TASTING THE FUTURE:

CHINA'S SUSTAINABLE PROTEIN OUTLOOK

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Commissioned by:

NEW ZEALAND

Ko Te Kaunihera o Aotearoa me Haina

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Executive summary

- Beijing is increasingly focused on environmental sustainability – including in food production – but food security remains the higher national priority. Where the two are at odds, food security will be prioritised over sustainability.

- Where it can, Beijing is making efforts toward a greener agriculture sector by reducing the visible local environmental impacts of agriculture, like agrochemical runoff and water pollution from livestock waste.

- Agriculture is not yet under pressure to contribute to China's efforts to reduce greenhouse gas emissions – energy, heavy industry, and transport are the main focus. But regulators are beginning to measure greenhouse gas emissions from the agriculture sector, laying the groundwork for future emissions reduction efforts.

- Reducing waste – both food waste and food packaging waste – have emerged as a prominent new regulatory priority, with a high degree of visibility to consumers.

- Where other key agri-food policy agendas are aligned with sustainability goals – including food security, food safety, public health, and innovation – they could drive very swift progress, amplifying the impact of sustainability policy and the speed at which regulatory requirements shift, or consumer preferences evolve.

Key Takeaways for New Zealand:

1. In China's context, government strategies, plans, policies, and regulations matter. They provide road signs that clearly indicate where leadership intend to take the country, and guardrails to guide investment and development.
    - Following evolving consumer sentiment is important, but understanding China's medium and long-term food policy and regulatory settings is also critical for New Zealand producers. There are an increasing number related to sustainable food.

2. China is still nearly a decade away from translating its ambitious climate policy into strict targets for the agri-food sector.
    - This means New Zealand should continue to take action to hone value propositions while we still have a head start. Once China catches up it will do so at 'China speed'.

3. Food security remains the highest priority in the agri-food sector. Beijing will stop short of adopting any sustainability strategies that threaten the ample, stable, and affordable supply of food for the Chinese people.
    - But New Zealand producers should be aware that where policies, products, or innovations are seen to support both sustainability and food security goals, this could catalyse significant support and rapid adoption.

4. Priorities like ensuring food safety, improving nutrition, boosting innovation, and limiting packaging waste are already front and centre for Beijing.
    - New Zealand is well-placed as a producer of high quality, sustainably produced protein, but companies will need to remain nimble and prepare to seize opportunities as China's policy environment evolves.

5. There is growing government and corporate interest in alternative and novel proteins, even if regulators' concerns about food safety will limit the pace at which some new technologies can be introduced – regardless of their sustainability potential.
    - 'Traditional' animal proteins – meat, dairy, seafood – will remain China's main protein sources for the foreseeable future. But new and alternative protein products are attracting attention of regulators, investors, and the market, and innovation can occur at 'China speed' – New Zealand producers need to keep up with cutting-edge developments in China as they do elsewhere.

6. Chinese investors are responding to clear policy signals supporting sustainability, endorsing innovation, and prioritising food security as they back a wide range of domestic and offshore investments from start-ups to large agribusinesses.
    - This presents opportunities for New Zealand businesses and innovators – both to access investment capital, and to collaborate with Chinese investors and companies that have the potential to open doors into the market. But the policy goals shaping investment choices must be understood.

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Foreword

Despite differences in scale and socio-economic structure, China and New Zealand face the common challenge of how to feed our expanding populations using finite or shrinking agricultural resources, in ways that are good for human health, the environment and the climate. Sustainable food production, response to climate change and impact on natural ecosystems are front of mind for governments and agri-businesses in both countries.

We are further connected by the fact that China remains New Zealand's largest export market for many of our agri-food products.

Given this critical and intertwined context, in July 2023 our Council established a new sustainable food working group to focus on bilateral sustainable food directions and innovations, to better understand China's future food directions and help identify where there could be areas for both countries to engage more closely.

As a first step, the working group agreed to commission a research report to gather core information on China's strategic, policy and regulatory roadmap in this area. Sustainable protein production, both of traditional products such as meat, dairy and seafood, as well as plant-based and novel proteins, was selected as the area where many of the largest issues intersect.

Our report surveys the large number of Chinese government policy responses already in place, developed with increasing speed, confirming that China is focused on the scale of the challenges it faces and the responses required. It makes it clear that China has made more progress in some areas than in others, and that sometimes its strategic priorities might be in tension. But in that it is not alone, of course.

The research also identifies areas of current and emerging relevance for New Zealand. This includes new regulations in areas like food product packaging and food waste which could impact our exporters; the sustainability measures that Chinese producers are starting to put in place, given that our companies both compete and partner with them; and the potential for this to drive changes in local consumer sentiment over time. It's also clear that both countries face some common unsolved challenges, for example how to incorporate agricultural emissions in respective trading schemes.

We commissioned this report from experienced China-based policy analysts Trivium China. I thank the authors for their very thorough, perceptive and clearly presented research.

I also thank our sponsors who made this report possible – the Meat Industry Association, the North Asia Centre of Asia-Pacific Excellence and Plant & Food Research.

Lastly I acknowledge the vision of our sustainable food working group members who see the importance of engaging with China in this important area. I look forward to the working group's continued activities, drawing on the findings in this research report, in 2024.

John McKinnon

Chair, New Zealand China Council

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Introduction, goals, and methods

China is the world's biggest producer and consumer of protein, importing more by volume, calorie, and value than any other country. As incomes rise, demand for animal protein has skyrocketed over the past few decades and continued to rise rapidly in recent years – average per-capita consumption of meat, eggs, and milk rose over 20% between 2012 and 2022. According to estimates from the Chinese Academy of Agricultural Sciences, by 2032, annual consumption of meat, eggs, and dairy is expected to grow nearly an additional 10%, reaching 104.85 million metric tons, 35.55 million metric tons, and 79.02 million metric tons, respectively[1].

While China's population is nearing its peak, its per capita spending power will continue to rise for the foreseeable future – and already, 1.4 billion Chinese people are investing in the global food system daily as they shop and eat. Meanwhile, top state and Party leaders in Beijing, including Xi Jinping himself, are increasingly focused on food security, sustainability, and the impacts of climate change.

The above has resulted in a highly attractive, yet complex and quickly evolving business environment for New Zealand agri-food companies – particularly those that supply high value dairy, meat, seafood, and other protein products. While China is a large and growing market, the increasing priority on sustainability policy, coupled with corresponding regulatory efforts and long-term plans – could result in rapidly shifting costs, consumer preferences, and market access rules. Simultaneously, this shift could increase investment in cutting-edge technologies and protein production methods that could ripple across global markets.

In the following report, we set out to identify how current Chinese government sustainability policies are impacting, and are likely to impact, its market for protein, and its investment into protein, in the coming decade. To do so, we reviewed:

- High-level Party documents and speeches about food security and sustainability
- China's national Five-Year Plan, and nine relevant sectoral five-year plans issued since 2021, where policymakers clearly lay out their goals and targets for the medium-term, indicating where policy is most likely to shift
- Key laws and regulations covering the space
- Dozens of national food and packaging standards
- Articles and reports from industry associations and investors in the livestock, fisheries, dairy, and new protein space

1.0 Policy Landscape

1.1 Macro Policy Context

The rise of sustainability policy under Xi

When he took on the Party's top job in 2012, Xi Jinping already recognised the substantial environmental degradation that had accompanied China's accelerated economic growth over three decades. Xi had begun reckoning with the ways in which severe industrial pollution was taking a toll on ecosystems, public health, and daily life during his time as governor and Party secretary of Zhejiang province, and had written extensively on the lack of adequate environmental governance, publishing 14 articles in the span of five years between 2002-2007 on the subject[2]. Shortly after his appointment at the 18th Party Congress, Xi advanced the concept of "ecological civilisation" – a framework intended to integrate environmental concerns with economic planning – for inclusion into the Party's constitution and development plan[3].

Ecological civilisation kicks off a decade of tightening environmental regulation

Xi's ecological civilisation paradigm posits that the environment should be valued and managed with the same level of importance as the economy, marking a significant shift in policy-making to address ecological concerns in China's developmental agenda. It is epitomised in Xi's turn of phrase about two mountains, which posits that:

> *"Green mountains and clear waters are as valuable as mountains of silver and gold."*

With this theoretical foundation in place at the highest levels of national leadership, Beijing's day-to-day approach toward environmental regulation began a significant pivot, evolving rapidly over the next decade with the release of China's first National Environmental Protection Plan in 2012, a ban on highly polluting fuels in 2013, crackdowns on industry and efforts to clean up severe air and water pollution, expanding subsidies for renewable power generation, the launch of national environmental inspections targeting major polluters and local malfeasance, and more.

Fig 1.a: Sustainability policy timeline

2012
- Ecological civilisation is enshrined into the Party constitution.
- Beijing releases the first National Environmental Protection Plan, which sets ambitious targets for reducing air and water pollution.

2013
- Beijing releases the first National Climate Change Adaptation Plan.
- Official public reporting of PM 2.5 air quality data begins across all major cities.
- China bans the production and sale of certain highly polluting fuels, such as leaded gasoline and high-sulphur diesel.

2014
- The state planner releases a National Plan on Climate Change (2014-2020).

2015	• China and the United States sign a historic agreement to reduce greenhouse gas emissions. • Beijing launches its first ever pilot round of national environmental inspections, dispatching central regulators to review local performance targeting major polluters and corrupt local officials supporting fudged environmental data.
2016	• Beijing launches efforts to tackle water pollution, which includes stricter enforcement of environmental laws and increased investment in wastewater treatment facilities.
2017	• China bans the import of waste in an effort to ensure its own waste and recyclables can be fully managed. • The government launches a new campaign to promote the use of electric vehicles.
2018	• Beijing upgrades the former Ministry of Environmental Protection into a superministry, the Ministry of Ecology and Environment, as part of broader institutional reforms. The upgraded ministry gains responsibility for all environmental supervision and enforcement previously spread across multiple agencies.
2019	• China sets out a roadmap and timeline for banning single-use plastics. • China's air quality continues to improve, with PM2.5 levels in Beijing falling by 43% from 2013 to 2019.
2020	• Xi Jinping announced that China would peak emissions before 2030 and achieve carbon neutrality before 2060.
2021	• The 14th Five Year Plan (2021-2025) prominently highlights environmental and sustainability goals, kicking off a new round of regulatory ambition.

The dual carbon targets send a strong signal on climate

In September 2020, Xi Jinping announced two national policy targets that will underpin China's environmental priorities and consequent market development for the foreseeable future:

- A target to achieve peak carbon emissions before 2030
- A target to achieve carbon neutrality before 2060

These targets have come to be known as the "dual carbon" and "30-60" targets.

China's dual carbon targets come in the context of nearly two decades of rising political attention to environmental protection (Fig 1.a). Building upon the gains under Xi's "ecological civilisation" framework, China's top leaders are broadly satisfied with the visible progress on previously acute domestic pollution issues and are now beginning to respond to global challenges, hoping to position China as a global leader on sustainability.

The dual carbon goals constitute a clear turning point in China's climate policy.

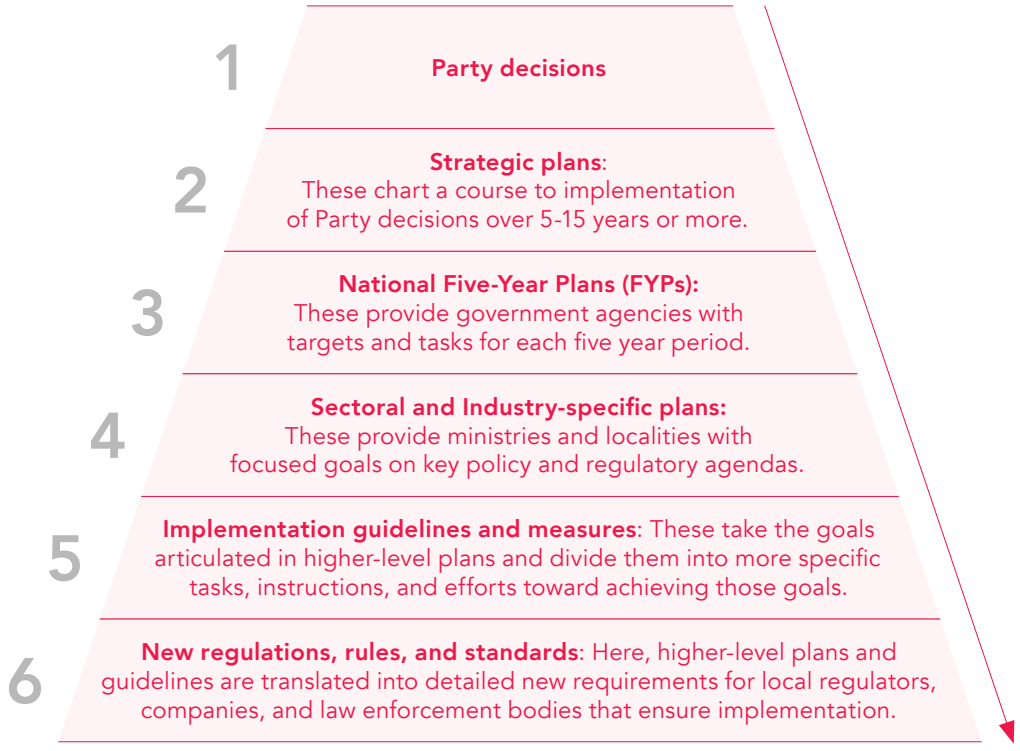
Achieving these highly visible, binding targets will have profound and long-lasting impacts on most aspects of China's economy. Already, the announcement of the targets has given increased impetus to ongoing efforts by the Chinese government to make the economy more environmentally sustainable. Unfortunately, in 2021, this translated into overzealous local enforcement of emissions and energy intensity rules on energy generators and heavy industry – resulting in widespread power curbs and shutdowns.

Going forward, Beijing has mandated an "orderly decarbonisation process" – that is, one that prioritises progress on climate goals without disrupting energy security or overtly destabilising other key markets. Xi himself explained this approach during a meeting of the Party's highest ranking political body, the Politburo, on January 25, 2022 – emphasising that emission reductions do not require reducing productivity or completely eliminating emissions. Xi instead called for China to engage in green and low-carbon development, promote a green transformation, and seek opportunities to boost its economy via environmental upgrades. In short, China wants to have its cake and eat it, too. Whether it actually can remains to be seen.

The role of long-term planning

In China's state-led policy context, policymakers send loud, clear signals about the direction of future regulatory efforts via the system of five-year plans (FYP). Under this system, a national FYP that outlines key, forward looking strategic priorities is developed and reviewed by the highest levels of leadership, then implemented by the State Council. The national FYP is then followed by focused, industry specific plans, where ministries and agencies outline their strategic priorities and signal key regulatory agendas and budget priorities over the next five years.

Fig 1.b: The policymaking process



In order to develop a picture of how Beijing's sustainability policy priorities would impact the protein sector in years to come, we conducted an extensive review of the latest batch of FYPs, covering the 14th FYP period, from 2021-2025. In section 1.2 and section 1.3, we present our detailed conclusions for how regulators are prioritising sustainability in the protein sector based this review. In Figure 1.b, we present our top-line takeaways from the National FYP and the nine sectoral FYPs we identified that are directly relevant to the sector.

Fig 1.c: Current Five-Year Plans with implications for protein sustainability, 2021-2025

Five Year Plans (for the 2021-2025 period)	Key agencies	Key targets and requirements
National 14th FYP	Party Central Committee, State Council	• Calls for improved management of "non-carbon climate pollutants" such as methane for the first time, but does not set a quantitative target, or name agriculture specifically as a source of such pollution. • Calls to step up carbon sequestration in ecosystems – but does not specify whether agricultural ecosystems should be included in this call. • Calls for "conservation of ocean ecologies" and pushes to develop "sustainable distant-water fishing" - adding the word sustainable since the 13th Five Year plan.
14th FYP for Emissions Reduction	State Council, MEE	• One of ten "key projects" is focused on rural and agricultural emissions reduction, with a focus on rural pollution management, agrochemical use reduction, elimination of crop straw burning, and management of livestock and poultry waste. • Targets an 80% livestock waste utilisation rate by 2025, up from 75% in 2020.
14th FYP for Water and Soil Protection	MEE, NDRC	• Reiterates a target to reach 80% livestock and poultry waste utilisation by 2025, calling for synergy with efforts to replace chemical fertiliser. • Calls to reduce methane emissions from "scaled up" livestock and poultry operations in the Beijing-Tianjin-Hebei area 5% by 2025. • Calls to "promote healthy and scientific" aquaculture, but sets no specific targets. • Calls to improve monitoring of emissions from livestock and poultry operations. This could set up China to introduce targets in the medium term.

Five Year Plans (for the 2021-2025 period)	Key agencies	Key targets and requirements
14th FYP for Marine Environmental Protection	MEE, NDRC	• Pushes environmental management of fishing boats, ie emissions requirements, requirements for waste management at port etc. • Calls to improve monitoring and enforcement of seasonal fishing bans.
14th FYP for Agricultural Modernisation	MARA, State Council	• Establishes the target to improve livestock waste utilisation to over 80% in 2025, from over 75% in 2020 (est). • Calls to stabilise pork production at around 55 million tons annually, and expand production of grass-fed livestock (cattle, sheep meat) and milk production bases. Steadily develop poultry. Expand the forage industry. • Calls to expand aquaculture production to 69 million tons in 2025, promote onshore and offshore green aquaculture and rice-fish intercropping. Pushes an expansion of offshore fishery bases. • Continues large-scale efforts to revitalise the domestic dairy industry. • Calls for significant investment in livestock breeding.
14th Five-Year Agricultural Green Development Plan	MARA	• Reiterates livestock waste utilisation target of 80% in 2025, and includes an extended section on implementation measures - including reiterating the 5% Beijing-Tianjin-Hebei methane reduction target. • Calls to improve the water efficiency of agriculture, including by expansion of grass-fed livestock, integration of livestock and farming operations, and setup of manmade forage production facilities. • Calls to control agricultural point-source pollution from livestock and aquaculture along key river basins – presumably including the Yangtze and Yellow rivers. • Calls for restoration of grassland ecosystems and "balance between livestock and grasslands". • Calls to improve the ecological value of agriculture, and researching technologies and approaches to sequester carbon, abate agricultural sector emissions, reduce energy demand, and improve agricultural climate adaptation capacity.

Five Year Plans (for the 2021-2025 period)	Key agencies	Key targets and requirements
14th Ag and Rural Science and Technology Development Plan	MARA	• Targets an expansion of "future food manufacturing". • Calls to research the cultivation and manufacturing technology of nutritious foods such as cell-cultured meat, synthetic eggs, and functional recombinant proteins. • Calls to promote the exploration of new food resources, functional foods, breakthroughs in molecular food, and other technological innovations.
14th FYP for Promoting Green Consumption	NDRC	• Promoting consumption of green foods is a major area of focus listed in the plan, spanning certified "green" and "organic" food products, and promotion of the reduction of food waste. No protein-specific contents. • Calls to promote green consumption (broadly) through tax rebates – but not through taxes on non-green products.
14th FYP for Developing the Bio-Economy	State Council	• Calls for major scitech projects in key areas of focus, including protein science, livestock genetics, a national germplasm resource bank, and agricultural biosecurity science centre. • Identifies improving food production capacity and quality as a key goal of the bio-economy. • Calls to promote industrial application of biological breeding and other fields to ensure the supply of important agricultural products such as grain, meat, eggs, milk, and oil crops. • prioritises specific breeding technologies and calls to carry out research and breeding of high-quality pigs, white-feathered broilers, dairy cows and other poultry and aquatic products. • Calls to develop synthetic biology technology, explore and develop novel foods including artificial protein to drive "iterative upgrading of the food industry" and reducing the pressure on environmental resources caused by the traditional animal agriculture industry.
14th FYP for Citizens' Health		• Includes calls for improvements to food safety and nutrition, but does not include any specific protein related guidance or priorities. • Promotes reduction of salt, fat, and sugar consumption, and other "healthy lifestyles". • Does not link its diet and nutrition requirements with its food safety or environmental requirements.

Key takeaways for New Zealand:

- A new green paradigm at the highest levels of politics is behind China's pivot to prioritise sustainability, improve environmental regulation, and commit to ambitious targets on climate change.
- In the short term, agricultural sector emissions are not being built into China's plans to peak greenhouse gas emissions before 2030. This is clear both from macro-policy direction, and from a close evaluation of current (2021-2025) five-year plans and other guiding policy documents.
- In the longer term, however, some global estimates indicate food systems are responsible for roughly a third of all greenhouse gas emissions associated with human activity[4], and agriculture is a crucial driver of global biodiversity loss. It is likely that China will not be able to achieve its long-term environmental goals or its 2060 climate target without taking additional action on sustainability in agriculture.
- China can be expected to delay highly ambitious, costly, or punitive regulatory efforts to deliver on agricultural sustainability goals at least until 2030, and likely beyond – seeking to ensure an ample, stable, and affordable supply of key food products first, and pursue sustainability as a second priority.
- New Zealand has already set an ambitious target to reach net zero by 2050. Many New Zealand companies have already set aligned targets and begun making efforts to meet or exceed that goal – driven as much by a response to the local market as by any policy requirement. As a result, New Zealand's agri-food sector will almost certainly move faster than, or at least keep pace with, China on key environmental compliance issues, and will be well positioned to continue supplying sustainable, low-emissions food products to China's market even if its requirements become more stringent.

1.2 Sustainability priorities and policies are beginning to reshape China's protein market

Sustainability priorities are increasingly shaping agri-food policy, as evidenced across China's national and sectoral FYPs (see figure 1.b, above). Broadly, we note four major sustainability priorities with implications for the protein sector, namely:

- Efforts to reduce the local environmental footprint of agriculture
- Efforts to mitigate the climate impacts of agriculture
- Efforts to reduce packaging waste, including food packaging
- Efforts to reduce food waste

Reducing the local environmental footprint of agriculture

Beijing's sustainability agenda in agriculture remains primarily focused on reining in water, soil, and air pollution and addressing the most prominent impacts on local ecosystems. Regulators have spent much of the last decade addressing local pollution and remediating the "green mountains and clear waters" called for by Xi's ecological civilisation paradigm.

This is reflected in ongoing efforts to improve livestock waste management, as well as new efforts to protect aquatic ecosystems from overfishing.

Local pollution and livestock waste management

China adopted its first set of regulations on managing pollution from livestock and poultry facilities in 2013[5], and has spent the last decade slowly ratcheting up pressure to comply.

One crucial regulatory requirement is ensuring livestock waste generated by "scaled up[6]" facilities is "comprehensively utilised"– that is, safely returned to local fields, processed into an organic fertiliser product, and/or used to generate biogas.

- As of 2020, the Ministry of Agriculture and Rural Affairs (MARA) estimated that 75% of livestock waste is utilised.
- Multiple FYPs target raising that figure even higher, to reach 80% by 2025 (see figure 1.b).

A second crucial regulatory requirement is that livestock producers are located outside of ecological "red lines" that demarcate critical areas like watersheds, wetlands, and drinking water reservoirs.

- We did not identify any further targets for agricultural facility red-lining during the 14th FYP period.
- This is likely driven by two factors – first, implementation efforts kicked off in 2016 and were expected to be "basically complete" by 2020; second, China's massive pig farming sector saw significant consolidation and upscaling in response to African swine fever (ASF); and third, the rising priority of food security has limited regulators' willingness to place further limits on agricultural production.

Protecting (aquatic) biodiversity

China is a party to the International Convention on Biological Diversity (CBD), and put in place a long-term plan covering efforts to improve biodiversity conservation in 2011. Notably, however, neither that plan, nor a 2021 white paper on biodiversity issued by China's State Council, addresses the agri-food sector specifically[7].

That makes it particularly notable that multiple recently-issued FYPs repeatedly highlight aquatic biodiversity and protection of aquatic ecosystems, setting a number of related goals including:

- In the National FYP: Calls to ensure "conservation of ocean ecologies" and pushing to develop "sustainable distant-water fishing"
- In the 14th FYP for marine environmental protection: Calls to improve monitoring and enforcement of seasonal fishing bans
- In the 14th FYP for Agricultural Green Development: Calls to control agricultural point-source pollution from large-scale livestock and aquaculture along key river basins
- In the 14th FYP for Agricultural Modernisation: Amid calls to significantly expand onshore and offshore aquaculture, the plan indicates a priority to promote "green aquaculture" – with limited specifics

Reducing the climate impact of agriculture

Efforts to reduce climate pollutant emissions from agriculture are in their infancy in China by comparison to the decade-long, robust effort to reduce other pollution and solid waste emissions. While regulators broadly recognise that a number of agricultural activities, including livestock waste and digestive processes, are a source of greenhouse gas emissions, they have remained focused on the much more significant impacts of China's massive, coal-fired power generation capacity and heavy industrial sectors. Meanwhile, addressing concerns about food security and protecting rural incomes have superseded climate efforts as they are higher priority.

Since 2020, however, we have begun to see climate impacts listed among the reasons that regulators are pursuing efforts to reduce agrochemical use and reuse livestock waste. Then, in 2021, Beijing announced it would release a national plan for methane emissions control as a result of talks on the sidelines of the Glasgow COP26 climate summit.

- That plan has now been released – and it is extremely unambitious[8].
- It sets no quantitative targets for methane emissions reductions whatsoever.
- While it calls for efforts to reduce methane emissions from agriculture, it is primarily focused on the methane released during coal mining and oil and gas drilling.
- Crucially, in addition to livestock-related methane emissions, a substantial portion of China's agricultural methane is emitted from soil management practices, particularly in lowland (paddy) rice production – an especially sensitive issue from a food security perspective.

Also in 2021, we noted the first-ever quantitative target for livestock methane emissions reduction, targeting a 5% reduction over 2020 levels by 2025.

- However, that effort was confined to an extremely limited area – only scaled up operations in the Beijing - Tianjin - Hebei region are subject to the limit.
- Large-scale livestock operations in all other regions are, however, subject to methane emissions data collection for the first time. That potentially sets the scale for nationwide targets as early as the 15th FYP period, beginning in 2026.

Despite the lack of any government-mandated quantitative targets for agriculture and food companies around climate pollutants, a number of China's leading livestock companies and food producers have voluntarily committed to carbon neutrality targets – with some targeting net-zero a full decade earlier than China's national 2060 goal. See Fig 1.c, below, for a representative list, and our case study focused on Yili's target in section 3.1.

Fig 1.d: Major Chinese agri-food companies adopting voluntary net-zero commitments

Company name	Sector(s)	Target year	Publicly listed?
Mengniu Dairy	Dairy	2050	Yes
Yili Group	Dairy	2050	Yes

Company name	Sector(s)	Target year	Publicly listed?
Bright Dairy	Dairy	2060	Yes
China Modern Dairy Holdings	Dairy	2060	Yes
Beijing Sanyuan Foods	Dairy	2060	Yes
Junlebao Dairy	Dairy	2050	Yes
Wens Foodstuffs Group	Pork, Poultry	2060	Yes
COFCO Meat	Pork, Imported Beef, Poultry, Mutton	2060	Yes
WH Group	Pork	2050	Yes
Yurun Foods	Pork, Poultry	2060	Yes

There has been no discussion of inclusion of agriculture into China's domestic carbon market – the National Emissions Trading Scheme – beyond the potential that some emissions-negative agribusinesses could add to their profits by selling carbon abatement credits. And in addition to the lack of quantitative targets, we have found no support among policymakers for greenhouse gas-related taxes, tariffs, or any other pricing mechanisms that would impact the livestock sector.

Reducing food packaging waste

Driven by rising incomes and accelerated by the explosive growth of ecommerce and online food and grocery delivery, China's product packaging waste has skyrocketed in recent years, creating a massive waste burden for urban waste management systems. This issue was further exacerbated during the pandemic, as a huge number of consumers relied on delivery services for more daily necessities. Additional public health-related waste also contributed to municipal waste systems becoming overwhelmed.

While none of the below efforts explicitly target the protein, meat, dairy, or seafood space as bad actors, products that are fresh, require cold chain, or present food safety risks are often sold in extensive packaging in China's retail context. Thus, these evolving requirements could significantly impact the protein sector – as much because of competing and complex issues impacting their roll-out as the generally higher degree of packaging on protein products.

In 2021, the National Development and Reform Commission (NDRC) and the Ministry of Ecology and Environment (MEE) introduced a five-year action plan to control plastic pollution, targeting the single-use plastics that are widely used in the agri-food sector specifically, advocating for design improvements, efforts to reduce use, and setting standards to eliminate the production of ultra-thin plastic bags. The plan also promotes adoption of environmentally friendly alternatives to plastic, including bamboo, wood, paper, and biodegradable materials, while aiming to enhance the safety and quality standards of these products.

By September 2022 the issue was acute, and the State Council responded with a national notice calling to crack down on excessive packaging waste. The notice indicated that

regulators will bring in strict limits – and strict enforcement – on "over packaging" by 2025 at the, and that manufacturers, retailers, and delivery companies should fall in line in advance.[9] As expected, the State Administration of Market Regulation (SAMR) issued a new, mandatory national standard covering excessive packaging on fresh edible agricultural products which will enter into force in April 2024.[10]

In light of the higher technical requirements associated with food packaging, regulators began rolling out detailed national standards to limit excessive packaging of food and cosmetic products in 2021. These standards were focused primarily on "festive foods" like mooncakes and fruit that are typically purchased as opulent holiday gifts on the basis of their elaborate packages, rather than strictly for food consumption. In 2022, regulators expanded the rules to cover a much wider range of food categories, acknowledging that the packaging waste problem extends also to fresh food categories, and foods purchased via ecommerce.[11]

Broadly, the updated rules promote sustainability in a number of respects, including:

- Setting specific limits for the number of packaging layers
- Restricting the total volume of packaging materials relative to products
- Promoting the use of specific recycled, recyclable, and biodegradable materials in food packaging

Notably, recycled materials are not yet permitted for use as direct food-contact materials in China.[12] This is consistent with China's generally conservative approach toward any action that could impact food safety. Other jurisdictions[13] [14] vary in their approach to restricting or regulating the use of post-consumer recycled materials in order to reduce potential food safety risks associated with potential contamination of post-consumer plastic waste streams and recycling processes.

Reducing food waste

In August 2020, Xi Jinping personally kicked off a national effort to reduce food waste that included:

- A national "clean plate campaign" encouraging consumers not to over-order in restaurants[15]
- The extremely rapid drafting and adoption of a national Anti-Food Waste Law
- The issuance of a Food Conservation Action Plan pushing implementation of food waste reduction efforts[16]
- A set of guidelines from the market regulator stipulating that online restaurant and grocery delivery services should adopt incentives to reduce excessive ordering[17]

Reducing food waste has significant sustainability implications – globally, some 40% of food is lost to post-harvest waste, spoilage along supply chains, wasted at food processing facilities, expires on grocers' shelves, or is left behind on plates and in the bottom drawer of the refrigerator. For each percentage point of food waste eliminated, associated land and water use is reduced, and greenhouse gas emissions are abated.

There are three significant agendas that could impact the agri-food space as a result of efforts to reduce food waste. These are:

- Significant investments in cold chain infrastructure and cold storage warehousing, and improvement of cold chain logistics systems – linked both with food waste reduction efforts, and with broader goals to improve the path to market for China's domestic agricultural products.
- Promotion by policymakers and grocers of frozen meat and seafood products, in an effort to boost the value of food products that have been frozen to reduce spoilage. This effort could begin to shift Chinese consumers' long-standing preference for fresh-never-frozen proteins, which add costs and complexity to supply chains, in addition to increasing spoilage risks.
- Potential incentives to encourage consumption of product categories that are least likely to spoil, particularly if supermarkets and wholesalers face pressure to reduce the amount of food waste they are generating.

Key takeaways for New Zealand:

- Beijing's primary regulatory focus remains on reducing the domestic environmental impacts of agriculture by monitoring and regulating large-scale domestic livestock and fisheries businesses. While Chinese citizens welcome lower levels of local pollution, this agenda has few direct implications for New Zealand's agri-food sector.
- Domestic environmental conditions have improved greatly over the last decade, and Beijing is now turning its attention to a wider set of issues, including biodiversity and climate goals in the agricultural sector.
- These new goals are at an extremely early stage in the agri-food sector, and regulatory efforts remain primarily focused on producers, and to a lesser degree, along supply chains. That means they are not yet impacting market access – or consumer awareness – in any meaningful way.
- However, all of the above agendas are beginning to inspire efforts by Chinese agribusinesses to align with – or move ahead of – Beijing's climate and environmental targets, which will build consumer awareness in the years to come.
- Over time, rising Chinese consumer awareness will translate into increasing opportunities for New Zealand brands to market based on shared sustainability values, and lower climate and biodiversity impacts.
- New Zealand agribusinesses should not expect extra taxes, tariffs, or other costs to be imposed on the basis of environmental impacts of agricultural products in the foreseeable future.
- In the meantime, efforts to reduce food packaging waste, and food waste itself, are currently among the most visible signals of sustainability in the food and protein space for Chinese consumers.

1.3 Other agri-food policy agendas could catalyse more significant action

Food security and self-sufficiency policies

China feeds roughly 20% of the world's population with less than 7% of global farmland and freshwater resources. Unsurprisingly, food security has long been a major national priority – and the quest to improve national food security has repeatedly driven ambitious policy reforms throughout China's history.

Since 2018, a series of crises have returned food security to the top of Beijing's priority list. These have included:

- Rising diplomatic conflicts and trade frictions with a number of China's key agricultural trade partners, including the US, Canada, and Australia
- The outbreak of African swine fever (ASF) in 2018, which decimated China's pig population before it was largely brought under control in 2020, resulting in record-high pork prices
- The COVID-19 pandemic, which resulted in lockdowns that disrupted farming and food supply chains domestically, caused chaos in international shipping links, and resulted in panic-buying of food the world over
- Russia's invasion of Ukraine, which destroyed ports, disrupted shipping, and impacted farming in one of the world's most productive grain and oilseed regions

This series of events has caused Beijing to double down on food security and self-sufficiency language across plans and policy documents, and created a clear mandate in Beijing to make food security "the highest national priority" – Xi Jinping has repeatedly referred to it using this language since 2020. At the 20th Party Congress in October 2022, Xi called to ensure that "the Chinese people's rice bowl remains firmly in their own hands," pushing to continue:

- Protecting and improving China's limited stock of farmland, including maintaining a 120 million hectare "red line" minimum
- Getting more equipment and technology into the hands of farmers, to ensure they can be as productive as possible
- Improving subsidy structures that incentivise farmers to produce staple crops, even if they can earn more growing cash crops like tea or fruit

Beijing has also kicked off efforts to protect food security by law, with the national legislature reviewing a first draft of a new Food Security Protection Law in June 2023[18], holding a special inquiry on the subject, and revising the draft law for a second round of review in October 2023.[19] It appears the new law will be rolled out much faster than usual, and put into effect in 2024.

The paramount importance of food security policy in Beijing has conflicting impacts and implications for sustainability in the protein space.

Efforts to bolster China's self-sufficiency rate in key food products often disrupt parallel efforts to make agricultural production more sustainable. In pursuit of self-sufficiency, regulators encourage farmers to triple down on growing grain and oilseed crops poorly suited to local conditions, rapidly scale up livestock production in areas without sufficient waste management capacity, and more broadly, to retain a higher percentage of agricultural production within China's borders. This occurs even where it would be less costly and less environmentally impactful to import commodities from abroad.

Fig 1.e: "self-sufficiency" in China' food security policy

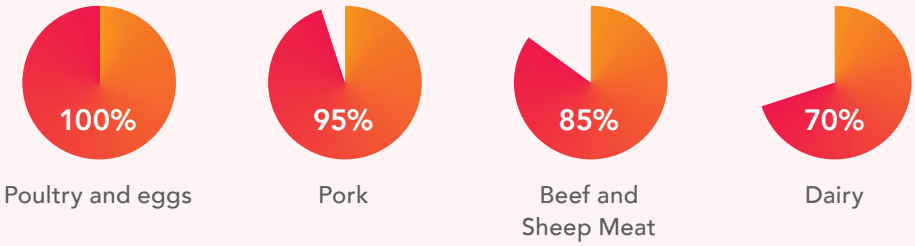
Driven by concerns that over-reliance on trade partners for food could create dangerous dependency and risks, China's food security policy has long been underpinned by efforts to ensure "self-sufficiency" in dietary staples – particularly prioritising a high rate of self supply in key grains, especially rice, wheat, and corn.

- For these three key grains, Beijing targets a **97%** rate of self supply.

However, as development shifted diets to include a larger proportion of eggs, meat, fish, and dairy products, demand for livestock feed grains and oilseeds rose rapidly, quickly outpacing domestic farmers' ability to supply them.

Beijing responded with a bit of statistical creativity: calculating self-sufficiency based on its demand for staple foods that people consume – but excluding grains and oilseeds imported for livestock feed. As a result, China is able to maintain a high rate of self-sufficiency, giving the public an impression of greater food security than might be the case if imported livestock feeds were included in the calculation.

Beijing also establishes self-sufficiency targets for livestock production. In the most recent 14th FYP for Livestock Industry Development, the targets are set at:[20]



But the alignment of food security and sustainability priorities could accelerate ambitious efforts to boost sustainability. Areas where these efforts are aligned include:

- The ongoing regulatory effort to reduce food waste, detailed above.
- Investments in modern, large-scale livestock and dairy facilities that are efficient and resilient, and capable of repurposing livestock waste as a sustainable replacement for chemical fertilisers
- Research, innovation, investment, and commercialisation of alternative proteins – including plant-based protein products, and new and novel protein research that could present approaches for China to generate a larger percentage of the protein it needs for livestock feeds, or for human consumption domestically, without imports.

At China's legislative Two Sessions in 2022, Xi Jinping himself hinted that Beijing was already exploring whether novel proteins could present food security advantages, calling on regulators to take a "broader approach to the concept of food" and seek food security "from forests, rivers, and lakes, from large-scale agricultural facilities, and at the same time exploring the biological resources of traditional crops and livestock, developing biotechnology and bio-industry, and extracting calories and protein from plants, animals, and microorganisms."[21]

Public health and nutrition policy

Broad demographic factors are reshaping China's population structure – in coming years, Chinese consumers will grow wealthier, and consumption is expected to expand to include a larger portion of higher value protein products. The population will also age significantly, and an older population will bring along a rising burden of chronic disease, impacting China's public health system.

Beijing is acutely aware of the implications of the rising chronic disease burden on public health costs and labor productivity. In late 2016 the 'Healthy China 2030 plan' was issued. Set out as a blueprint to achieve UN sustainable development goals, the plan covers public health services, environmental management, the medical industry, and food and pharmaceutical safety and physical fitness. While living standards have risen, the plan acknowledges that industrialisation, urbanisation, an aging population, as well as environmental change have created new health challenges. By 2030, the plan aims to:

- Increase average life expectancy to 79 (77.3 by 2020), up from 76.34 in 2015, and reduce infant mortality from 8 to 5 every 1,000 births
- Control negative factors in population health, promote healthy lifestyles and guarantee food safety

The plan's prominent inclusion of food aspects of health likely results from China's high and rising incidence of non-communicable diseases (NCDs), including diabetes, cardiovascular disease, and some cancers with clear dietary risk factors. China's demographic structure and rapidly changing diet leaves it particularly vulnerable to high and rising NCD costs, which are estimated to exceed US$23 trillion by 2030.[22] Despite the extremely high social costs associated with diet-linked NCDs, to date, little policy or social sector engagement has explicitly linked food choices with NCDs or actively sought to shift diets in China's context.

Fig 1.f: 'food pagoda' from Chinese Nutrition Society

As a result, food policy is increasingly shifting toward a health and nutrition-forward posture. At the 2016 revision of China's national Dietary Guidelines for Chinese Residents, the recommended amount of fruit, eggs, meat, and poultry were all revised downward slightly. Dairy consumption recommendations were not revised. Perhaps more notable, however, was the text accompanying more recent updates to the recommendations, in 2022, which included language drawing attention to the high fat content of pork, and the potential for fruit juices or processed products to include high sugar content.[23]

Food safety concerns moderate policy ambition

A series of high-profile food safety scandals in the 2000s and early 2010s, most notably including the adulteration of raw milk with melamine that resulted in the death of a number of infants in 2008, significantly eroded public trust in the government's capacity to ensure food safety. In the wake of these scandals, Beijing has worked overtime to rebuild trust, adopting some of the most stringent food safety laws and regulations in the world, and maintaining an extremely cautious posture on any and all regulatory issues that are viewed as having the potential to impact food safety.

As a result, and by contrast to other sectors and arenas, China has been extremely slow to adopt some categories of new technologies in the agri-food sector. These include:

- Genetically modified (GM) crop varieties, where Beijing has taken a cautious approach to both imports and domestic cultivation. Regulators now appear on the verge of a breakthrough approval of GM corn and soybean seeds for commercial sale domestically, but spent two decades getting there.
- Novel food ingredients produced using genetically modified microorganisms or other GM processes – including heme, the ingredient that makes plant-based Impossible Burgers "bleed," which is produced by genetically modified yeast.
- Other novel food ingredients – broadly speaking, the process of getting any new human-made substances and ingredients approved for human consumption in China is long and complex.
- Recycled materials – as noted above, China has restricted use of recycled materials for use in packaging that comes in direct contact with food, driven by concerns about contaminants that might be introduced during the recycling process.

Key Takeaways for New Zealand:

- Food security is the highest agri-food policy priority in Beijing, and it will remain so for the foreseeable future. Where sustainability trades off with food security, the latter will win out.
- As Beijing faces an ageing population and rising chronic disease burden it has already shown willingness to make nutritional recommendations to reduce consumption of foods – including meats – it deems less healthy, and encourage consumption of alternatives that are viewed as healthier. Such tools may also be brought to bear to encourage more sustainable consumption in years to come.
- While nutritional guidelines are voluntary, they may also play a significant role in shaping dietary preferences, and may also be used to inform purchasing decisions

by large, government affiliated institutions like the cafeterias of government bureaus, schools, and universities.

- Regulators' concerns about food safety also limit the pace at which certain new and novel technologies, particularly genetically modified organisms, can be introduced into the agri-food space – regardless of their sustainability potential.
- All of the above policy agendas offer opportunities for New Zealand – companies that can support China's food security, health and nutrition, and food safety will find a large and growing market.
- Crucially, where Beijing's food security, food safety, and public health priorities align with sustainability goals, that alignment could drive very swift progress toward ambitious outcomes in areas like food waste reduction, livestock waste management, and even alternative protein innovation.

2.0 Innovation and investment outlook

The above policy agendas are reshaping the innovation and investment environment in China's agri-food sector. The World Economic Forum indicates that *"China and Singapore have emerged as capital hotspots, providing support and growth for [sustainable protein] entrepreneurs and businesses."*[24]

2.1 Domestic and international policy drivers of investment

Innovation policy is driving domestic agri-food investment

Domestically, Beijing is prioritising innovation across every sector of its economy, as much in an effort to de-risk the economy and address technical dependence on foreign trade partners as to kick off the next wave of innovation-driven growth. The agri-food sector is no exception – a significant policy effort is underway to expand and fund innovation in the space, with specific implications for the protein sector.

That effort is evident in China's 14th FYP for the Bio-Economy.[25] The latest bio-economy FYP reflects a notable shift in tone from the prior iteration: the sector's previous FYP was framed as a technical and industrial development plan. But in the new FYP, issued in May 2022, language has been adjusted to explicitly address means of scaling up new bio-enabled technologies to commercial scale and facilitating the promotion of new innovations into use. The language change reflects both the maturation of the biological industry in China's context and the increasing priority on ensuring that government research and development funding into strategic sectors is not wasted when innovations remain solely in the hands of research organisations or other non-commercial players.

The plan includes extensive language with direct implications for the agriculture industry and protein sector specifically, including:

- Calls for major scitech projects in key areas of focus, including protein science, livestock genetics, a national germplasm resource bank, and agricultural biosecurity science centre.
- Identifies improving food production capacity and quality as a key goal of the bio-economy.
- Calls to promote industrial application of biological breeding and other fields to ensure the supply of important agricultural products such as grain, meat, eggs, milk, and oil crops.
- prioritises specific breeding technologies and calls to carry out research and breeding of high-quality pigs, white-feathered broilers, dairy cows and other poultry and aquatic products.
- Calls to develop synthetic biology technology, explore and develop novel foods including artificial protein to drive "iterative upgrading of the food industry" and reduce the pressure on environmental resources caused by traditional agricultural practices.

Aligned with these efforts, a series of national innovation projects and funds have been launched in recent years.

- In late 2020, the Ministry of Science and Technology launched a green biological manufacturing national key R&D program, and applications for the program opened in 2022[26]. Alternative meats, including both plant-based and cultivated meat production, are both included within the scope of the program, which is expected to deploy at least RMB 600 million in funding in coming years.[27]
- A three-year government-funded project titled "High-efficiency biological manufacturing technology of artificial meat" was launched under the program's umbrella in 2021, led by Jiangnan University – one of China's leading agricultural research universities.

Food security policy is driving strategic international ag investment

Internationally, Beijing has increasingly prioritised strategic investments along key agri-food supply chains, driven in large part by efforts to bolster its own food security. These efforts predate the more recent re-prioritisation of food security domestically, but are no less significant in their implications for major agricultural exporters.

Beginning as early as 2013, Beijing began supporting its leading agribusinesses to make acquisitions abroad – particularly in areas where China was poised to be a major importer. By May 2016, the State Council had outlined this new strategy on global engagement in agriculture in an internal document[28], aspects of which were included in the 13th FYP for agricultural modernisation issued in October 2016.[29] That FYP dedicated a full chapter to international agricultural cooperation, sending a clear signal to major agribusinesses and investors, promising policy and regulatory support, discounted financial services, and access to public and private funding for those that pursued international acquisitions and investments that could guarantee stable, affordable access to food produced abroad.

That strategy has borne fruit, resulting in a decade of high-profile investments by some of China's largest agribusinesses, including:

- A decade-long series of dozens of major acquisitions and investments by state-owned grains trader COFCO, including acquisition of grain trading businesses and significant investments into ports around the world
- Pig producer Shuanghui's acquisition of the US Smithfield in 2013
- Meat producer New Hope's acquisition of Australia's Kilcoy Pastoral in 2013, and US beef processor Ruprecht Co. in 2015
- Dairy giant Yili's acquisition of New Zealand's Oceania Dairy (2013) and Westland Milk (2019)
- State-owned chemical company ChemChina's acquisition of seed and agrochemical leader Syngenta (2017)
- Dairy giant Mengniu's attempted acquisition of Australia's Lion Dairy (2020)

Beijing has also begun issuing a policy document aimed at guiding investment by "social capital" – including both private investors and those that manage public investment funds – into the agri-food sector. The most recent edition of this document, issued in 2022, identifies a number of investment priorities beyond China's borders with specific relevance to the protein sector, namely:[30]

- Projects in Belt and Road countries, including in production, processing, storage, and logistics for both livestock and fisheries
- International technologies with benefits for food security, climate change, and agricultural green development
- Agricultural product processing and logistics projects
- Projects located in overseas cooperation parks, trade development bases, pilot zones, and other government-led platforms for investment

2.2 Investment and investors in sustainable protein

The loud, clear policy signals from Beijing are driving unprecedented private investment into Chinese agri-food companies that are viewed as aligned with the domestic innovation and food security policy agendas outlined above. Leading agtech investment platform Agfunder estimates that agtech companies in China closed a whopping US 1.3 billion dollars in investment in 2022, and an additional roughly US 830 million in H1 2023.[31]

These include:

- Massive investments into the agricultural biotechnology space – Agfunder estimates agricultural biotechnology attracted US 813 million across the Asia Pacific region, and US 633 million in China alone in 2022. That's a 472% increase, year on year, over 2021 levels.
- Ongoing investment support for new and novel food products – attracting an estimated US 122 million in private investment funding in China in 2022.
- Rising investment in "upstream" agtech (in contrast to investment further "downstream" along the supply chain, for example in the e-grocery or foodtech space), a category which spans a range of on-farm technologies that enable smarter, more efficient management of large-scale agricultural operations, as well as biotechnology and novel foods.

Key Takeaways for New Zealand:

- China's investors – from venture capital firms to massive state-owned enterprises – are responding to clear policy signals supporting sustainability, endorsing innovation, and prioritising food security as they back a wide range of investments, from seed capital for innovative start-ups to acquisition of some of the world's largest agribusinesses.
- This presents opportunities for New Zealand businesses and innovators to access investment capital and to collaborate with Chinese investors and companies that have the potential to open doors into the market.

- However, it may also create risks, including the potential for more competition as new, innovative companies grow in China and in other markets, with support from Chinese investment.
- It is crucial for New Zealand to understand the policy goals that are shaping investors' choices in order to reduce information asymmetry.

3.0 Case studies

3.1 The early mover on climate neutrality: Yili

Company name: Yili Group

Headquarters: Inner Mongolia, China

Company background: Founded in 1993 and publicly listed in 1996, Yili Group grew out of a dairy cooperative set up in 1956. It is Asia's largest dairy company and among the top five dairy companies in the world. Yili has operations and partners in 39 countries across six continents, and its products are on markets in more than 60 countries. Notably, Yili purchased New Zealand's Westland Co-Operative Dairy Company in 2019.

Products: Yili produces a wide range of dairy products, from liquid milk and milk powder, to yoghurt, ice cream, cheese, and more. In 2017, Yili launched a product line of plant-based dairy alternatives including soy and oat milks, and expanded that line to include yoghurt in 2020.

Revenue and investment:

- → Yili's revenue totalled roughly 28.5 billion NZD in 2022, according to the company's financial reports.
- → Yili Group is publicly listed on the Shanghai Stock Exchange.

Sustainability in action:

Yili has consistently been an early mover on environmental and sustainability goals, acting well before regulatory pressure to do so.

- Yili has released a sustainability report each year since 2007.
- In 2010, Yili became China's first food company to launch an annual corporate carbon inventory, and has continued to issue the assessment annually.
- In 2016, Yili became the first Chinese company to sign the Business and Biodiversity Pledge of the 2016 Conference of Parties (COP) to the Convention on Biological Diversity.
- In 2022, Yili became the first Chinese food company to announce carbon peak and neutrality targets, along with a roadmap. That roadmap targets delivering carbon neutrality throughout the company's entire supply chain by 2050, a decade earlier than China's national neutrality target.

Yili is building a global alliance with its supply chain partners in order to deliver on its carbon neutrality pledge.

- At its founding in 2022, the alliance included 43 of the company's "upstream and downstream partners," including Roquette, Tetra Pak, Chr. Hansen, and Cargill.[32]

- It has subsequently gathered these alliance partners for conferences and workshops.[33]

Yili has begun to launch sustainability forward and zero-carbon products onto the market.

- The company indicates it is operating three "zero-carbon" production facilities.
- In 2022, it debuted its "zero-carbon milk" at the Boao Forum for Asia – becoming the first Chinese dairy company to launch such a product. It has subsequently launched China's first "zero-carbon yoghurt."[34]
- Yili has also expended significant effort to develop innovative new dairy packaging that showcases its sustainability – including developing a plant-based replacement for plastic carton caps, producing cartons from recycled materials, and eliminating ink through use of laser-etched labelling directly onto the package itself.
- Yili is working with Bureau Veritas, an independent international certification group, to conduct carbon lifecycle evaluations of its products and independently verify sustainability claims.

Key takeaways for New Zealand:

- Yili isn't alone – some of China's largest traditional animal protein companies are moving faster than national targets require to achieve carbon neutrality, at or near the same pace as New Zealand's leading companies.
- Yili's carbon neutrality efforts are not theoretical, confined to the boardroom, or relegated to the pages of ESG reports. The company's pledge is already being translated throughout its supply chain and into the language of its brands and products – with over 25 years remaining.
- As domestic market leaders like Yili introduce products with explicit "zero-carbon" branding, consumer awareness will follow. This will likely benefit other dairy products and brands that are sustainability-forward, building interest and momentum around these values.
- Yili also provides a valuable reference for how to translate sustainability brand value into innovative, environmentally friendly packaging – signalling to consumers that your product has something unique to offer.

3.2 The market's plant-based meat darling: Omni Foods

Company name: Omni Foods

Headquarters: Hong Kong, China

Company Background: Omni was founded in 2015 by former investment banker David Yeung, and its first product, OmniPork, was launched in Hong Kong's market in 2018. Since then, Omni Foods has gained commercial traction and secured approvals to distribute its products in over 20 countries and regions, including China and Macau, Singapore, Malaysia, the United States, Canada, the UK, and beyond. While Omni has grown to become a global company, its early focus was on developing products suitable for Chinese and Asian markets, and it grew in large part due to its early traction in China – notably including a partnership with western restaurant chain Wagas, which operates over 250 restaurants in major Chinese cities.

Products: Omni has launched a wide range of plant-based meat alternatives made from a blend of non-GMO soy, peas, and mushrooms. These products include a ground pork alternative, a luncheon meat alternative, a bacon alternative, two kinds of fish fillet alternatives, a plant-based fish burger, and a plant-based tuna salad. Omni has also launched a stand-alone plant-based fat substitute which is used in its luncheon meat and bacon alternatives.

Revenue and investment:

- → We were not able to find any credible estimates of Omni's current revenue. However, the company estimated sales would grow by 50% in 2023, driven by the US, China, and Japan.
- → Omni raised roughly NZD 160 million in series C investment funding in March 2023.

Sustainability in action:

Sustainability is front and centre in the company's value proposition.

- Omni's mission statement is to innovate food that will "treat the planet right, treat animals right, and treat us right." The company highlights negative environmental externalities of livestock industries and indicates it was founded to disrupt the sector.
- Omni Foods provides comparative data on the land and water use of its products versus their traditional protein alternatives – for example, Omnipork, its flagship product, requires 90% less water and 87% less land to produce than traditional ground pork.
- The company has consistently launched partnerships and promotions that highlight its sustainability proposition, including during "Veganuary" – an effort where people adopt a plant based diet in January, and around Earth Day, a globally designated environmental awareness event.

Omni's long list of prominent partners also highlight its eco-friendliness.

- Omni is among the most successful plant-based meat alternative companies in the world – rivalling Impossible Foods and Beyond Meat. That success has been driven largely by early regulatory approval across Asian markets, including China – where it has built partnerships with a long list of regional and global food companies.
- These partners include restaurants like McDonalds, Starbucks, KFC, Taco Bell, and China-based western restaurant chain Wagas; retailers like 7-Eleven, WalMart, and Whole Foods, and other major food ingredient and service providers, from hotels like Four Seasons and Grand Hyatt to travel companies like Disneyland and Cathay Pacific, to ingredient suppliers like Entyce in the Australian and New Zealand market.
- Nearly all of the above partners highlight the sustainability of Omni's plant-based meat alternatives in materials introducing the product.

Key takeaways for New Zealand:

- Some Chinese protein companies are well prepared to compete not just within the mainland and greater China market, but across Asia and globally.
- Omni avoided regulatory hurdles by ensuring its products, while novel, fell within the scope of existing approved food ingredients. That allowed it to get to market fast, and emerge as a leader.
- Another major driver of growth for Omni was its partnerships with major restaurant and hospitality brands, which introduced a wide cross-section of consumers to its products while generating revenue, rather than incurring cost, for the company. It was able to do so in large part because of its early market entry and rapid, stable scale to serve major chain customers.
- Omni's sustainability value proposition is front and centre in its brand identity, but the company focuses primarily on local environmental impacts and land and water use, along with biodiversity and animal welfare, rather than on greenhouse gas emissions. In fact, we were unable to ascertain whether the company has made any carbon neutrality commitments.

3.3 The alt dairy innovator: Changing Bio

Company name: Changing Bio

Headquarters: Shanghai, China

Company Background: Founded in 2016 by food industry veteran Luo Bin, Changing Bio is an innovative microbial protein technology company based in Shanghai's Zhangjiang Science City. As of early 2023, the company employs some 30 PhDs with backgrounds in a range of biological and technological disciplines. It has grown rapidly following venture funding in 2021 and 2022, and plans to expand its current production capacity 20-fold in Q4 2023.

Products: Changing currently produces dairy protein alternatives using fermentation to produce microbial proteins that mimic the qualities of dairy. The start-up's first biomass fermentation-derived protein, known as Kluvy, has been approved by the China Food and Drug Administration. A second product line in development involves using genetically engineered microbes and claims to deliver proteins that are nearly identical to dairy – but these GM processes are not yet approved for commercial use in China. Changing is, first and foremost, a technology company – it holds at least ten patents, and a number of its processes, techniques, and microbial strains have gained trade secret protection.

Government support: Changing Bio partnered with Nanchang University School of Food Sciences to establish the Joint Laboratory for Synthetic Biological Innovation Food in 2023. Nanchang University is a provincial public university in Jiangxi province, and administrators indicated the partnership was in part due to Xi Jinping's calls to establish a "broad concept of food" and inclusion of the topic in high-level policy documents.[35]

Revenue and investment:

- → We were not able to find a credible estimate of Changing's revenue. However, as the company gained approval for its first product in 2023, we expect revenue is nascent.
- → Changing raised series A investment funding of roughly NZD 36 million in June 2022, and an additional (undisclosed) A+ round in January 2023.

Sustainability in action:

Changing's founder indicates the company has fundraised on the basis of sustainability policy.

- In an interview shortly after the latest Series A financing was closed, CEO Luo Bin attributed the RMB 200 million raise to the company's technological breakthroughs, and to the fact that *"Changing's business is in line with the country's strategic needs, including conserving farmland, reducing carbon emissions, and ensuring food supply."*[36]

- Luo's language suggests that he believes policy support – both for sustainability and food security goals – is a crucial support of bringing novel dairy alternatives to market.

Changing's emissions reduction potential is significant.

- Per the company's calculations in 2021, a single 600 square metre tank facility could generate 10 million litres of alternative milk protein annually. If the company operated 100 such tank facilities, it could produce a billion litres of alternative milk protein, reduce carbon emissions by 1.24 million tons annually, and reduce farmland use by 2 million *mu* – roughly 133,000 hectares, even after accounting for its pea protein inputs.[37]
- Luo describes Changing's process as "thousands of times" more efficient than its traditional equivalent, indicating that dairy production tanks can be prepared in "a few dozen hours," contrasting that with the years it takes to raise a dairy cow.

Large food brands are seeking out Changing's products to deliver on carbon reduction commitments.

- Changing is initially focused on developing a B2B business model, in part due to its products' appeal to the world's largest food companies.
- According to interviews, Changing is being sought out by large food brands that have made carbon neutrality pledges and are now looking for carbon-neutral dairy alternatives as ingredients in their products.

Key takeaways for New Zealand:

- Some innovative domestic players are managing to navigate China's high regulatory hurdles and launch cutting edge novel protein products.
- Novel dairy protein production methods like Changing Bio's have the potential to offer significant food security benefits in China's unique context – boosting production of novel dairy alternatives without growing the domestic dairy herd.
- To the extent that alternative dairy protein ingredients can be produced using less land, less water, and/or a smaller emissions footprint than traditional dairy, these ingredients will become increasingly appealing to food companies seeking to demonstrate environmental bonafides or achieve carbon neutrality targets.
- New Zealand dairy producers should prepare for competition not just with other dairy producers, but with a rising cohort of novel dairy ingredient alternatives – including some that may soon be biologically indistinguishable from traditional dairy proteins.
- New Zealand dairy producers also have an opportunity (and potentially, an advantage) to innovate or cooperate with innovators in this space and launch new products that offer the best of both traditional and novel dairy.

3.4 The traditional Chinese veg protein supplier: Shuangta

Company name: Shuangta Food

Headquarters: Shandong, China

Company Background: Set up in 1992, Shuangta is a state-owned enterprise (SOE) founded to supply the bean starches needed for production of Longkou vermicelli, a thin, translucent noodle that is a specialty product of Longkou – a small city in Shandong. In 2012, it began producing pea protein, and now claims to supply roughly 40% of the world's pea starch – likely making it the world's largest supplier of plant proteins for alternative meats.[38] [39]

Products: Shuangta produces a wide range of vegetable starches and proteins, including pea protein and pea protein isolate, fava bean protein, mung bean protein, pea starch, a range of fiber products, mushrooms, and a number of finished plant-based meat alternatives. It supplies a long list of food and nutrition companies, including makers of vegetarian workout beverages, nutrition bars, and pet foods, in addition to alternative meat leaders like Beyond Meats – making it an indirect supplier to KFC.[40]

Revenue and investment:

- → Shuangta's revenue totalled over NZD 556 million in 2022; as of September 2023, that figure had fallen roughly 14%.
- → Shuangta is publicly listed on the Shenzhen Stock Exchange.

Sustainability in action:

Shuangta takes an incredibly conservative approach to sustainability.

- Despite the company's large size and dominant market position, as a local SOE, it does not have a well-developed environmental or climate value proposition.
- The company quietly complies with national policy agendas on energy conservation, waste and emissions reduction, and green development, but does not advertise its product as an emissions-abating alternative to animal proteins.
- Shuangta has invested in a number of technologies and techniques that enable it to reuse waste streams, including extracting protein from vermicelli production process, producing biogas using its facilities' wastewater, and using other waste streams to produce substrates for mushroom cultivation.

Key takeaways for New Zealand:

- China is not a new entrant to the plant-based protein space. China's cuisine has long included plant-based proteins like tofu and seitan, and some of its oldest and most traditional companies already hold dominant market positions in the sector.

- These companies and their products may communicate their sustainability bonafides in a way that is much more intelligible to a Chinese government audience – and may offer lessons for government relations.
- However, these traditional alternative protein players may struggle to launch effective B2C brands that appeal to younger, more affluent, and more environmentally conscious consumers in major urban markets.
- That provides opportunities for partnerships that bring together the expertise of consumer-facing brands with the deep relationships and experience navigating the Chinese regulatory environment of traditional plant protein suppliers.

3.5 Cellular seafood: Avant Meats

Company name: Avant Meats

Headquarters: Hong Kong, China

Company Background: Founded in 2018, Avant has raised a total of roughly NZD 23 million from leading innovation funds and venture capital firms to facilitate research and development, and launch of cell-based fish products, targeting Asian – and particularly China's – markets. However, it has not yet brought its products to market, nor has it secured approvals in China. It is currently expanding R&D and scaling up production in Singapore.[41] [42]

Products: Avant has developed a number of pre-market prototypes, including GMO-free cultivated fish maw and fish fillet. The company has also launched a functional cosmetic ingredient containing marine protein peptides produced using their proprietary bio-process.

Revenue and investment:

- → As Avant's products are not yet on the market, we expect the company has limited revenue.
- → Avant raised over NZD 17.7 million in its most recent Series A investment round in 2022.

Sustainability in action:

Avant's core value proposition is anchored on sustainability.

- The products seek to replicate fish ingredients without the need to raise or catch fish – significantly reducing environmental impacts during production processes.
- Producing fish protein in a laboratory or factory setting almost certainly reduces land and water use, and eliminates use of other veterinary medicines like antibiotics and hormones that might be used in traditional aquaculture.
- Compared to wild-caught fish, Avant's products avert wake emissions and environmental impacts from fishing vessels, overfishing, and disruption of aquatic ecosystems all too often caused by mismanaged fishing industries.
- Depending on the exact details of Avant's technical process, it is possible that the company also reduces greenhouse gas emissions relative to conventional methods, though Avant does not make that specific claim.

Avant's product also offers consumers an environment-related health benefit.

- By producing fish proteins in a "fully contained" environment, Avant promises consumers a product that it says will be completely free of contaminants like antibiotics, microplastics, and heavy metals that are often present in farmed and wild-caught fish.

Key takeaways for New Zealand:

- Chinese innovators are already exploring cutting edge cellular protein technology, and raising significant capital to develop innovative products tailored to regional tastes.
- These innovators and investors are inspired by personal commitments to sustainability, and they believe consumers will be too – their value propositions reflect that.
- Even where sustainability is a brand priority, safety and health benefits remain an equal or greater focus of companies' value propositions.
- Regulatory challenges and barriers to entry in mainland China's market remain high, especially where new and novel food ingredients and production techniques are concerned. Even culturally native, locally tailored, and well capitalised businesses are hesitant to dive in before proving their concept elsewhere.

3.6 The plant-based dairy upstart: Marvelous Foods

Company name: Marvelous Foods

Headquarters: Beijing

Company Background: Founded in Beijing by a Chinese-New Zealander seeking a dairy-free, probiotic food option for her own health, Marvelous grew organically through word-of-mouth for years before attracting funding from venture capital to scale up production in 2021. The company's products are now found in a long list of supermarkets and restaurants, and it has a brand tie-up with global fitness brand LuluLemon and German supermarket chain Aldi.

Products: Marvelous produces a range of coconut-based yoghurts and ice creams under its flagship brand, Yeyo. It has recently expanded into functional coconut-based electrolyte concentrate. Its yoghurt product line is made with no added sugar, but does include probiotics – just like traditional yoghurt. Crucially, its lactose-free products offer an alternative to dairy in a market where the vast majority of adults are likely to be at least somewhat lactose intolerant.

Revenue and Investment:

→ Following a successful launch on e-commerce platform Tmall in 2021, Marvelous estimated its own (annual) revenue run-rate on that single platform at roughly NZD 150,000. This estimate is outdated and limited, but we were unable to find other credible estimates of the company's revenue.

→ Marvelous raised nearly NZD 2 million in seed funding in 2022 to support it reaching commercial scale.

Sustainability in action:

Marvelous isn't highlighting sustainability in its mission statement or product branding and marketing.

- Yeyo's branding efforts are focused on appealing to its target market – health-conscious, fashionable 25-35 year old women in tier 1 cities. Partnerships initially focused heavily on fitness and yoga communities, and current marketing efforts heavily prioritise health, nutrition, taste, and convenience.
- That is notable in part because Marvelous' products likely offer sustainability benefits, including a lower land use and emissions footprint relative to traditional dairy-based yoghurts, and a shorter and less energy-intensive supply chain.
- However, the company is well aware of its products' appeal to consumers that eat vegetarian or vegan diets due to environmental concerns, and has joined a number of related promotions and events, and engaged with nonprofits, investors, and other stakeholders that prioritise sustainability.

Key takeaways for New Zealand:

- Even where products offer obvious sustainability benefits, it is crucial for each company to determine whether that pitch currently appeals to their target consumers.
- In the short term, it may make sense to focus on other values and attributes entirely – recognizing that this doesn't need to trade off with future efforts to highlight sustainability more prominently as a brand value.

Endnotes

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