proteins

While the rate of growth in “innovation interest” has stagnated since 2015 for plant proteins as commercial maturity has picked up, technology innovation will still play a role in unlocking future opportunities. These innovations will either directly or indirectly influence crop production factors, and largely serve three purposes:

- **Increasing inherent protein content in crops.** Through either advanced computational breeding approaches or gene editing techniques (e.g., CRISPR), crops will reach new heights in protein content and quality. This will especially be the case for “staple” crops that are already in extreme abundance like rice. This can allow growers to demand a premium while also defraying protein extraction costs downstream.
- **Enabling new crops as sources of protein isolates and concentrates.** There are numerous crops that have medium to high protein content but are not utilized as sources for protein isolates and concentrates (e.g., chickpea). This can be due to myriad factors, but a major one is the inability to extract and purify the protein. New methods will change this to accelerate the diversification of plant protein sources beyond soy at an even faster rate.
- **Improving the sensory and/or nutritional quality of plant proteins.** Even in instances where a protein isolate or concentrate can be obtained, sensory and nutritional quality can be lacking relative to both animal-based counterparts and peer plant protein sources. Novel processing technologies and ingredients will alleviate these challenges and are the piece needed to further broaden the consumer appeal of plant-based products.

The winning combinations will be those where these technology innovations are paired with plant protein sources that are sufficiently affordable, accessible, and abundant.



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