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Threats and Opportunities to Improve the Almond Value Chain

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Abstract

The aim of this paper is to examine the current threats to the almond industry in Australia as related to the performance of the almond value chain, and to suggest ways to minimise these threats to ensure industry growth can continue. The almond value chain is vertically integrated, with a streamlined approach to operations, with only a few buyers and sellers along the chain. The key threats to the almond industry considered include the effect of varroa mite, irrigation water availability, a changing climate, labour shortages to perform essential on-farm tasks, a high reliance on export markets, (specifically Asia and the United States), and currency risk and the variable $US exchange rate.

Ways to minimise these threats are then suggested. By diversifying the pollination sources and regions where almond farming occurs, the issues of varroa mite and water availability could be managed successfully. Implementing water supply strategies for both price and availability has provided a successful way to manage a changing climate for Australia's largest almond producer. Employee stock option plans and specialist training programs could be implemented to improve labour hiring and retention. Currency risk mitigation is a crucial strategy for the almond industry in Australia, as export supply outstrips domestic demand. To diversify market risk, the Australian almond industry and Australian government can continue to pursue free trade agreements to gain access and open up new markets to increase sales.

Key words: Almonds, Irrigation, Pollination, Currency Risk, Managing Climate, Labour Shortages, Varroa Mite, Export Risk

The Australian Almond Industry

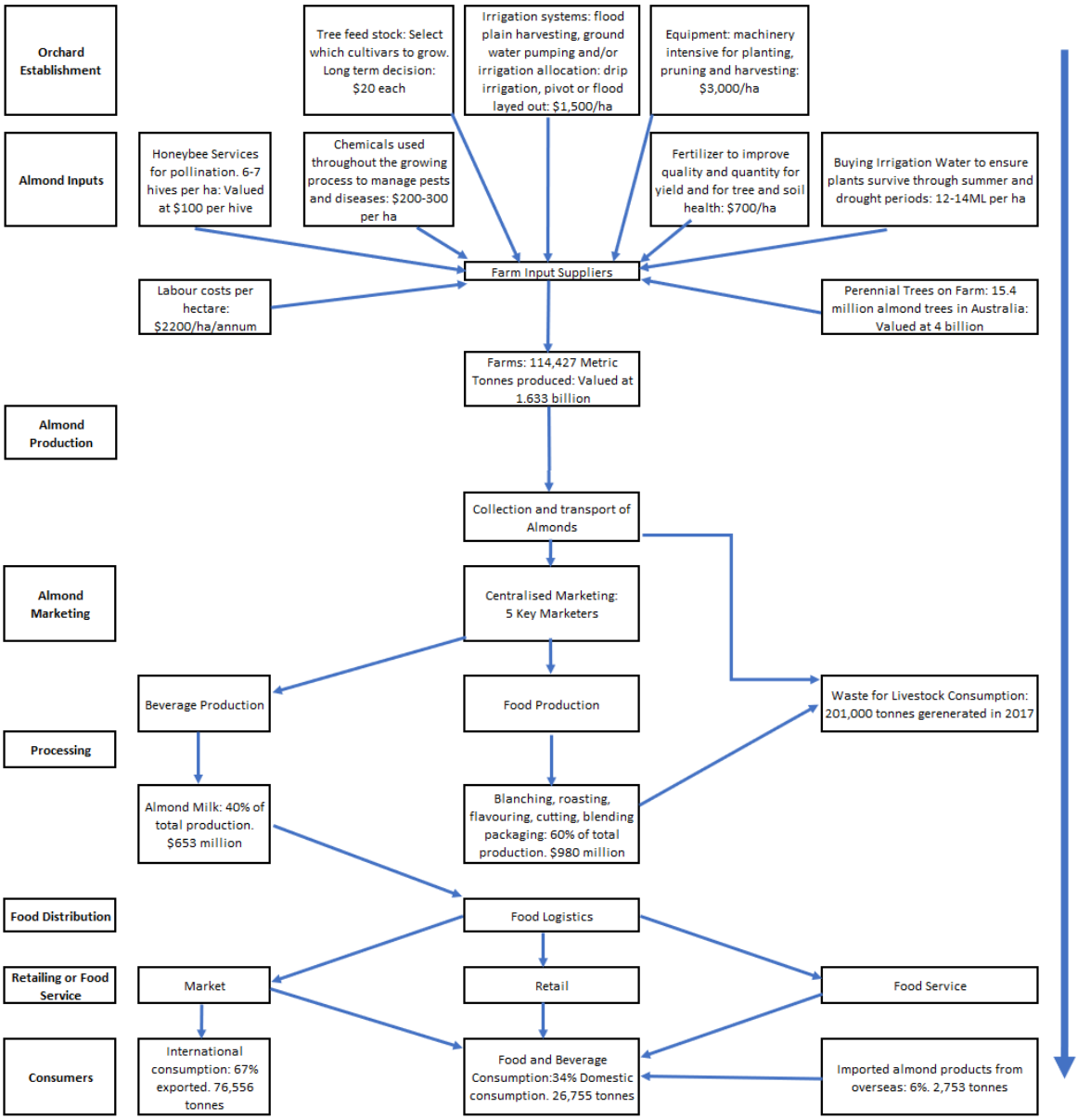
The Australian nut industry is dominated by almonds, with more than 50 per cent of the total area planted to nuts occupied by almonds (The Australian Nut Industry Council, 2020). The almond crop of 2020/21 had an export value of $545.3 million. The industry is expanding with increasing production and consumption, both domestically and internationally. The Australian almond industry has five key regions where production occurs: North Adelaide plains and Riverland (South Australia), Sunraysia (Victoria), Riverina (New South Wales) and the Swan region (Western Australia) (Almond Board of Australia, 2021). The Australian almond industry is growing rapidly year-on-year, with the current orchard area 58,232 hectares. The 2020-21 almond harvest in Australia was 10 per cent higher than in 2019-20 at 114,427 tonnes. Of this total production, 76,693 tonnes were exported. During the same period, the Californian almond harvest was 17 per cent greater compared to the previous year, resulting in a sharp global almond price reduction. This is important as marginal revenue per tonne of

almonds has reduced. In contrast, the 2017 total Australian planting of almonds was close to 40,000 ha and earned $429 million (Thomas, 2019).

Australian Almond Value Chain

A map of the Australian almond value chain is shown in Figure 1.

Figure 1. The almond value chain in Australia



Source: Author compilation (Almond Board of Australia, 2021; Waycott, 2018; Bungard, 2019)

The Australian almond value chain is very dynamic, vertically integrated with a few major producers and suppliers, with a streamlined approach to operations. This involves direct ownership over various stages of production rather than relying on external suppliers and contractors. Australian agriculture, more broadly, relies on a wide range of off-farm inputs for production including labour, fuel, fertilizer and irrigation water for production. The almond value chain is unique in that the industry is marketing

its product through five key marketers: Almondco, Bright Light Agribusiness, Nut Producers Australia, Olam Edible Nuts and Select Harvest (Almond Board of Australia, 2021).

Current Threats to the Almond Value Chain in Australia

Varroa mite

Agriculture in Australia is highly dependent on insect pollination, specifically from the introduced European honeybee, *Apis mellifera* (Cunningham et al., 2002). Two thirds of agricultural and horticultural crops produced in Australia only achieve commercially viable yields with the successful timing of bee pollination services (Somerville, 2021). In particular, the Australian almond industry is highly dependent on bees for pollination. During the 2021 season, 300,000 beehives were transported around the country to pollinate the national crop (May, 2022).

One of the key risks to bee numbers and pollination services in Australia is hive health. The Australian almond industry is currently at risk from the varroa mite. Varroa mite is a parasite that effects adult honeybees and honeybee brood. Infected beehives are weakened, and colonies are killed. The varroa mite is extremely mobile and can readily travel on adult bees. As occurred in New South Wales in 2022, an incursion of varroa mite from overseas restricted hive movements and the destruction of hives within biosecurity control zones which, due to a loss of bees for pollination, is estimated to have reduced the almond crop value by $200 million (Bernasconi et al., 2022).

Water availability and price

Almond production, especially for almond milk, requires large volumes of water. A mature orchard uses 10-14 megalitres per hectare depending on seasonal rainfall deficits (Pedersen, 2021). Varying rainfall means almond growers in Australian eastern and southern growing regions utilise irrigation water. Irrigation sources consist of groundwater and river flows to supplement the need when crops are unable to receive optimal amounts of rainfall for crop production and plant survival. The main risk for irrigators is the volatility in the annual price of water due to fluctuations in water storages (supply) and demand (tree water needs in deficit or surplus from rainfall volatility).

Unlike cereal cropping, almonds are perennial crops, with a 20 to 25-year lifespan. During periods of drought, farmers must keep irrigating trees to avoid losses from tree death, and any potential permanent reductions in tree productivity. However, during periods of drought, irrigation water prices increase, as water irrigation supplies from river systems are reduced. During the drought period of 2020, it was reported that major almond producer and marketer Select Harvest had a 63 per cent increase in water costs in the 12 months to the end of September 2020 (Thompson, 2020).

There is also a supply risk with water delivery. Depending on the location of orchards, irrigation water quantities may be limited and not able to be delivered in a timely manner. Water delivery risk is in the regions downstream of the Barmah ‘Choke’ - the Sunraysia, Riverland and North Adelaide plains almond growing regions. The Barmah Choke is the narrowest section of the Murray River, that runs through the Barmah-Millewa Forest (MDBA, 2021a). It is located downstream of Tocumwal in New South Wales and finishes upstream of Echuca in Victoria. The Choke has a trade restriction to protect delivery to existing water entitlement holders and to maintain river environmental health in the Choke region (Pedersen, 2021). This section of the Murray River restricts flow to 7,000 megalitres per day, which is the lowest flow along the entire river (MDBA, 2021a). This presents a risk to almond growers as it can limit the delivery of irrigation water during periods of peak demand, generally during spring and summer for these almond growing regions.

The changing demand for water across the agricultural sector is also contributing to greater risk in water markets. In recent years, the category of 'fruit and nuts' was the third highest in water usage in Australia. In Table 1 is listed the top five industries by consumption of irrigation water in Australia. Almonds are a high value crop in Australia's irrigation districts. During drought periods, when water prices increase, the marginal benefit to watering almonds is one of the highest compared with many other agricultural sectors. Growth in the almond industry has altered the demand characteristics for irrigation water with a change in the profitability of irrigated activities (MDBA, 2021b). These changes in water demand have risen from price shifts in the global market for products such as milk, cotton, almonds and rice. The rise in permanent plantings has led to an increase in irrigation water demand, especially when seasonal rainfall is higher or lower than expected (MDBA, 2021b).

Table 1. Quantity of irrigation water applied

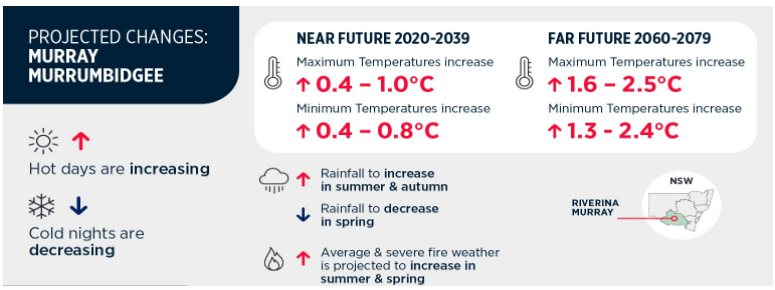
	Category	Million's of Megalitres Applied
1	Pasture	2.1
2	Cotton	1.3
3	Fruit and Nuts	1.1
4	Sugar Cane	0.795
5	Grapevines	0.517

Source: Author's own with data from Australian Bureau of Statistics (2022)

Changing climate

Almond production in Australia is sensitive to other weather and climatic conditions apart from water availability. The industry is vulnerable to insufficient chill units, heat waves, drought and untimely rainfall (Thomas, 2019). In Figure 2 is shown the key effects of a changing climate in the Riverina almond growing region. In the Murray Darling Basin growing region, there is high confidence that the almond growing regions will be warmer and local rainfall will reduce during spring but increase during summer and autumn (New South Wales Government, 2020). There is uncertainty regarding the extent of warming and exact changes in rainfall. The reason for this uncertainty is due to the different future scenarios for carbon dioxide concentration.

Figure 2. Projected effects of climate change on climate in the Murray and Murrumbidgee region



Source: (New South Wales Government, 2020)

Labour shortages

The inability to gain skilled labour is a threat to the almond value chain in Australia. Labour is a key input to Australian agriculture and the Covid-19 pandemic, including border restrictions and lockdowns, have magnified the problem (ABARES, 2020). The Australian unemployment rate is currently 3.4 per cent which is exacerbating current skilled worker shortages in Australian agriculture

(ABS, 2022). The Australian agricultural sector is currently experiencing a shortage of at least 200,000 seasonal and full-time workers (Bakan, 2022). This results in major supply chain disruptions and delays including crops not being transported on time and delays in receiving fertilizer, chemicals and fuel to be used on farm in time for critical tasks (Isa, 2018). Labour shortages also result in higher prices. Produce takes longer to get to shop shelves around the world resulting in product shortages at retail (Bakan, 2022). The Almond Board of Australia is trying to take a holistic approach by promoting itself as a career for future agricultural students (Isa, 2018). The Board argues that labour issues are systemic across agriculture and almonds are another casualty of long-term failed government policy (Isa, 2018).

Trade exposure

The Australian almond industry is heavily reliant on the export market. Overseas consumers receive 76 per cent of the Australian almond crop, valued at $545.3 million (Almond Board of Australia, 2021). The ability to export Australian product to a global market presents risks related to logistics, market access and currency. Australian almonds are primarily exported into the Asia Pacific and Oceania market (67 per cent) and European market (22 per cent) (Almond Board of Australia, 2021). This allows for diversification and a spreading of risk. As illustrated by the Australian barley industry and their reliance on China, when a tariff is imposed, there is a substantial reduction in price (Cao & Greenville, 2021). The almond industry has mitigated this potential risk by serving multiple markets.

The concept of competitive advantage is also relevant with the reliance on trade where, in the longer term, relative production costs and risk to other key producing countries are relevant. For almonds, the relative medium-term cost structure to the Californian almond industry presents a strategic risk. Determinants of such risk can include both within-country productivity gains within each respective almond industry, and also external factors including macroeconomic factors. For example, macroeconomic reforms and polices contributed to allowing Brazil to emerge as one of the most competitive agricultural exporters (Valdes et al., 2020). The Brazilian Government implemented policies that lowered interest rates and reduced tariffs for critical inputs. The Brazilian Government's devaluation of the currency contributed to restraining on-farm production cost increases.

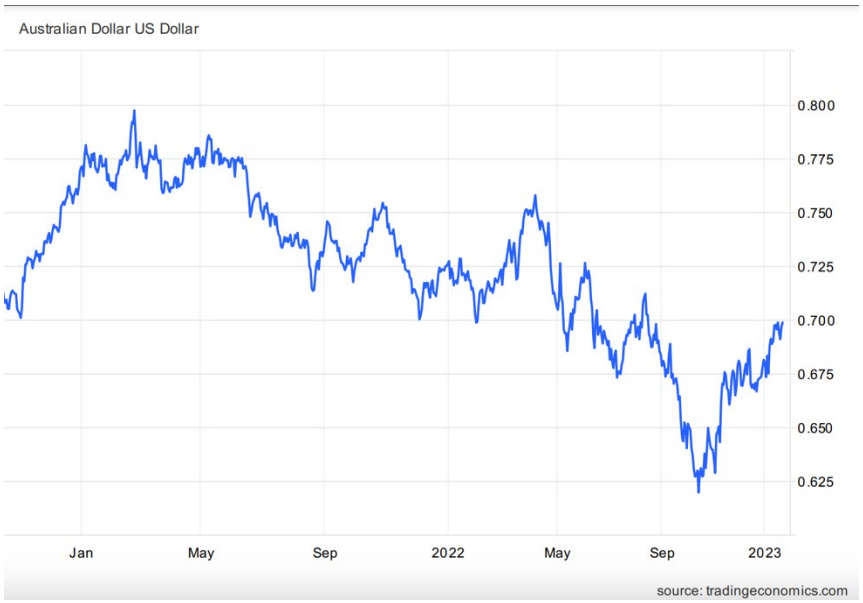
Currency risk and the $US exchange rate

Currency risk is commonly referred to as exchange-rate risk, arising from the change in the price ratio of one currency to another (Chen, 2019). With a high reliance on export markets, the almond industry is constantly managing volatility in foreign currency markets, particularly the $AU/$US exchange rate. The United States produces 76 per cent of the world production, so all almonds sold overseas are priced in $US. Thus the $AU/$US rate in-part determines the revenue and volatility in the price for Australian producers and exporters in $AU. For example, Australian sellers benefit when the $US is low relative to the $AU (Almond Board of Australia, 2021). This currency risk is inevitably impacted by events and circumstances outside the control of almond operations, so the Australian almond industry can only mitigate and take precautions to protect against the negative impact of the risk, through hedging or forward contracting prices in $AU terms or, in the case of an exporter, direct hedging of currency against immediate and future expected sales. Hedging can also be used to manage the cost of inputs for importers includes machinery, fertilizer, fuel and other technology related to the agricultural sector. In Figure 3 is shown the value of the Australian dollar in relation to the US dollar.

Options to Improve the Almond Value Chain

Despite the current threats to the Australian almond industry mentioned above, the industry is reasonably well-placed for the future. The use of technology is highly advanced, aiding its ability to be

Figure 3. Value of the Australian dollar in relation to the US dollar, 2021-2023



Source: (Trade Economics, 2023)

prepared for the future (Thompson, 2022). There are five key areas that could be considered by the almond industry in Australia to become more 'future ready'.

Diversifying pollination

Honeybees will remain Australia's largest pollinator of almonds, even if varroa mite becomes endemic. It is forecasted that up to 30 per cent of all beehives in Australia could be destroyed should varroa mite become widespread (Hargreaves, 2022). The bee industry in Australia is already stretched for pollination services to meet current demand. One strategy for the almond industry could be to diversify pollination sources and services that do not include honeybees.

The use of blowflies to pollinate plants is being investigated to potentially fill the role honeybees play in the almond industry. The annual gross economic value of crops requiring pollination services is estimated to be $US6 billion in Australia (Cook et al., 2020). Honeybees account for 92 per cent of worldwide cross-pollination, with flies the remaining 8 per cent. Blowflies have a large demand for sugar, which they can inhale from the nectar in flowers. Flowers are the bright advertisement for insects to come and feed on them. Blowflies are overly large flying insects, which make them very good at pollinating. Pollen is accidently distributed over the hairs on their body and transferred to the next flower (Hargreaves, 2022). It is suggested in research that flies can be as efficient as, or even moreso than, bees in certain agricultural crops (Ssymank et al., 2008). One key benefit to the almond industry in Australia, is that blowfly production costs are approximately one third less compared to bees. There is also a reduced health risk when using blow flies as pollinators as there is a lower risk of them spreading pathogens or diseases (Cook et al., 2020).

To combat the issues related to pollination, research and development from the United States has developed new and improved self-pollinating almond tree varieties (Flores, 2010). Although self-pollinating of almonds is not new, risks with bee diseases and acceptance by consumers of these varieties have accelerated their development. Self-pollinating varieties would allow a 'bountiful harvest without being pollinated by insects' (Flores, 2010, p. 14). Uptake of planting self-pollinating almond varieties has increased as customer demands have allowed these varieties to become commercially viable (Almond Board of California, 2020).

Increasing almond output

In the past 15 years there has been a rapid expansion of almond farms in locations optimal for almond production (Gouk, 2016). The future of almonds in Australia is positive; however, the total area of almonds planted in Australia is slowing (Almond Board of Australia, 2022). . Future growth in almond production and exports by the industry can increase economies of scale and increase the potential for greater productivity gains over time. Higher future almond production can be either through expansion in different production regions or intensification in existing regions. The rate of expansion of almond farms in Australia is slowing, as it is becoming more challenging to find aggregations of land at a justifiable price, in the right location. Unlike annual crops, horticulture and nut trees have more specific growing requirements. Almond farms cannot be purchased on the basis of good soil alone; it also requires a combination of correct climate, access to labour and access to water (Hossain et al., 2020). For example, frost damage to spring blossoms is a major limiting factor in defining the location of where almonds can be grown successfully in Australia (Wirthensohn, 2017).

There are still regions of Australia that meet the right mix of soil, climate and key inputs, (ignoring land price), which is upstream of the Barmah Choke along the New South Wales/Victoria border. As mentioned earlier, the Barmah Choke is a natural geological fault that reduces the flow of the Murray River and limits the delivery of irrigation water below it during periods of peak demand. Shortages generally occur in spring and summer when rainfall is less than plant requirements. In Figure 4 are shown the areas of Victoria and New South Wales that have high water availability and security. Regions below the Choke, into the Sunraysia region, are not viable long-term for permanent plantings (MDBA, 2012). It has become apparent to the almond industry in Australia, that if the industry is to grow and develop in this region with a reliable water source, this has to occur above the Barmah Choke (MDBA, 2019). Longer term, bypass options for the Choke could be explored or more water allocated to downstream areas from the Darling or Murrumbidgee rivers which enter the Murray downstream of the Barmah Choke.

Figure 4. Area of Australia's irrigation district with reliable irrigation water

Source: (Simpson, 2016)

Alternatively, future Australian almond output expansion could be through intensification. Australia's largest almond producer, Select Harvest, has been confronting difficulties in finding viable greenfield sites for further expansion by replacing older trees with new varieties and in new planting patterns (Thompson, 2022). This has resulted in 30 per cent more trees per acre, increasing total output. Other benefits include introducing varieties that are being demanded more strongly by consumers, resulting in price premiums.

Managing climate

Managing climate variability is the greatest risk faced by almond producers in Australia (Thomas and Hayman, 2018). There are no regions of almond production in Australia that do not require additional watering of some form, as no region has the correct heat requirements and summer rainfall to keep

plants in optimal condition every season. Rainfall patterns are either too high or low across most years (Thomas & Hayman, 2019). This manifests as a broader distribution of rainfall, with very few optimal growing years (Kolikow, 2012). Almond trees do not like wet growing conditions in winter or summer, creating more issues into the future with reduced fruit set or death of trees (Grant, 2021). Seasons of wetter-than-average rainfall result in rapid tree growth, due to trees absorbing unseasonal moisture, high in nitrogen. This rapid tree growth in young trees produces main branches that are not strong enough to withstand future harvest yields, as they grow too quickly in their developmental phase.

To manage shorter-term climate risk, and particularly years with inadequate rainfall to meet tree requirements, some large Australian almond producers have implemented a water-availability and price-averaging strategy (including consideration of capital efficiency and allocation). This includes owning one third 'high security' water, long-term leasing of one third of 'high security' water and buying one third on the spot market (Thompson, 2022).

Medium term almond producers are exposed to any future changes in climate. Climate change may increase both production risks (such as altering the probability of required chill hours, frost frequency and severity, and water availability) and input cost volatility (water prices) which will require the industry to adapt over time through innovation, technology and management. The ability for the almond industry to adapt and survive will be crucial in their ability to remain globally competitive. For example, in the Southern Riverina almond growing area, adequate water is available for future almond production but there are future climate concerns. In this region, as it is likely to be warmer and possibly drier, there will be an increase in the reliance on irrigation (Thomas & Hayman, 2019). The uncertainty regarding future climate is particularly acute for rainfall, with climate models varying as to the direction and magnitude of changes to rainfall.

Labour shortages

The Australian almond industry is positioned favourably compared to many international competitors as the farming systems are not labour intensive, but it still requires machinery operators, general farm hands and managers to operate and manage large multi-million-dollar investments. But like many sectors in Australia at present, the almond industry is challenged in attracting and retaining skilled labour. One solution (Wirthensohn, 2021) is the ability of the Australian almond industry to increase wages to ensure a supply of labour is available for time-critical tasks.

Another option the almond industry in Australia could consider to assist the retention of managers and high-value employees is to enter an employee stock option plan (ESOP). This occurs when employees have a share in the profits. This is hoped to lead to them making better decisions through aligning their interests with those of shareholders (Ikäheimo et al., 2004). Employees under an ESOP arrangement are more likely to commit themselves to the business for a longer period of time, which contributes to the long-term viability of the organisation. Although Australian almond farms are capital intensive operations, other options are possible. Another arrangement could be made with employees to have a bonus scheme for each tonne of almonds produced, rather than a stock option in the business. This may have a greater impact on the employees as it links their effort more directly to rewards achieved.

Specialised training programs are another option for almond operations to consider in managing their workforce shortages. Training programs offer organisations the ability to reduce staff turnover rates and have a more engaged workforce with more proactive workers. Modern organisations who want to stay competitive need to retain engaged employees who have high levels of energy and commitment. Engaged employees have an abundance of 'resources' which they can invest in their work. They are enthusiastic about their work, immersed in their work activities, and persistent when

confronted with challenges. The almond industry in Australia could run industry-wide specialised training programs (not just at the farm level). This would create an industry that puts employee skills and wellbeing at the forefront of business objectives.

Market access, trade barriers

The recent free trade agreement Australia signed with India is positive for almond producers in Australia (Thompson, 2022). It opens a new market to increase sales. Trade wars and tariffs between America and China have also been beneficial to Australian almond producers. This resulted in 50 per cent of all Australian almonds now being sold into China. Opening up new markets for Australian almond production is a traditional supply chain risk mitigation strategy to manage price concerns (Christoffersen et al., 2011).

Conclusion

Almond farming in Australia is growing rapidly with young trees planted that are due to bear fruit in the next five years. The value chain associated with almond farming is vertically integrated with the almond processing industry. Direct ownership over various stages of production, rather than relying on external suppliers and contractors, is a characteristic of the Australian almond industry. The almond industry in Australia faces many threats beyond the control of value chain participants, such as exotic disease outbreaks (infestation of varroa mite), a changing climate, an inability to attract labour and currency risk.

Future improvements to the Australian almond industry could include diversification of production methods (pollination sources) and markets. Geographic diversification away from regions where water delivery risk is high (below 'Choke') may be a natural evolution of future almond production growth in Australia, which may include Identification and development of new suitable regions (if they exist in Australia). Growth in output through inw tensification of existing production regions upstream of the Barmah Choke is another avenue. For existing risks to labour, entering employees into stock options as well as training employees, can assist in managing labour shortages. Revenue volatility can continue to be in part managed by currency hedging, but the Australian industry remains exposed to longer term trends in cost competitiveness against the California almond industry driven by both macro-economic trends and productivity gains. Improved market access, such as via the free trade agreement with India, can reduce market risk.

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