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Labour shortage – The role of technology led innovation in the kiwifruit industry

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Table of Contents

1 Executive Summary 6
2 Introduction 7
2.1 Aim and objective 9
3 Methodology 9
4 Literature review 9
4.1 Current industry growth and labour status 9
4.2 Possible Solutions 12
Technology led innovation 12
4.2.1 Why does the kiwifruit industry need innovation? 14
4.3 Innovation at Zespri 15
5 Main Findings and Discussion 17
6 Conclusions 24
6.1 Not enough permanent staff 24
6.2 New immigration laws and border restrictions 24
6.3 Locals reluctant to work for industry 24
6.4 Old systems set up at the packhouses 24
6.5 Tiny innovations for a collective big change 25
6.6 Demographic locations 26
6.7 Lack of staff engagement 26
6.8 Role of Zespri 26
7 Recommendations 26
7.1 Creating positive workplace culture 26
7.2 Introducing flexible working hours 26
7.3 Implementing training and development programs 27
7.4 Following the change management process 27
7.5 How to attract young people for blue collar jobs? 27
7.6 Industry focussed teams of scientists 28
7.7 Generate more skilled workforce 28
7.8 Invest in new production systems to assist automation in orchards 28
7.9 High rate/hr and border restrictions – An opportunity to innovate? 29
7.10 Increase rate of commercialisation and spinouts from research 29
7.11 Implementation of efficient technology adoption process 29
8 Overall conclusion 29
9 References 30

Table of Figures

Figure 1: New Zealand kiwifruit export markets (year 30 June 2020)..... 7
Figure 2: Global kiwifruit sales (Source Zespri, 2021) 7
Figure 3: Kiwifruit growing regions New Zealand (Source Zespri, 2020)..... 8
Figure 4: Sources of workers as of season 2019. (Source NZKGI,2019)..... 10
Figure 5: Peak season timeline in Orchard/Packhouse (Source: NZKGI,2019)..... 11
Figure 6: Current and future workforce (Source: NZKGI, 2019) 12
Figure 7: Callaghan Innovation Agritech customers areas of activity Source: Growing innovative industries in New Zealand: Agritech industry transformation plan - July 2020 13
Figure 8: Robot kiwifruit picker (source Robotics Plus, n.d.) 13
Figure 9: Innovation framework (Source Zespri, 2020..... 16
Figure 10: Near infrared grading machine (source https://www.compacsort.com/) .. 21
Figure 11: The Abundant Robotics commercial robotic apple harvester at work on a T&G Global orchard in New Zealand. (Source Farm Weekly) 23
Figure 12: Grading and packing lines at Mpack BOP (source https://www.mountpac.co.nz/why-choose-mpac/)..... 25

1 Executive Summary

Kiwifruit represents 32% of New Zealand's total horticultural export revenue. Kiwifruit growers and the wider industry works hard to make sure consumers across the world can enjoy fresh, healthy kiwifruit; however labour shortage could easily put high kiwifruit returns into jeopardy. If industry doesn't pick and pack kiwifruit on time it can result in substantial fruit loss in terms of quality and revenue. The current and predicted labour shortage is already having a significant impact on the horticultural sector including the kiwifruit industry. Projected growth in kiwifruit sales is predicted to reach 190 million trays by 2027. However, with the record-breaking volume increase every year, the tsunami of kiwifruit may arrive earlier than 2027. An additional 8,000 seasonal workers will be required if projected growth targets are to be achieved successfully, in addition to 23,000 seasonal workers in peak season (2021 data). Hence the extent of the labour shortages is critical for the kiwifruit industry. The aim of this study was to investigate the extent of the labour shortage in the kiwifruit industry especially within postharvest, and how technology led innovation can help to ease the burden of the shortage in labour.

The physical, inconsistent/seasonal nature of the job plus lack of training and work culture, tighter immigration laws and COVID-19 are among the main factors hindering the industry from attracting and retaining people year on year. In most of the interviews, lack of change management, work culture, effective communication and leadership were raised as major barriers in technology-led solution of labour shortage. Kiwifruit, along with the other horticultural industries needs certainty of labour supply. Key recommendations from this project are discussed here. One way kiwifruit industry can attract labour is by supporting employment staggered year-round or fixed contract with flexibility to provide job security. Improving work culture, where everyone is treated fairly, will help to build industry reputation and would encourage everyone to work and stay. To empower and attract young locals, the kiwifruit sector needs to incorporate innovation, sponsor apprenticeships, change marketing strategies, provide accommodation, and travel facilities for seasonal workers. Universities and Polytechnic institutes need to encourage students to gain horticulture knowledge to produce a future workforce for the kiwifruit industry.

Even if all the unemployed in NZ would work, industry would still need more seasonal workers. What should industry be focusing on, to resolve long term labour issues? Industry needs to be creative and look for innovative solutions to ease the labour shortage issue. Technology adoption could serve two major benefits to the industry: first easing the pressure on manual labour jobs, and secondly generating technical jobs for young kiwis. This new job market will call for skilled people to build, service and maintain technologies. To successfully introduce and implement innovation in the industry, employers need to follow a change management process. Industry needs to make sure that contractors follow compliance requirements and keep investing in fit-for -purpose innovation to improve supply chain efficiency. All stakeholders need to understand that continued small and large operational improvements and enhancements will move the industry toward efficient and reduced labour efforts. A dedicated investment in technology innovation and a collective effort for adoption needs to be supported by Zespri, postharvest facilities, Government, and the private sector to improve performance and brace for future challenges.

2 Introduction

The New Zealand kiwifruit industry is the biggest sector in the country's horticultural industry. According to the NZ Horticulture Export Authority, almost 2,800 kiwifruit growers produce approximately 150 million trays for export from 12,185 productive hectares. Kiwifruit alone contributed a massive share ($1.8 billion) of total horticulturalexport revenue ($5.5 billion).

Zespri International Limited is the world's largest marketer of kiwifruit, selling into more than 53 countries (Figure 1) and managing 30 percent of the global volume. Zespri is the sole global exporter of New Zealand grown kiwifruit and is the most recognised fruit brand in China's largest cities (NZKGI, 2020).

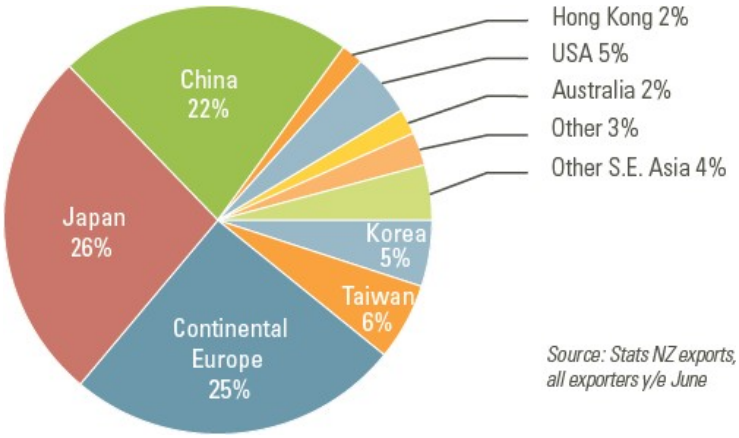

Figure 1: New Zealand kiwifruit export markets (year 30 June 2020)

According to a recent Zespri media release "Zespri is expecting to supply around 177 million trays of kiwifruit in 2021, or approximately 700,000 tonnes, which will be a record-breaking crop of New Zealand-grown Zespri Kiwifruit". In 2020/21 Zespri's net global kiwifruit sales increased 14 percent to $3.58 billion compared to last year and global operating revenue (including sales and licence income) reached $3.89 billion (Figure 2).

Figure 2: Global kiwifruit sales (Source Zespri, 2021)

The 2020/21 results show average orchard gate returns have again increased, with strong returns per tray and per hectare. According to a report published by IndexBox, despite the C restrictions New Zealand was the largest kiwifruit exporting country, supplying almost 572K tonnes in 2020 approximately 41% of the global shipments. There was an increase of an 8.3% year to year export comparison. Production has been also recorded to be highest as compared to previous years. Main areas of interest in terms of kiwifruit growth are the Bay of Plenty (mainly Katikati, Te Puke, Tauranga, Opotiki and Whakatane), producing over 81% of the total crop (Figure 3). There are three main kiwifruit varieties currently grown commercially in New Zealand. Green (Hayward) and SunGold™ (Gold3) from the large majority of producing hectares. More recently, a new Red coloured kiwifruit variety has also become commercially available but only a small amount of license is currently available.

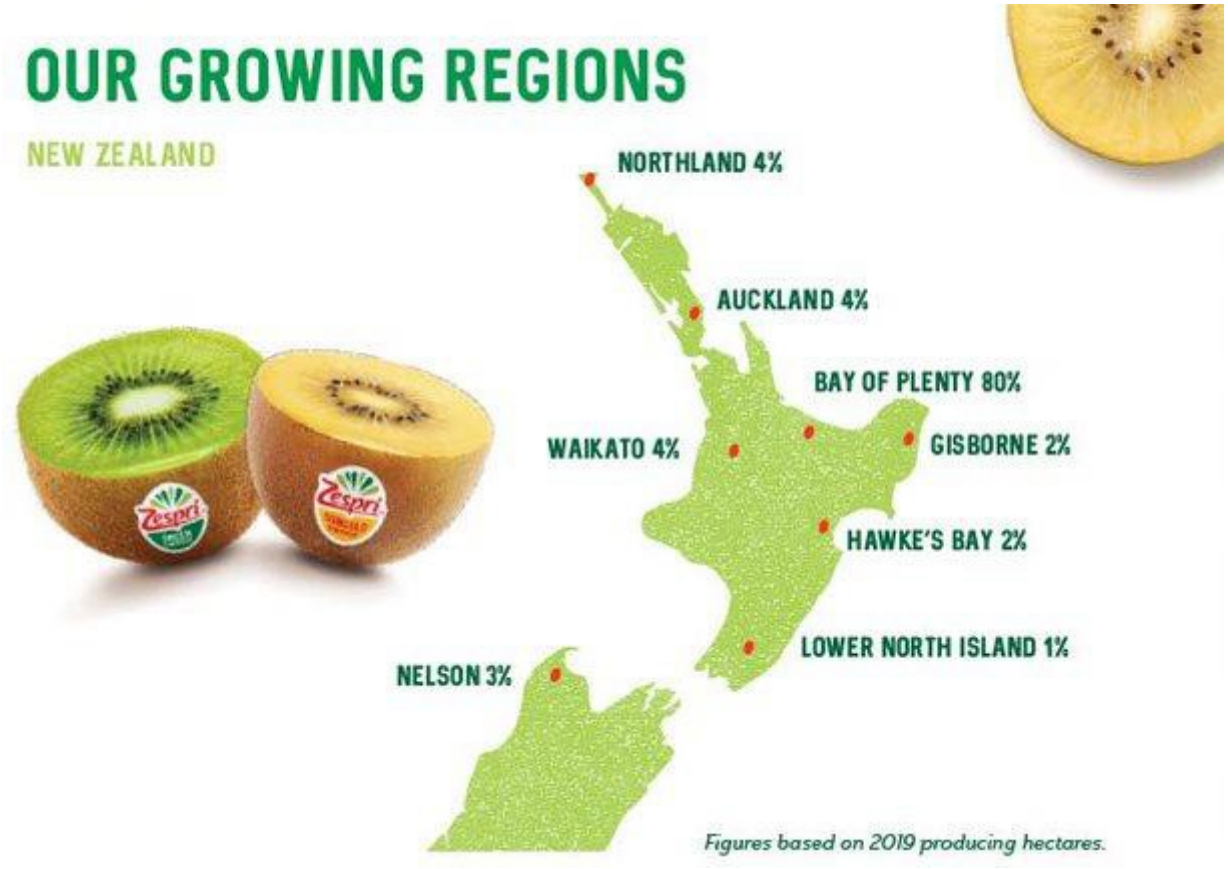

Figure 3: Kiwifruit growing regions New Zealand (Source Zespri, 2020)

According to Zespri's media release "we are expecting to supply around 177 million trays of kiwifruit in 2021, or approximately 700,000 tonnes, which will be a record-breaking crop of New Zealand-grown Zespri Kiwifruit". Projected growth in kiwifruit sale is to reach 190 million trays by 2027. However, seeing the record-breaking volume increase each year, this tsunami of kiwifruit seems to arrive on us earlier than 2027. An additional 7,000 workers will be required if projected growth is to be achieved in addition to 23,000 seasonal workers in peak season (2021 data) so the extent of the labour shortages is critical to the industry. The processes including pruning, harvesting at orchard, and packing at packhouses are physically demanding are one of the main hinderance for hiring people into this industry.

2.1 Aim and objective

The aim of this study was to gain perspectives on labour issues in industry- major drivers behind this shortage and possible solutions especially the role technology led innovation and role of Zespri in this whole situation.

3 Methodology

I started with a literature review to gather information related to my topic. My sources of literature were mainly newspaper articles and industry reports. My literature review was then compared/contrasted to views from industry leaders.
Semi-structured interviews were carried out to allow the flexibility to explore topics of interest raised by interviewees. Following the semi-structured interviews, primary industry leaders (kiwifruit and apple) were asked more specific questions (included in the report) with more focus around the areas of interest raised by interviewees. After the interviews, I reached out to key stakeholders (University, Research Institute, Callaghan Innovation, and Zespri) for informal discussions to gain more knowledge and views about my study topic. Interviews and discussions were carried out predominantly via video call and some in person. Questions were open ended, and were not pre-circulated, so all the answers are spontaneous and instinctive.

Thematic analysis (a method for identifying themes from a set of qualitative data (Clarke & Braun, 2006) was conducted on the data to extract the main points of interest and was compared/ contrasted to reported literature sources. Interview participants permission has been sought and granted to include comments and opinions in this report. However, unless directly quoted, comments have either been amalgamated or been reported anonymously to retain privacy and freedom of opinion.

4 Literature review

4.1 Current industry growth and labour status

The Kiwifruit industry has been recognised for being resilient and resourceful, as demonstrated by its recovery after Pseudomonas *syringae* pv. *actinidiae* ((Psa-v) a bacterial canker disease specific to kiwifruit), hit hard in November 2010. A similar resilience skillset has been brought to the fore during COVID-19, whereby the industry worked collaboratively to overcome the challenges. Figure 4 shows sources of workers for orchard and packhouses. The growers, contractors and post-harvest sector agreed to collaborate and cooperate with each to get through this hard time. Everyone said “yes” and agreed to work out whatever it took to get through the uncertain times.

NZ Kiwifruit Growers Inc. (NZKGI) was ready to launch its ‘Labour Attraction Strategy’ which usually targets students and retirees, but the Government brought in new COVID-19 regulations that impacted its strategy. People aged over 70 were not allowed to work under lockdown level 4 conditions, people couldn’t travel due to travel restrictions, and the introduction of the wage subsidy incentivised people to rely on the subsidy rather than going to work (Fisher, 2020). According to Nikki Johnson (Former CEO of NZKGI) “We had to change focus and switched to New Zealanders who were recently displaced. We contacted the tourism and hospitality industries in the Waikato,

Bay of Plenty and Rotorua to give people the opportunity to work within the kiwifruit industry." People who lost their jobs came to work for postharvest, however many pulled out when the wage subsidy came into place (Fisher, 2020).

"While some people were not confident to go to work, Trevelyan's had a group of staff who were very grumpy that they couldn't. Many of the seasonal staff, who return year on year and stay in the Trevelyan's 'campground' in mobile homes, are over 70 years old. They were not allowed to come to work at Level 4, and they couldn't go home either" said James Trevelyan, managing director Trevelyan packhouse. Uncertainty of staff coming and going was hard for the packhouses, but they managed and worked it through.

At the start of the 2021 season, Nikki Johnson, said that "around 23,000 workers are needed for this year's harvest season, but with a lack of backpackers and foreign seasonal workers in the country due to our closed borders, many orchards are struggling to fill positions. Due to the need for labour, there was plenty of flexibility available for workers wanting to work reduced hours or less than full time, as well as good pay rates on offer too", she said.

When talking about Trevelyan employment strategies, James Trevelyan stated "People don't need to come and do six days a week, they need to find an employer who is able to work with what they're prepared to do - if they want to do two- or three-days' work or part-time hours then they shouldn't be shy in saying that".

SunGold™ kiwifruit is more labour demanding than the Hayward variety. SunGold™ is predicted to account for two-thirds of the industry by 2027, almost double the volume from where it started. Demand for delicious and vitamin C enriched gold kiwifruit is increasing. Zespri has been launching marketing campaigns in new markets, which is good for revenue generation and also challenging at the same time around how to manage the kiwifruit operations. Not only will the industry require more workers in 2027, but there will also be an extreme peak of workers required during the SunGold™ harvest (Figure 5). In addition, with the full commercialisation of the new cultivar Zespri Red it's going to be challenging for industry to resource labour.

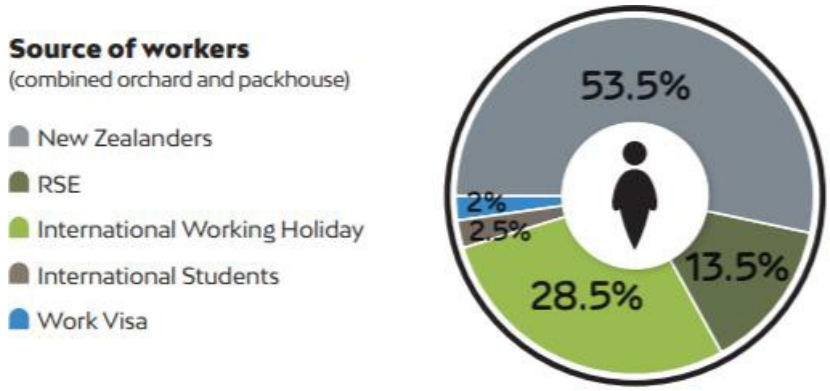

Figure 4: Sources of workers as of season 2019. (Source NZKGI,2019)

In 2019, NZKGI indicated in their report on 'Labour shortage in New Zealand' that if the Government and industry didn't do something to stop the storm of labour shortage brewing, industry would face a severe labour crisis.

According to the report, the kiwifruit industry's labour crisis is likely to continue with the main reasons highlighted as follows:

1- Low unemployment especially in BOP region (as low as 3.8% (quarter 3, 2019))
2- Decrease in international students
3- Decrease in employees with working holiday visas: this category along with international students fill around 20-30% vacancies
4- Work nature – seasonality and inconsistency
5- Negative perception around pay rate and worker welfare
6- Competitive behaviour between employees

Industry has welcomed the Government's decision to allow one-way quarantine-free travel for RSC workers. However, industry will still be short of seasonal labour in harvest peak season. Industry needs to look for more innovative ways to overcome the short term and long-term labour shortage.

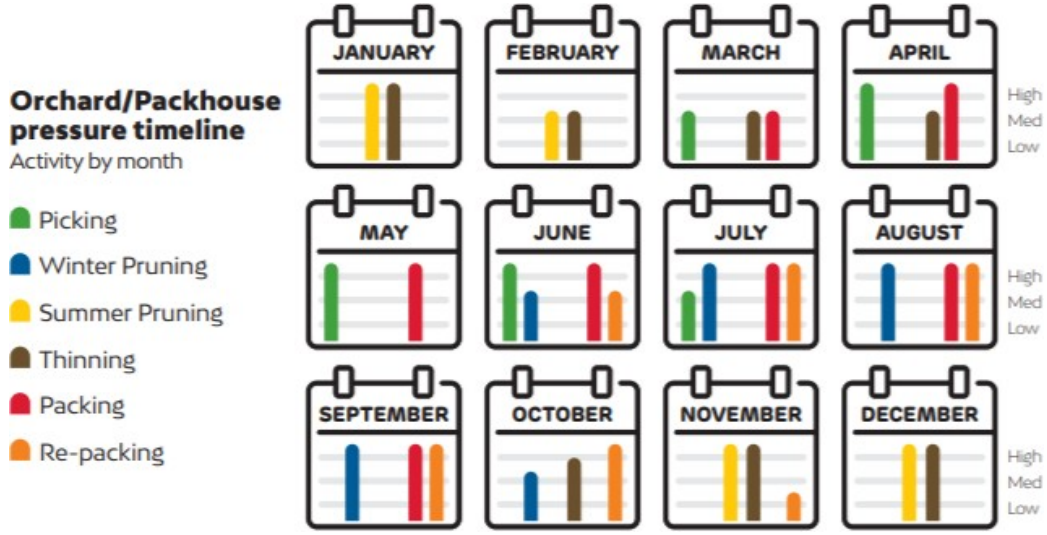

Figure 5: Peak season timeline in Orchard/Packhouse (Source: NZKGI,2019)

NZKGI CEO Colin Bond said, "in 2022 we estimate that the kiwifruit industry will require 24,000 seasonal workers. Historically 25% of those workers have been backpackers and a further 17% RSE. Even with a change to border settings, it is unlikely that this workforce will be available to the extent it has been in the past" (NZKGI,2021). According to an estimate the Kiwifruit industry will need another 8,000 seasonal employees by 2027 (Figure 6).

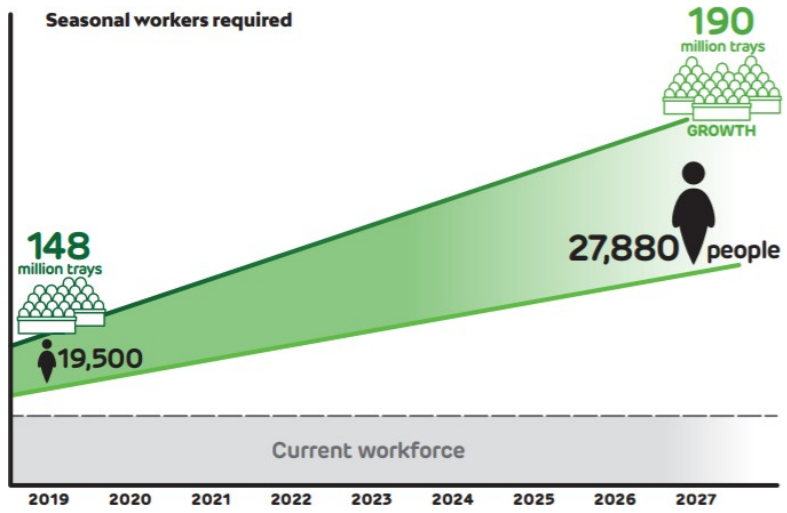

Figure 6: Current and future workforce (Source: NZKGI, 2019)

4.2 Possible Solutions

Technology led innovation

Although 2020 was a terrible year in many respects, it was a good time to reflect on the nature and value of jobs and work, and on the way the working lives of New Zealanders could be affected by increased use of technology in the provision of goods and services and in the workplace. People used to fear that technology would take over their jobs, however lockdown restrictions forced the nation to move towards online working and shopping.

Research is underway on the potential for automation in both orchard and packhouse operations (Figures 7 and8). Automated kiwifruit harvester was initially developed by Alistair Scarfe during his PhD at Massey University, in Palmerston North, New Zealand. Model has proven that it is possible to use a robot to identify fruit, reach up, pull it off the plant and collect it on a hopper. Mounting this on a mobile platform means it can harvest fruit, sort them into bins by size and deliver them to the pack house before driving back out to carry on picking (Scarfe, A. 2012). Robotics plus has already tested a prototype on farms in New Zealand and in California, with improved technology (Figure 9). “But it is not quite as simple as turning these machines out on a production line to send out to farmers around the world. It is going to take some serious investment to produce a commercial product that farmers can use” said Steve Saunders CEO and cofounder of RoboticsPlus (Figure 9). Robotic arms and vision systems are not very good at getting clusters of fruit that are hidden behind branches or leaves for example. People in the kiwifruit industry are getting frustrated that how much money and time this technology is taking but still not any close to completion. Currently Robotics Plus are seeking not only financial support but collaboration from around the world to make this technology work for kiwifruit and other crops.

However, there is very little practically available in the near future which will help to alleviate the burden of labour shortages. Automation can complement rather than replace existing jobs and can lead to jobs that are better suited to our human capabilities and with better pay. Smart use of technology will enable industry and companies to move beyond volume and towards value in their output and exports, helping to move New Zealand up the value chain globally. There are strong

opportunities for further growth in existing and emerging sectors especially kiwifruit and apple.

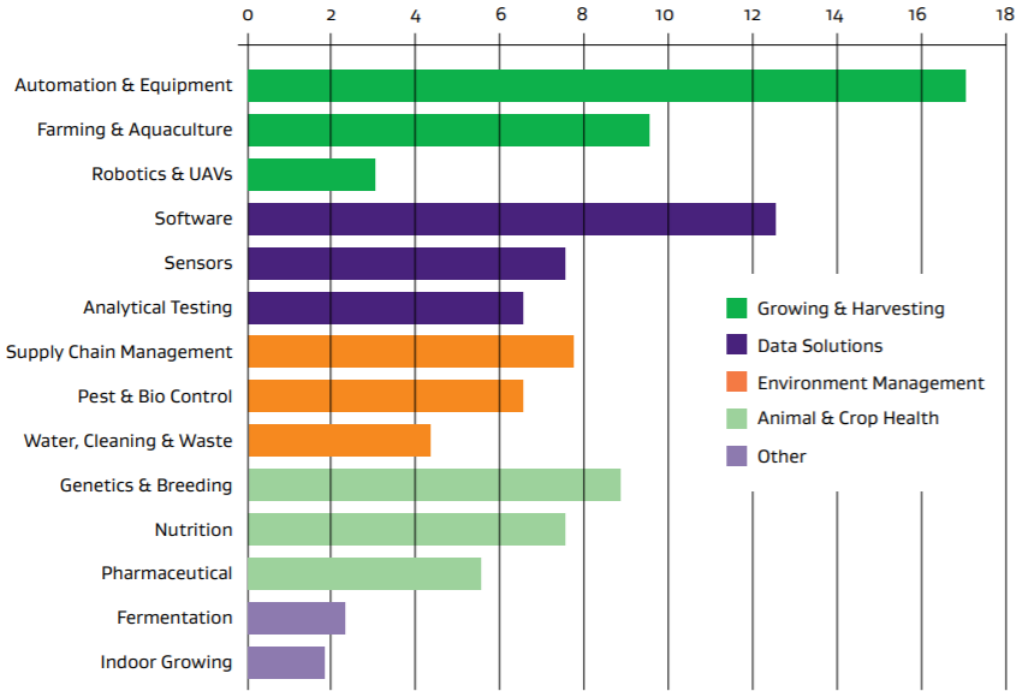

Figure 7: Callaghan Innovation Agritech customers areas of activity Source: Growing innovative industries in New Zealand: Agritech industry transformation plan - July 2020

Figure 8: Robot kiwifruit picker (source Robotics Plus, n.d.)

Labour shortages and disruptions caused by COVID-19 has been one of the major drivers known to move promptly towards innovation and technology. Successful adoption of technology will not help to alleviate labour scarcity but will also produce an entirely new job market of skilled people.

Attract New Zealanders to the primary sector

Campaigns like the Ministry for Primary Industries' 'Opportunity Grows Here' to meet long-term workforce demands and build resilience will be necessary to attract, train and retain school leavers, university graduates, and other new workers. Through the Primary Sector Workforce Programme and campaigns such as Opportunity Grows Here, so far over 5,200 people have been placed into primary sector roles (Ministry of Primary Industries, 2021).

The 'Opportunity Grows Here' initiative is aiming to:

1- Attract a larger, more diverse talent pool by ensuring that primary sector employment and education opportunities are widely understood, respected, and sought after by New Zealanders
2- Attract and train locals who have been moved from other industries with none to minimal skills and knowledge needed to enter primary sector jobs
3- Upskill the current and future primary sector workforce at all career stages across the value chain
4- Launch programmes and initiatives to maintain year-round employment in the primary sector.
5- Develop a publicly accessible skills and employment dataset to help forecast and prepare for future demand.
6- Scale up primary sector social and employment support services and resources.

Work on rural communities

Government bodies need to develop rural communities, to create a place where the future workforce for the primary sector would love to grow and connect. Challenges often faced by rural communities include social isolation, accessing services, and increased complexity in managing environmental issues such as climate change.

MPI proposed in their report to establish a platform for rural communities to:

- Increase engagement with Government
- Accelerate digital connectivity
- Build capability of rural support trusts
- Implement complementary services that provide wellbeing support for the most vulnerable and hard to reach communities.
- Implement community-led development and investment, working with communities to establish a network of hubs across New Zealand to support social resilience.
- Develop services to assist with response and recovery from adverse events and to build future resilience.

MPI is working closely with other Government agencies on the 'Rural Broadband Initiative'. The rollout of rural broadband is on target to ensure 99.8 percent of the population is covered by 2023. There are now 63,000 rural homes and businesses that have access to improved broadband, which is 74 percent of those in scope for the programme.

4.2.1 Why does the kiwifruit industry need innovation?

Labour shortage - motivation for innovation: The labour issues act both as a constraint to the sector, and a major motivator for innovation. We are already seeing some businesses in the sector struggling to find seasonal staff, often in the roles that require

a lot of physical work. This situation raises questions about the sustainability of such business models and the typically regional communities that may rely upon such work. However, COVID-19 is also bringing forward some opportunities as its impacts increase the demand for Agritech products. For example, restrictions on the movement of migrant workers are aggravating labour shortages in the horticulture sector and increasing demand for automation solutions.
Consumer demands: Consumers are well informed these days and are putting a lot of pressure on food production companies to be considerate of the environment and communities. This trend is also driving demand for sustainable, ethical, low carbon emissions and fair treatment of workers. Industry is already seeing the impacts of changing consumer demands in New Zealand, as well as internationally. Traceability from farm to plate has become very important these days. The world we are living in is a global village and connected via social media. Community opinion through social media is affecting purchasing decisions and companies have to change their strategies and adapt quickly to meet everchanging consumer demands.
Future work force: New generation don't feel like sticking to older working methods. Some of these trends will mean that our future growers or farmers will not necessarily emerge from the current food and fibre sector but rather, the biotechnology or digital sectors.

4.3 Innovation at Zespri

It's important to understand the role of Zespri innovation since there will be some specific discussion about this topic later in the report. Zespri has a long history of innovation and continuous improvement. This includes research and development of new technology that allows Zespri to continue enhancing the way it operates across the integrated supply chain – the Zespri System.

"Our ongoing commitment to innovation enables us to create better ways of delivering value, meet changing consumer needs through new products and varieties, raise our productivity sustainably, optimise our fruit quality, protect against pests and diseases, and prove the health attributes of our amazing kiwifruit" said Juliet Ansell (Head of Global Science and Innovation). Continued investment in this space remains crucial if Zespri wants to protect the environment and stay ahead of increasing competition, which remains critical in generating even more value for growers and communities (Zespri, 2021). Zespri spends about almost 0.9% of the total revenue. on innovation is split into two halves at Zespri. One focus is on new cultivar development and the other relates to value chain innovation, finding the research-based solutions from orchard to consumer after a variety has been commercialised (Figure 9).

Zespri has an open innovation strategy for its research and development, and partners with universities, research institutes and commercial companies around New Zealand and overseas to conduct R&D work. Zespri's innovation research programmes are fit-for-purpose, after the release of varieties other platforms move forward to help in commercialisation of the new variety by working in the areas of orchard productivity, plant protection, and continuous improvements in postharvest supply chain to deliver consistent quality kiwifruit throughout the season and provide research for health and nutrition claims.

Over the last decade, the success of Zespri innovation's new cultivar breeding programme has provided the platform for Zespri's current growth. This has been led by Zespri SunGold™, a product of the Zespri/Plant and Food breeding programme, released in 2010 that is in huge demand and provides great returns to growers. Zespri SunGold™ already represents more than half of Zespri sales and is expected to generate around $40 billion in sales over the period this variety is in market. Waikato University has predicted that GDP contribution from kiwifruit would reach 6 billion by 2030. Zespri Red was released for commercial production in December 2019 after almost 14 years of research trials. Extensive research has been underway over the last 2 years in the areas of orchard productivity, supply chain, and market phases to successfully move the variety from trial phase to onset of commercial orchard production. The first of the 150 hectares licences that were released back in 2020 will produce their first commercial crop in 2022. The Zespri Red concept has been in development for more than 20 years, with the original Red19 seedling first planted at the Kerikeri Research Centre in 2007 (Zespri,2020). The red variety was initially launched in Asia given the shorter marine transit times. Trials will continue to improve the postharvest storage performance to make sure Zespri Red can reach the shelves of distant markets (pers. comm).

The knowledge on how to utilise Controlled Atmosphere (CA) storage to extend the packing window of SunGold™ Kiwifruit as volumes increase, without compromising fruit quality outcomes, has been expanded. This is through research trials and post-harvest innovation fund trials (Zespri partnering with packhouses), which has built confidence in this approach. In 2020/21, 2.4 million trays of Zespri fruit went through CA across the industry (up from 0.5 million trays in 2019, and 0.02 million trays in 2018 (Zespri Annual report).

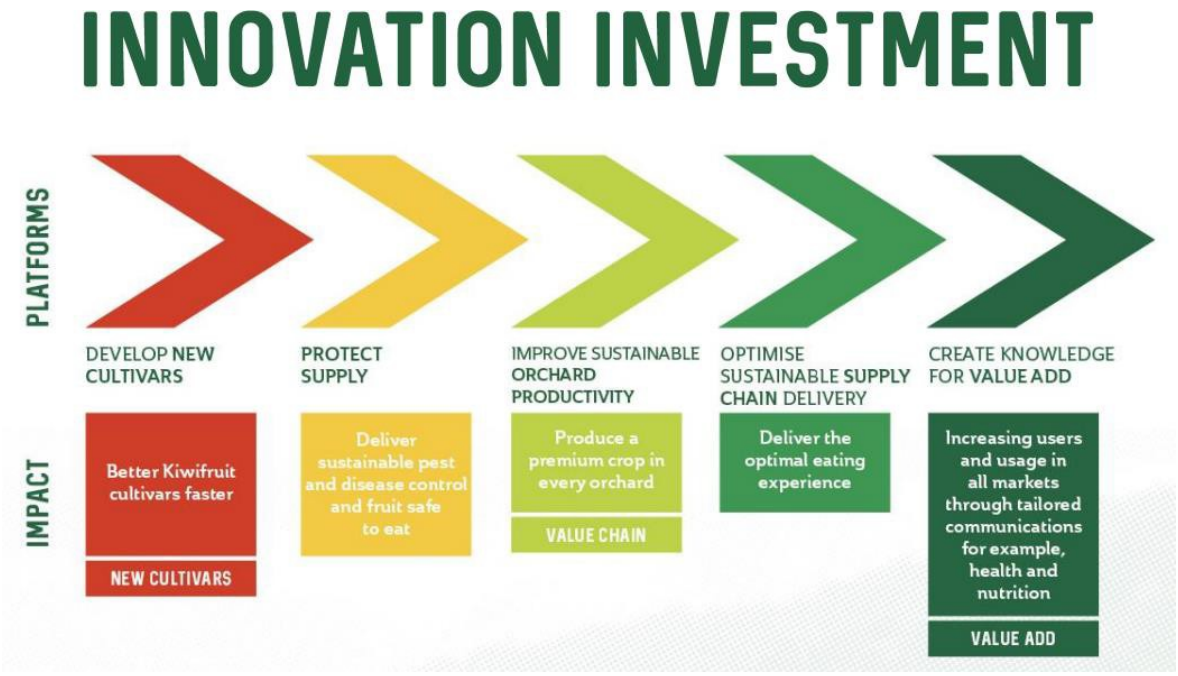

Figure 9:Innovation framework (Source Zespri, 2020

5 Main Findings and Discussion

Interviews carried out for this project asked several questions to understand the labour shortage issue in industry and possible solutions through innovation and technology.

Major themes from the interviews are listed below in the table.

Question number	Themes
Q1	Low RSE workers, no backpackers, Government's negligence, unreliable workers, hard and inconsistent job, timing
Q2	Hard job, wrong perception, lack of training, work culture, employee engagement, wage rate, inconsistent hours, kiwis not willing
Q3	Worse future situation, crop volume, immigration restrictions, low unemployment rate
Q4	Work culture, process improvement, better adoption
Q5	Technology adoption – long term solution
Q6	Voice to Government, create solutions, communication
Q7	Change management, risk factor, lack of capital investment
Q8	Poor communication down the chain, old infra structure, poor engagement
Q9	Learn from apple industry, need for better investment and adoption, more collaboration

1. Can you please describe your labour challenges?

A common theme from the interviews was 'it's a big issue for the whole industry', industry is facing labour shortages in orchards and packhouses. Similar issues that came up during the interviews were 'time', 'pay rate', 'low RSE workers', 'not many backpackers', 'hard job', 'unreliable workers', 'inconsistency', 'hard to attract people'

An interesting comment from one of the respondents was that "industry got lucky because people lost their usual jobs and they moved to working for us in 2020". While another respondent commented that "when lockdown happened people ran towards the kiwifruit industry and began working for us however as soon as the Government announced wage subsidies they left". "The labour shortage is not limited to blue collar workers, but also highly skilled people at management levels; they are all very hard to find". "Usually, packhouses compete with other packhouses to fill those roles because nobody really wants to train people on the job" explained one industry leader.

There are almost 150 new jobs being advertised industry wide but not many people who are willing to work for the kiwifruit sector. Industry is struggling for technical people and even people with a basic horticultural understanding. "I think we have got a lack of resources in the universities" said the industry leader. "There are not many staff in horticulture to train the students and not many students are interested to study for a degree in the area". He further added that different universities and institutes are doing different bits but not very well, industries are using an apprenticeship scheme which is good but not perfect and not enough. This is quite a different angle compared to what other leaders described. I will discuss it further in the conclusions and recommendation sections.

As described earlier NZKGI has declared with the projected volume growth industry will need 8000 more seasonal workers and currently there is critical shortage due to Covid and border restrictions. University individuals think there are not enough resources in the Government institutes to train future horticulture workers. Students are more interested in fields like biotechnology, IT and artificial intelligence (pers. Comm.).

2. Do you face trouble retaining people (skilled or minimally skilled) on the job?

Respondents unanimously agreed it's a tough job both in orchard as well as in the packhouse and they cannot offer people jobs year-round and that's the main hurdle in retaining people on the job. It is always difficult retaining people on the job although most of the time these people are uneducated or have minimal education. NZKGI (2019) also mentioned that the nature of the work – seasonality and inconsistency - is one of the main reasons for the labour shortage in the industry.

"The postharvest sector is really competitive and packhouses used to charge growers more for packing before PSA but now they charge less. The Regional Council (Council is a body of people elected to manage the affairs of a city, county, or other municipal district) started charging some packhouses that also added to the difficulties" said one industry leader.

Few respondents think the low wage rate is one of the reasons for the failure to keep people in job. While others had different views. "There is a percentage of New Zealand workers who only need to earn a certain amount each week and that is it" one industry leader said. "Paying a higher rate could work in favour or against the industry because workers can decide to work less hours since they can earn more money in less time".

This is very interesting since the Government has increased adult minimum wage from NZ$18.90 to NZ$20.00 per hour and the Living Wage receiver will earn $22.75 per hr (increase of 67c per hour) effective from 1 September 2021. When the RSE scheme was started by the Government, industry had to pay the living wage (The Living Wage rate is normally voluntary and is paid by employers who want to make sure their workers get enough money to live with dignity. source *https://www.livingwage.org.nz/.*

"Training in industry is really difficult because most of the time there is no environment for training" one industry leader said. Lack of training could be another reason for workers not being attracted to kiwifruit work and they perceive they wouldn't be able to do a task because they haven't been trained. A similar trend has been noticed by other people. A Stuff news reporter who worked as a kiwifruit picker for one day to gain the experience, wrote in his article "Training consisted of a seven-minute animated video which spent a lot of its run time talking about pay cheque deductions if you cause any damage to equipment or the orchard while on the job". "This was followed by a five-minute video about picking fruit which featured migrant workers running to work holding Garcia signs, before grabbing kiwifruit off the vine like a human windmill". Contracts were handed out, with instructions to sign it and read it over later without any health and safety briefing (Shand, 2019).

"We should be more concerned about the actual deal, the ability to have labour that will keep businesses running as sustainably as possible. This is the way they are, and

it enables them to grow and take on the new challenges as they arise" one industry leader said. "Even if there are no infrastructure changes, packhouses still need to strengthen the internal culture and everything else to sustain what they already have. I think that's where our real labour shortage exists because work culture matters a lot in training people on the job or make them come back year after year for seasonal work" one respondent said.

A positive work culture is very important to attract and retain people on job. According to Global human capital trends (2016), only 12% of companies surveyed in 2016 believe they understand their work culture, and in 2015 less than half reported they were prepared to tackle employee engagement (Deloitte, 2015). Work culture impacts happiness and satisfaction among workers. Leadership, management strategies, workplace practices, policies, people all impact culture significantly. Industry needs to create a vortex to pull people in and that could be achieved by creating a strong work culture. Effective engagement would help employees adjust themselves in the ever-changing environment. See further in the recommendation section.

3: In your opinion, is the labour shortage issue going to worsen or get better?

Most respondents agreed that irrespective of the COVID-19 restrictions, the labour shortage problem is going to get worse in future years and no one has control over it. Possible reasons for that are:

a- Huge crop volume (Gold3 and new variety Red) coming in future years
b- Immigration restrictions or border rules
c- Low unemployment rate

It is interesting to see the low employment rate coming up again and again as one of the main reasons for the labour shortage. NZKGI (2019) also mentioned in their report that with low employment rate, it is hard to meet the industry demand for workforce. The low unemployment rate means there are not many people available in the country for hard jobs like kiwifruit picking or packing. Government agencies are putting efforts to attract more kiwis towards primary industries. However, industry leaders thought that even if all unemployed people worked for the industry, there would still be a labour shortage. This year, the Ministry of Social Development and Ministry for Primary Industries came forward for support which made significant contributions to getunemployed New Zealanders into the kiwifruit industry in 2021. However, industry is unlikely to get the required 24,000 seasonal workers in 2022. Historically 25% of the workers have been backpackers and a further 17% RSE (NZKGI, 2021). In October last year the 'Ministry of Social Development' (MSD) made some major changes to the 'Essential Skills Work Visa' category which has complicated the process if businesses want to hire migrant workers. The MSD wants to provide New Zealanders with the first opportunity to apply for jobs, however businesses including the Kiwifruit industry are complaining that not many New Zealanders are applying for jobs.

The Kiwifruit industry has faced the impact of border closures this season. Delays in fruit harvest and poor harvesting practices have resulted in more quality issues in New Zealand's markets.

4. What solutions do you suggest for resolving the labour shortage issue?

Some themes came up repetitively in the interviews which were:

a- Education to improve work culture
b- Continuous process improvements
c- Introduce and adopt innovative ways to do the manual jobs

It was clear from the responses that industry should continue to try new things, but the other very important part is actually having to treat people better. Employers need to look after the people in the industry and be prepared to pay them more money and give them better working conditions. It's quite a labour-intensive job both at packhouses and orchards and treating people better will help to keep them on the job and feel valued. It was also reported in another Kellogg report by Glenda Hutchison (2018) that "the constrained labour market will require owners and employers reconnecting directly with employees".

Industry should move towards fast paced technology adoption which could offer a solution to long term labour shortage issues. NZKGI is also being vocal about the need of innovation and technology in the industry along with their campaigns to attract more locals towards the Kiwifruit industry. The Ministry of Primary Industries is hoping that their clear vision for the agriculture, food and fibres sector will trigger bold changes in how science, technology, education, and training organisations are funded and run in New Zealand. Organizations need to priorities the sector needs, and then work collaboratively to achieve the targets.

Based on the reading and interviews conducted it is evident that innovation is an important factor for continuous growth and to overcome the labour shortage issues. Discussions indicated that there is space for industry to be more innovative going forward.

5: How do you think technology could help with the labour crisis?

Technology is defined as '*science or knowledge put into practical use to solve problems or invent useful tools'* (yourdictionary, n.d.).

Respondents had positive views about the use of technology in the industry. The greatest concentration of labour in packhouses is on the packing lines (Figure 5). If industry can automate or semi automate this area, industry can easily reduce the number of people required for that operation. For example, technology like 'Near Infrared Camera Grading' has changed things massively in the packhouse (Figure 10). Before this grading system, all of the grading was done by individuals handling every piece of fruit. "The use of this technology has reduced the number of manual graders on an average shift from 20 down to 3. Now it can grade up to 90% fruit and the rest is done by people" said a kiwifruit industry leader.

Figure 10: Near infrared grading machine (source https://www.compacsort.com/)

6: What role Zespri can play in helping with the labour crisis?

Common themes in answer to this question were:

1- Zespri must be a voice to Government to try and facilitate more people coming into the country.
2- Zespri should play a role in terms of facilitating new technology.

Some respondents think Zespri is doing great while others think they are not, because they cannot see any uptake of the messages Zespri is delivering. One respondent commented that "Zespri needs to prioritize certain parts or regions of the industry e.g. smaller packhouses in KatiKati, Auckland and up North, see which packhouses need what, in which area, and then go and help them; engage more with them". Another person said "Zespri should help to develop a great workforce for the industry".

Respondents insisted that Zespri should focus on more fit-for-purpose research for the postharvest sector and for that they need to bring researchers up to speed faster. One respondent commented "Encourage scientists to be involved more with the packhouses to gain some hands-on experience to understand what industry is going through right now". "Stop pushing material at people as they are not going to take it unless they have confidence what scientists are doing is right" he explained.

Some respondents expressed their frustration that Zespri is not playing a huge role in helping to change the old processes and methods. They felt a huge gap exists between postharvest and Zespri. They think Zespri's quality standards are too tough to be followed and facilities need a lot of people repacking fruit while there is already a shortage of labour and it's not helping packhouses. A different view came from another interviewee "It's not only Zespri's role; businesses need to be more adaptive. People don't use the new equipment/process even if you show them the results".

7: How confident would you feel trialing new technologies if you were given a chance?

This was a very interesting question where people shared different views in totally different ways. Most respondents answered this question in two ways: personal and representing the organisation.

From a personal perspective the majority considered themselves as ‘innovators’ or ‘early adopters’ willing to try new things once they have the evidence of success. While others considered themselves in the middle ‘who make conscious decisions even if they are provided with evidence’. At an organisation level it depends upon the risk factors. “Small packhouses look towards big packhouses to adopt new processes or technology first because they can afford to do so, while others cannot”. “One major hurdle in trialling new things or technology is people feel threatened, they feel you are going to take away their jobs from them” one industry leader said. This issue could be resolved by improving the work culture, reassuring people that they are going to stay with a slightly different or even better job. It is important to take these people on board before trialling anything new.

According to Tim Stobierski, marketing specialist and contributing write for Harvard Business School Online, “Without effective organizational change management, company transitions can be rocky and expensive in terms of both time and resources. They can also result in lower employee morale and competent skill development. Ultimately, a lack of effective change management can lead the organization to fail”.

8: Do you see any difficulty implementing new processes or technologies suggested by Zespri or grader companies?

This question was again an interesting one where people had different views. In response to this question some respondents said that Zespri is not doing enough to bring solutions to the industry problems while, here when they were asked about adoption, they felt they are being ‘controlled’ by Zespri. Most interviewees referred to poor communication down the chain. “Usually, people who are doing ground jobs are the last person to hear about the change, how do you expect them to react?” said one respondent defending the “doers”.
One group of respondents thinks that there is a lot of politics involved whenever it comes to the adoption of any technology offered by Zespri. While others think Zespri is not good at bringing the message to the operational staff at the packhouses. If workers cannot access the information disseminated by Zespri then it means they don’t have good communication inside the organisation. Senior management from packhouses are usually the ones who hear about any progress first; they need to make sure that the message has been delivered safely to the individuals who will bear most impact.

“We need to focus on short term solutions as well the long term, so I don't think that robotic picking of kiwifruit is really the best target” said an industry leader. Another leader added “we have been spending the money and time in robotic picking for many years and it’s still far away from implementation”.

“Assisted harvesting is absolutely a step in the right direction. We don't have a lot of that, and kiwifruit is behind apples right now. Nobody wears a picking bag in some of the apple orchards in Hawkes Bay”.

9: Does the Kiwifruit industry have the appetite to adopt the learnings from other horticulture / agriculture industries?

Industry leaders admitted that the kiwifruit industry is way behind other industries. Usually, industries don't have time to look at other industries, however they keep an eye on some other industries especially apples. They compared kiwifruit a lot with the apple industry. That's interesting because both crops are quite different from each other. Kiwifruit infrastructure in the orchards and packhouses are old and most of the time are not favourable to automation, because of the cost and time to adopt any new technology. This is another major hinderance.

A good example is a commercial robotic harvester used by T&G Global (Figure 11). Automation enables us to continue at scale to meet increasing global demand for food, in the face of current and future labour market challenges," Mr Landon-Lane (T&G Global chief operating officer) said. In addition to massive investment, successful application of the harvester involves a series of changes at orchard level such as high-density planting and specific pruning methods. The latter were implemented at T&G's Hawkes Bay orchards to make them suitable for Abundant Robotics' technology.

The current model was developed from its research-based origins after delivering a proof-of-concept prototype in 2015 and approached commercialisation of the technology as a global opportunity from the start (Anonymous, 2019).

Figure 11:The Abundant Robotics commercial robotic apple harvester at work on a T&G Global orchard in New Zealand. (Source Farm Weekly)

The company decided to commercialise the technology and approached the US-based technology partner Abundant Robotics. This partnership resulted in the world's first commercial robotic apple harvester. The technology is currently being used to pick T&G's proprietary JAZZ™ and Envy™ apples in the Hawkes Bay. T&G are looking

forward to expanding the technology to other orchards in coming years (Anonymous, 2019).

The Kiwifruit industry can learn from T&G's model of commercialization from the very beginning and working with potential market competitors in US – who can sell this technology to US apple growers too. Canopy innovation and trialling of different ways of achieving automation compatibility has been part of the trial since 2017; but we don't see any automation compatibility trials in kiwifruit orchards.

Currently Zespri is very sensitive for any IP (intellectual property) generated by research partners – they cannot use the final product or data for their marketing purposes. However, in future Zespri might need to change their innovation model and be more open to collaborate with research partners from around the globe. Zespri could make an agreement with them to keep the right as first user of any updated/improvedversion of the final product.

What I concluded from the interviews is that industry not only needs to learn from other industries but there is also an appetite to learn from other packhouses. It is a very interesting aspect of all the kiwifruit industry that they work collectively to sell the fruit, but are highly competitive at post-harvest level. COVID-19 disruptions are providing an opportunity to understand technology and make processes go faster, smoother, better at faster pace.

6 Conclusions

Reasons of labour shortage, slow technology adoption in the industry and possible solutions are listed below.

6.1 Not enough permanent staff

One of the biggest challenges is the actual ability to retain good knowledgeable staff over a 12-month period because packhouse business is, essentially 5-6 months and after that it's very difficult to retain a large group of staff to be able to tie them over to the next season. Industry needs to generate permanent positions (flexible or staggered hours) to secure trained people on jobs.

6.2 New immigration laws and border restrictions

Having the border closed means NZ primary industries including kiwifruit cannot rely on holiday work visa holders or RSE workers. Easing border restrictions for RSE workers and visa process for seasonal migrants could ease off growers and packhouse's worries for time being however we still need thousands of more workers in coming years with expected growth kiwifruit volume.

6.3 Locals reluctant to work for industry

New Zealanders do not like to work as seasonal workers for a number of reasons including inconsistency, physical nature of job and family or lifestyle commitments. With border restrictions in place, it is likely that more New Zealand workers from nonfarming backgrounds will be recruited, some of whom will have had challenging upbringings. The development of positive coping skills will be necessary to ensure longer-term retention in a challenging industry.

6.4 Old systems set up at the packhouses

Most of the pack houses have been set up a certain way many years ago. It is really challenging for them to try to fit new technology within the current space. It is easy to

setup new packhouses e.g. Mpac (mount pack & cool) largest and most technologically advanced packhouse in the Bay of Plenty. Mpac has installed two state-of-the-art MAF Roda cameras (Figure 11). The MAF Roda Pomone 10 lane pre-grading sizer and 8 lane packing line separates the quality grading and packing functions to maintain constant cup fill and efficiency on the manual pack outs. 2nd grade fruit is packed on a 2 lane Uniway sizer online or it can be bin filled for packing later.

6.5 Tiny innovations for a collective big change

A simple innovation like digitalising the data entry system can save a lot of time which eventually will decrease the labour requirement. Postharvest facilities have to manually evaluate and enter the data for each fruit during repacking process. This process is quite labour intensive and only trained workers can do it. However, if we can replace the subjectivity with system/app on portable device with AI (artificial intelligence) support, it will offer several benefits such as less chances of error by replacing the subjectivity with objectivity, decreasing the time to complete the process and most importantly anyone would be able to do that.

Fruit harvesting is very tough with a person carrying a picking bag in front. A simple automotive trolley suitable to operate in the orchards which move with the pickers so that they don't have to carry several kgs hanging on their shoulder. However, their height needs to be adjustable to mitigate the dropping damage caused to fruit.

Instead of fully automated harvester, semi-automated or assisted harvester where a person doesn't have to walk bending down could also be trialled.

People are still lifting 20kg or 10kg boxes in the packhouse, a platform to help lifting the boxes where they don't have to lift the box above their waist would be good.

Figure 12: Grading and packing lines at Mpack BOP (source https://www.mountpac.co.nz/why-choose-mpac/)

6.6 Demographic locations

The challenge then lies for those located far from technology ‘hubs’ to overcome the barriers created by geography. Not only is New Zealand challenged with getting products to market from which it is geographically isolated, but also the challenge of absorbing knowledge and technology from other parts of the world is very difficult.

6.7 Lack of staff engagement

Before introducing any new technology leaders need to engage actively with the people who have been operating the system from 20 years for example. Make sure they don’t feel threatened rather valued by engaging them in the conversations of change from the start and provide them an environment to learn.

6.8 Role of Zespri

There are still opportunities for Zespri innovation to be more proactive and collaborate, especially in the space of implementation of innovation outputs. Zespri can learn from other industries such as apple regarding how to innovate faster and make adoption process easy.

Two-way communication is vital to make this system work. If postharvest sector wants Zespri to innovate faster than they also need to step forward and be there when it comes to the commercialisation process. They need to be honest and think collectively instead of being concerned of losing their competitive advantage. Competition is good however a crisis like labour shortage cannot be solved by any single party alone.

7 Recommendations

7.1 Creating positive workplace culture

By developing and maintaining a positive workplace culture, employers can attract desired talent, drive engagement and retention, employees and improve performance. Workplace culture is a continuous progress and changes according to the situations, it should be as important as business strategy. COVID-19 has changed the scene of work environment completely, health and wellbeing had become the centre of healthy workplace.

Various assessment tools such as observation, behaviour inspections, meetings, discussions, interviews, and surveys can help organisations evaluate their work culture. These can reveal the gap between the current and desired work culture. After the evaluation, the most important part is to start action and open a dialogue with your leadership team about it. Happy and healthy workers will be more productive than depressed ones (ERC, 2019).

7.2 Introducing flexible working hours

Providing workers, a surety of flexibility will help them to think about the industry which is perceived as hard with long working hours. If employers put out wide and clear in their advertisement that “if you are juggling the kids, housework, study or another job, we will try our best to give you the hours that fit around your busy schedule”**.** They potentially will see an increase of job applications.

With the inconsistency associated with this job flexibility could be employed different ways such as hours rotation where employers are committed to work certain number of hours but can work out which days and week, they will do the job and for the rest of

the time they can go work for other industry. Other option is job sharing where two people can work on alternate days or weeks.

7.3 Implementing training and development programs

Training is crucial to ensure workers productivity and satisfaction level. Organisations need to continuously update their training programs to suit with changing requirements within business. Training and development program can potentially help companies or contractors to attract and retain the people who know nothing about work before joining (Explore insiders, 2019). Along with proper induction training in the start if postharvest facility employers can give new recruits opportunities to learn and rotate them around in the facility to find out where they will actually fit, they will definitely be more productive. Research has proved that proper training program offer several benefits listed below:

1- Boost employees working efficiency
2- Improve their morale and satisfaction
3- Provide a framework to identify weaknesses and develop strength
4- Platform to learn new skills
5- Encourage innovation and risk acceptance
6- Improve organisation image
7- Reduce employee turnover

7.4 Following the change management process

Organisations need to follow systematic approach known as change management to introduce new change to avoid disrupting the workflow and help support the employers through the process. There are many different change management models available and should be adapted according to the organisation's needs. However, any effective change management plan should incorporate following steps:

1- Decide what change is required and why?
2- Understand the impact of change at each level – do not forget the entry level
3- Develop an effective communication plan for dissemination of the information and training
4- Organise training for senior management to employees – leaders and managers can play a part of training for their staff
5- Manage resistance – it is common for people to feel threatened, communicate with them to understand their concerns and try to solve them before they become a threat to project of change
6- Post implementation review – gather feedback from the people who were directly or indirectly involved in the change, reassess and plan adjustments if required

7.5 How to attract young people for blue collar jobs?

Generally, there is a misconception that white collar jobs are superior to blue collar jobs. White collar jobs need more education that's true, but smartness is not linked to academic education. Whole society not only the organisation needs a right mindset shift, to understand that people work blue-collar jobs because they want to, not because they have no other career options. With this mindset people will feel more comfortable to come and work as seasonal worker in the industry. With older generation reaching to retirement age skill gap is going to widen unless industry more and more young people. Facilities and contractors in the kiwifruit industry can try

following techniques to attract more young people towards blue-collar jobs and break the stereotypes once and for all.

1- Offer apprenticeship programs to train young people with the right skills
2- Recognise blue collar workers and make sure to provide them career progression, engage with them for strategic decisions. More youngsters will come to join if they see a potential of career progression.
3- Do a proper advertisement, employers should attend career fairs at high school and colleges to educate students about the opportunities and how much they could earn
4- Companies need to work smartly and be innovative to incorporate technology to empower their blue-collar workers, young people would love to learn and use latest technology

7.6 Industry focussed teams of scientists

Evidence based research can convince industry to adopt new processes and technologies faster. Scientists purely focussed on sciences are integral part of the universities and crown research institutes however each faculty or group with technical experts who understands science as well as industry problems will be a great asset. These technical experts can help to provide solutions to industry problems with realistic innovation approach.

7.7 Generate more skilled workforce

Packhouses are moving slowly towards automation e.g., optical grader system. They need people who will make sure that graders are running smoothly and would be able to sort the problem if there is any. In future years, we might see a demand increase of people with agri-engineering and artificial intelligence background. This could change the perception of kiwifruit industry work and help to attract more kiwis towards industry especially youth. However, universities and Polytechnique institutes need to bring back the agriculture and horticulture courses and voice differently to attract students. Industries can raise voice to Government to allow more funding for universities to invest in agriculture/horticulture. They can attract funding for core research from government and private sector.

7.8 Invest in new production systems to assist automation in orchards

Robotics plus should move on from their original model and target to develop semi-automated harvester especially designed for orchards at uneven places. Unless we change our whole infrastructure, it is not possible to implement the robotic harvester here. Companies needs to learn from the apple industry, side modifications to production system are very important to make automation possible in the orchards.

Lack of available investment capital is a key constraint to the emergence and expansion of start-ups, and the commercialisation of research in the New Zealand Agritech ecosystem. While global investment into the Agritech sector has exploded in recent years, we haven’t seen the same level of investment into the New Zealand domestic sector (according to Pitchbook), although there have been notable exceptions. In May 2019, the Government announced the establishment of a $300 million, 15-year venture capital fund as part of budget 2019. Initiatives like this can effectively address the gap in early-stage Agritech funding.

7.9 High rate/hr and border restrictions – An opportunity to innovate?

Industry can take up the opportunity to invest now to save millions in coming years. COVID-19 and higher wages decision must have forced industry to think about other options e.g., to digitalise the repack system to decrease the labour requirement.

7.10 Increase rate of commercialisation and spinouts from research

To ensure world class research is well utilised by the industry, more work is required to enhance our understanding of research commercialisation. The Government's draft 'Research, Science and Innovation' strategy includes proposed actions to develop a world-class research commercialisation system, and ensure knowledge has been used efficiently (MBI, 2020).

7.11 Implementation of efficient technology adoption process

Organisations need to carefully plan and think about the adoption process. The main problems begin after bringing technology into the existing organisational system. The adoption process should include 'integration' or 'readiness' along with identification, development and selection. Most of the time big projects fail due to lack of integration and diffusion process.

8 Overall conclusion

Kiwifruit industry is growing rapidly, with greater investment from growers to meet the global demand of fresh kiwifruit. However critical labour shortage could seriously hamper industry growth. Like other industries, having enough workers for the coming season has been a major concern for industry. Kiwifruit sector (growers, post-harvest operators, Zespri, and industry bodies, such NZKGI, together with local and national Government) need to work together to solve this challenge. Packhouses and orchard contractors need to work on developing work culture, providing a favourable environment where workers feel safe, supported and valued. Work culture where everyone is treated fairly will build a reputation of industry where everyone wants to work and stay. To attract the young New Zealander sector, industry needs to sponsor apprenticeships, change marketing strategies, provide accommodation, and travel facilities for seasonal workers, recognise and reward and most importantly incorporate innovation to empower their manual workers. Increased training, qualifications and pathways into the industry through schools and tertiary organisations is another way of bringing young individuals to the industry.

However, industry will still require thousands of workers in coming years and the only way to ease that pressure is to dedicatedly put efforts to bring innovation to the industry. Technology adoption will serve two major benefits to the industry; first easing the pressure on labour requirement for manual jobs, second it will generate an entirely new job market. This new job market will call for skilled people to build, service and maintain technologies and other set of skilled people will help to improve supply chain efficiency by analysing and interpreting the data. To successfully introduce and implement innovation in the industry, employers need to follow the proper change management process from scoping to implementation. Universities and polytechnic institutes also need to step forward and start producing more individuals with horticulture knowledge and produce future workforce for kiwifruit industry. Zespri needs to make sure the contractors are following compliance requirement, keep investing in the fit-for-purpose innovation to improve the supply chain efficiency. The

industry's efforts need to be complemented by government initiatives so the booming kiwifruit industry can make the most of the growth opportunities ahead.

"Your success in life is not based on your ability to change simply. It is based on your ability to change faster than your competition, customers, and business."

– Mark Sanborn

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