# Alternatives to Plastic Packaging on Fresh Produce

**Options for Vegetable Growers** 

A report for



By Natasha Shields

2019 Nuffield Scholar

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# **Executive Summary**

This report is based on a study conducted into the issues facing fresh food producers in Australia, and the requirements to use plastic packaging to maintain produce freshness and ensure food safety and hygiene standards, as well as meet retailer and consumer expectations. The research focused on finding alternatives to traditional plastic packaging for fresh food producers available in the global market, with a focus on sustainability, affordability whilst ensuring food safety and being environmentally friendly.

The aim was to investigate and share knowledge and practices from 'farm to fridge' that are occurring around the world. This report has focused on applying these potential solutions to the Australian context to assist producers, retailers, consumers, the rest of the fresh produce supply chain and the packaging and recycling sector. It provides an overview of the main issues facing producers of fresh foods, the retail sector's expectations, and the successes of innovators with technological solutions aiming to provide alternatives to current plastic packaging.

Specifically, this research aims to achieve the following objectives:

- To find alternatives to plastic packaging for fresh produce
- Find packaging options to keep produce fresher for longer
- Seek economically viable alternatives to plastic packaging on fresh produce
- Search for compostable/biodegradable packaging for use on fresh produce
- Better understand the "War on Waste", including better environmental alternatives

The issue of plastic packaging in the horticulture industry in Australia is examined through understanding consumer perceptions, retail sector demands, different needs of wholesalers and issue around food safety. The implications of the current COVID-19 global pandemic and the need for increased hygiene standards are examined, and it is concluded that the "war on waste" will have to wait, as consumers demand protection from handling and contamination of their fresh food in supermarkets and other settings.

The necessity for solutions to the current plastic packaging demands are examined in relation to the benefits of a circular economy over the predominant linear structure with regard to packaging and goods. Plastic alternatives such as bioplastics are discussed, as well as the issues around 'compostability' including home and industrial composting. Recycling facilities and the issues surrounding consumer comprehension of the processes are also discussed in relation to requirements for labelling and verification. Examples of new technologies as alternatives to traditional plastic packaging are examined. Australian producers, retailers and consumers should be able to find a comfortable solution to the current impasse in single-use plastics and waste management. However, there is no one simple solution and current targets set by the Australian Government to create 100% recycled packaging by 2025 will require many strategies with the lifecycle of 'farm to fridge'.

The issues and challenges surrounding plastic packaging on fresh produce are ongoing. This report provides a better understanding of the 'war on waste' in Australia. There are alternatives being used in the global market and most of these are economically viable options to keep produce fresher for longer. Nonetheless, consumer perceptions, retailer demands, different needs of wholesalers, and issues around food safety – particularly during the current COVID-19 global pandemic and the need for increased hygiene standards – have all indicated that alternatives to traditional plastic packaging are needed. While these alternatives may enable a more 'circular economy' in relation to produce and packaging, ultimately the results will depend on consumer awareness and understanding, and the requirement for labelling and national and international standards to ensure a competitive and level market.

During and after COVID-19, it is likely that some form of packaging will be required by certain retailers on all fresh produce. However, it is the consumer who determines which products they purchase, and then what happens to the packaging once it is no longer required. While consumer demand is the driver for change, national and international standards are needed to ensure the alternatives complete 'the loop' for a fully recyclable economy that minimises waste. While there appears to be some alternatives there is no ONE simple solution – no 'magic bullet'. In most cases it seems each country, state, or municipality has its own problems, and is trying its own solutions.

Any solution needs to include some plastic packaging for fresh produce which is recyclable. However, the reliance on recycling is limited until further infrastructure is built. Nonetheless, this report contributes to a better understanding of the 'war on waste', because each stakeholder from 'farm to fridge', must consider changing their practices, and nothing can be achieved by any one person, or one producer, or simply by changing any one step in the process.

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### Foreword

Based on my childhood and most of my adult life, I would call myself a city girl. Coming from both administrative and IT based jobs, I am relatively new to agriculture. My husband Wayne has been a market gardener his whole life. One Friday night in 2009 after being stuck in peak hour traffic for almost four hours, I resigned from my city position of ten years and joined Wayne on the farm. We have been Certified Organic vegetable growers since January 2010, where we started growing on three acres.

My role initially was to propagate all our own seedlings, as well as packing up vegetable boxes for home delivery and selling our vegetables at farmers' markets. I remember our very first market, it was a wet and stormy day in a Melbourne suburb. We had a little van, a tent, some wooden boxes and a trestle table. We were blown away, not by the wind but by the sales. I recall it was around \$450 – it seemed too easy! This is what spurred us on and gave us the confidence to actually make a go of our farm. We filled out paperwork that had been sitting on the table for years and finally obtained our Organic Certification.

We now attend five farmers' markets every weekend.

We have expanded our operation and grow on almost 200 acres. We initially grew vegetables to supply our small home delivery business and farmers' markets, however, as our quality and brand grew, we were sought after by the wholesale vegetable markets in Victoria, and then in New South Wales and Queensland. Over the last two years, we have also struck up relationships with two of Australia's largest supermarkets. It is always a challenge to ensure we have the supply they require when faced with different events including weather (e.g. drought) and pest damage (e.g. ducks, insects, deer).

Going to the farmers' markets has enabled us to find out directly what the customer wants. This inspired and encouraged us to try new varieties and types of vegetables. At one point, we were growing over 40 varieties of vegetables in any given year. It was clear that our customers loved the quality and freshness of our produce, sold in the open air, unpackaged.

When we introduced packing on some of our lines (e.g. fragile lettuce), there was a pushback from some of our customers, who for example asked us to empty the produce into their own bags. Whilst such actions by consumers are encouraged and guided to protect the environment, as producers we were mindful of ensuring less damage to the fragile lettuce for example, and thus less food wastage. Furthermore, we also felt it was better to sell some of our produce, such as beans and potatoes, in packets or bags, to prevent the constant handling of food by multiple customers. Nonetheless, one thing that became clear to us as organic growers, is that our consumers do not like plastic coverings on fresh produce.

However, a requirement of the supermarkets in particular, and some of the wholesale retail stores, is that our organic produce is placed in a plastic sleeve/bag, usually with a barcode, so

that it can be scanned at the register to get the correct price. Without this system the organic produce could easily be confused with the equivalent conventional item also for sale. The plastic sleeve/bag on the produce also prolongs its shelf life, as it is protected from the drying air in the stores. Plastic and other forms of packaging have another added benefit of protecting the item from being handled by consumers, thus adding another layer of food safety.

On our produce we have implemented brown paper bags for potatoes, small calico bags for Brussel sprouts, and we band carrots and other veg into weighed bundles. This encourages the customer to buy for example half a kilogram of carrots, rather than one or two individual carrots, after touching them all to see which ones they like better.

In Australia there has been a focus on the "war on waste" and seeking alternatives to plastic packaging. The opportunity for me to find out how the rest of the world is dealing with these issues and apply this to the Australian context has been enabled through being awarded a Nuffield Scholarship.

As part of the six-week Global Focus (GFP) Program, I was very fortunate to have been able to travel to Singapore, Japan, Indonesia, France, Canada and the United States of America (USA) with a group of nine scholars, all of which have become lifelong friends. I also travelled to Hong Kong, Singapore, Ireland, Italy, the United Kingdom (UK), Denmark, Sweden, Germany, Spain, Dubai, and the USA to conduct independent research. I attended exhibitions at the Sustainable Food Summit in Singapore, the Asia Fruit Logistica in Hong Kong and FachPack in Nuremberg, where I was able to speak to many company representatives about some of the great innovations around packaging and produce currently being used around the world.

Although I was set to attend the Expo West in Anaheim, USA in March 2020, this was unfortunately cancelled due to COVID-19 and the declaration of a global pandemic. Thus, most of my appointments that were scheduled to take place were also subsequently cancelled as people were reluctant to have any visitors. As the travel warnings increased, I cut my trip short and returned home to 14 days of mandated self-isolation.

Writing this report has been an opportunity for me to reflect on the objectives and lessons learnt during the scholarship. While my research was limited by the outbreak of COVID-19, this has also created an opportunity to increase awareness of the alternatives to plastic packaging available to vegetable growers in Australia.

# Acknowledgments

First and foremost, I would like to thank my husband, Wayne, for encouraging me to apply. When I first mentioned that I would like to apply, he said it was something he had wanted to do for years. Without his support, I would not have applied and benefited from this once in a lifetime opportunity. It was a tough gig for Wayne who remained in Victoria to look after our two farms (4.5 hours apart) as well as our four children while I travelled for 17 weeks. I felt honoured that he believed in me.

I also wish to thank Wayne's parents who helped with school runs, extra meals and babysitting. I also want to thank my sister Cherie and her fiancé Dave who took the boys away a few times whilst I was away to give Wayne a bit of a break.

I would like to thank Nuffield Australia and the teams of interviewers at state and national interviews who believed in me. I was extremely nervous and was thrown some curly questions which I was sure I failed to answer satisfactorily. Receiving the phone call advising me I was to be awarded a scholarship was one of the most memorable days of my life.

I also sincerely thank my investor The William Buckland Foundation. Without them I would certainly not have had the opportunity to do this research which hopefully will make a difference in the horticulture industry.

My thanks also go to the other scholars in my GFP group – Al, Ali, Allan, Christoph (for part of it) Hamish, Karina, Renee and Richard. What an amazing and supportive group of people! Many lessons learnt, many friendships made, many experiences shared – I could not have travelled with a better bunch of people. The Japan element was made amazing by Jodie and Wayne Redcliffe! Thanks so much for organising all of those visits – it was a very intense itinerary, but it was fantastic that we were able to achieve so many visits in the short time we had. You made the country more fantastic with your knowledge and experience. Great bus driving Wayne, and great playlist and translation services Jodie!



Figure 1: Nuffield Japan GFP 2019 group – Mt Fuji, June 2019

To the many farms and businesses that opened your doors, the knowledge sharing and welcoming receptions around the world, in the name of Nuffield and helping others, thank you. I have been blown away by some of the things I have found. I feel that my eyes and mind have been substantially opened in many areas of agriculture. Given that I went from a career in IT to managing a small vegetable farm, I had no exposure or any basic understanding of the many other areas of agriculture. It was thoroughly enjoyable gaining insights into broadacre cropping, the dairy industry, beef industry, viticulture, water systems, wild blueberry growing, maple syrup farms, poultry farming and processing, mixed farming operations and more. I feel I have gained insights and ideas that I can relate back to my own business down the track, and through this report, to the industry more widely.

# Abbreviations

АРСО	Australian Packaging Covenant Organisation
CO2	carbon dioxide
CSA	Community Supported Agriculture
CSC	Contemporary Scholars Conference
GFP	Global Focus Program
GMO	Genetically Modified Organism
НАССР	Hazard Analysis and Critical Control Points Certification
HARPS	Harmonised Australian Retailer Produce Scheme
PET	polyethylene terephthalate
PLA	Polylactic Acid
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation

# Objectives

This report is based on a study of plastic packaging alternatives for fresh food producers. The focus is on sustainability, affordability, and also ensuring food safety, while still caring for the environment.

The overall objective of this study is to investigate and share the knowledge and practices within the supply chain from 'farm to fridge' that are occurring around the world.

Other objectives include:

- To find alternatives to plastic packaging for fresh produce.
- Find packaging options to keep produce fresher for longer.
- Seek economically viable alternatives to plastic packaging on fresh produce.
- Search for compostable/biodegradable packaging for use on fresh produce.
- Better understand the "War on Waste", including better environmental alternatives.

This report will focus on applying these potential solutions to the Australian context to assist producers, retailers, consumers and the rest of the fresh produce supply chain and, more generally, the packaging and recycling sector.

# Introduction

The research for the study was undertaken in Australia, the USA, the UK Ireland and throughout the European Union (EU) in 2019-20. The focus is particularly on the current alternatives to traditional plastic packaging available in the global market.

### The War on Waste

The "war on waste" was encapsulated by the ABC TV documentary series hosted by Craig Reucassel, bringing to the attention of consumers, the actual processes that occur with the rubbish that households and individuals generate, and looking at ways to reduce this waste (ABC, 2017). As a result, consumers began demanding more alternatives to plastic packaging as well as accountability from producers, retailers and recyclers. This report provides a unique perspective on these issues from the point of view of fresh food producers and their challenges to get their produce to wholesale and retail markets, and to the consumers.

Chapter One examines the issue of plastic packaging in the horticulture industry in Australia, through understanding consumer perceptions, demands from the retail sector, the different needs of the wholesalers, and issues around food safety. The implications of COVID-19 and the need for increased hygiene standards will be examined.

Chapter Two provides an analysis of the necessity for solutions to packaging by firstly examining the structure of the economy; and secondly providing a discussion of the benefits of a circular economy over the predominant linear structure in relation to packaging and goods. The plastic alternatives, such as bioplastics, are discussed, as well as issues around 'compostability' including home and industrial composting. Recycling facilities and the issues surrounding consumer comprehension of the processes will also be discussed in relation to requirements for labelling and verification, and importantly consumer education.

Chapter Three provides an opportunity for the current market alternatives to be discussed. The examples reported on here are based on the data collected during research.

The Conclusion will demonstrate that while consumer demand is the driver for change, national and international standards are needed to ensure that any alternatives to plastic packaging complete 'the loop' for a fully recyclable economy that minimises waste.

### Chapter 1: Plastic Packaging in Horticulture

### 1.1 Overview

The horticulture industry is a constantly changing and evolving industry and often panders to consumer demand. It is an industry at the whim of retailers who tell growers how they want the produce presented.

### 1.1.1 Costs of packaging

Packaging is used to extend shelf life, marketing purposes and encouraging consumers to buy more volume. While this can also lead to more food waste, the focus of this report will be on the packaging and alternatives to plastic. Packaging is a huge cost to the horticulture industry and the environment, with the large amount of single-use plastics contributing to the world's pollution levels. To date, humans have produced more than 8.3 billion metric tonnes of plastic, and near two thirds of this (6.3 billion metric tonnes) is now considered waste with only 9% of this being recycled worldwide (Parker, 2018). In Australia, "only 16% of Australia's plastic packaging was recycled or composted in 2017-18" (Topsfield, 2020).

However, horticultural producers need to ensure their produce is not damaged in transit or at point of sale, and retailers need to prevent the constant handling of food by multiple customers to ensure food safety. Supermarkets and some of the wholesale retail stores require a system to ensure organic produce is in a plastic sleeve or bag, usually with a barcode, so that it can be scanned at the register to get the correct price. Without this system, the organic produce could easily be confused with the equivalent conventional item also for sale.

Furthermore, the plastic sleeve or bag on the produce also prolongs its shelf life as it is protected from the drying air in the stores. For example, just 1.5g of plastic film for wrapping a cucumber can extend its shelf life from three days to 14 days. Another example, based on in-house testing at *Peninsula Fresh Organics* (Victoria, Australia) has shown that a Cos/Romaine Lettuce will stay fresh and crisp up to 14 days from harvest once washed and placed in a plastic sleeve and stored in a cool room at 4 degrees Celsius. The same lettuce that is washed and placed on a shelf in the cool room at the same temperature is already limp and tired looking after three days. Washing in cold water and then re-refrigerating will rejuvenate the lettuce, but only for another two to three days (*Peninsula Fresh Organics*, 2020).

The current cost on average for plastic packaging as shown in Figure 2 is AUD\$0.02 per sleeve. The author runs a business with her husband Wayne Shields (*Peninsula Fresh Organics*). Wayne said that the business currently spends approximately \$55,000 per year on plastic packaging alone for supermarket and wholesale distribution. In fact, there are several other ways of presenting produce with marketing without the need for plastic. For example, as Figure 3 shows there is the tape option. The cost for this option is approximately AUD\$8.00 for 400 bunches of the same product. However, cost differences aside, the issue is that the products simply do not last long enough on the retail shelf compared to a packaged item.



Figure 2: Bok Choy in a Plastic Sleeve. Source: Author



Figure 3: Bok Choy with tape option. Source: Author

The advantages of using plastic packaging bags for food are also promoted by the plastics industry. Figure 4 illustrates eight reasons why plastic should be used according to XL Plastics.

With the growing population and the rising demand for consumer goods, food and beverage manufacturers are constantly looking for ways to enhance their practices and create additional value. They are also required to ensure that the food product is well-preserved using appropriate packaging till the point of sale. While there are multiple alternatives and materials that can be used to package food, plastic food packaging has always been the most preferred option. Plastic has retained this popularity over the years due to its adaptability and durability. Take a look at some of the other benefits plastic food packaging offer:

- 1. Plastic packaging is a very flexible and adaptable form of packaging, which allows manufacturers to customize its shape, size and style as per their customers' requirements.
- 2. Plastic packaging is an extremely light-weight storage option that doesn't require a lot of storage space either. Since they don't take up much storage space, they are also extremely easy to transport, thus reducing the carbon footprint during transportation.
- 3. Plastic packaging can survive extreme environments and don't easily degrade in hot and cold temperatures, thus preserving the integrity of the food or beverage inside it. It also protects your products from moisture, oxygen, dust, light and odours.
- 4. Since plastic is extremely durable and resistant to external influences, you can ensure your product is well-preserved at all times. This in turn, helps you avoid losses due to wastage of inventory and also helps you bring about consistency in product delivery, thus increasing brand value.
- 5. The high versatility of plastic allows for ease of reuse and recycling. In fact, these days' companies are creating specialized <u>plastic bag making machines</u> that help you optimize on the recyclability of plastic.
- 6. The durability offered by plastic packaging also allows manufacturers to print eyecatching, high-quality custom designs, and thereby increase product visibility in a retail setting.
- 7. Plastic packaging is highly economical and can be used by all industries irrespective of their scale of operations. The cost-effectiveness of plastic food packaging is especially beneficial to small-scale product manufacturers as it allows access to standardised packaging options in spite of lower budgets.
- 8. As mentioned above, plastic bags are easily recyclable and require lesser energy to produce in comparison to the other packaging alternatives available. According to a study conducted by United States EPA, plastic bags use 40% less energy to produce and generate 80% less solid waste than paper. The study also revealed a pound of plastic takes 91% less energy to recycle as compared to a pound of paper

#### Figure 4: Advantages of Using Plastic Packaging Bags for Food Packaging Source: XL Plastics, 2018

When talking about supplying organic leeks into the supermarkets, Wayne Shields said that each leek must be sleeved, with a barcoded label. This adds another \$0.01 to the cost of the packaging. In addition to this, because the leeks are packaged individually, the supermarkets want the leeks delievered in crates of five or six leeks per crate. The crate hire is \$1.10 per crate and 144 crates can be shipped on a pallet, this is a total of 720 leeks. The total packing cost of this line is \$186 per pallet. Wayne pointed out that *"If we were not required to use so much packaging, we would be able to shift a higher volume of produce and also reduce transport costs,"* (Shields, 2020)

By comparison, Sam Taranto of Taranto Farms (Victoria, Australia) ships loose leeks without any packaging at a rate of 20 loose leeks per crate. The crate size used allows for 66 crates on a pallet, with a total of 1,320 leeks on the same size pallet space. He also ships packaged twinpack leeks. Doing their own in-house testing of these pre-packed leeks (a totally sealed package), demonstrated that these leeks store for three weeks and are still quite fresh after this time. Sam Taranto also said "An exposed leek on the shelf usually lasts approximately one week before it starts to wilt. It is always recommended to store leeks in plastic in the refigerator as this will extend the shelf-life out to around two weeks" (Taranto, 2020).

#### **1.1.2 Consumer perceptions**

For organic farmers, the issue extends to their consumers and the market. Organic consumers, probably more so than conventional produce buyers, are averse to plastic packaging on their fresh produce due to the perception that the plastic is harmful to their food. For example, there is a common perception among some organic produce customers, (often not based on fact, but on what people have decided based on many factors such as 'social influencers', 'word of mouth' from friends and family, and the array of social media news and stories, and more), that there will be microplastic residue on the produce. Some customers also do not even like to consider the alternative bioplastics made from corn starch on their food, as they perceive that the corn must be genetically modified (GM), and they do not want 'GM corn starch' leeching onto their produce (Shields, 2019). If the plastic is made from GM corn, the genetic material cannot transfer onto food (see for example European Bioplastics, 2016a; Green America, 2020; and Phillips, 2008). In relation to this, Wayne pointed out that "social licence is quite high in organic farming. This is due to the fact that organic farmers look after the soil and environment, but then organic growers are typically required to place their produce in plastic packaging, which is bad for the environment and is undermining this same social licence" (Shields, 2020).

A main challenge is how to achieve these requirements for product quality and take into consideration consumer demands and environmental concerns. Farmers' Markets, Farm Gates, Community Supported Agriculture (CSA) and box delivery schemes, help to connect

consumers to food production and producers which can also help reduce food packaging and waste because it can be presented in boxes or crates rather than individually wrapped or bundled for retail scanning. However, there is still a need for some packaging in certain circumstances, including demands from the retail sector, wholesalers, and for food safety since March 2020 when COVID-19 was declared.

#### 1.1.3 Retail needs

For the supermarkets and some retail stores, organic growers in Australia are typically more likely to be required to package all produce in some form of plastic sleeve, bag or container (whether this is traditional polyethylene terephthalate [PET] or other bioplastic to be discussed below), to keep the produce fresh and to also ensure their organic price is charged at the checkout. As reported by Brook in 2017 the reason is more-so about the latter:

In a statement .... Coles said it was to 'allow differentiation between organic products and conventional products — so that our customers receive what they pay for'. What that means is that without the wrap — and the 'organic' sticker on the wrap — checkout staff could accidentally ring up the produce at the lower non-organic price. And, of course, unscrupulous shoppers could also pass off organics as cheaper at the self-serve registers (Brook, 2018)

Furthermore, from discussions with two large supermarkets in Australia, *Peninsula Fresh Organics* (2020) noted that they both have different requirements for packaging produce, which makes it challenging for the grower to organise appropriate packaging. While one supermarket was willing to accept a compostable type of packaging, the other required recycled. These challenges were also apparent in the UK where one major supermarket chain will not allow fresh food producers to use any compostable packaging products as it could potentially pollute the recycling stations if the consumer placed the item in the wrong recycling bin. One potato producer's solution was initially to look into paper packaging. However, they found this process left a larger carbon footprint than plastic recycling. Therefore they supplied more bulk lines to reduce packaging, which also assisted consumers who find it more difficult to shop and tend to buy less when purchasing from loose products (Prescott and Collins, 2019).

#### 1.1.4 Wholesale needs

It is generally easier for a grower to supply wholesale agents in the wholesale market as they order in bulk. They will accept produce in large bins, tubs, crates and cardboard cartons resulting in less labour and packaging costs. However, because many leafy products (e.g. lettuce, kale, silverbeet etc.) are washed post-harvest, they are usually required to be packed into wax cartons as the residual water on the produce turns the ordinary cardboard to mush

and the box will collapse. For those growers who have their own stands in the wholesale market, the same applies. The majority of their own produce is sold in bulk and not in retail-ready packs (Food Standards Australia New Zealand, 2019).

#### 1.1.5 Food safety

Plastic packaging also maintains food quality and meets food safety requirements. Any horticulture grower in Australia who sells their produce to wholesale markets or to supermarkets is required to have some form of a Food Safety Certificate. Some form of packaging on fresh produce, particularly fresh cut produce, is required for this. Packhouse and farm worker hygiene is particularly important both at harvest and post-harvest. Rules are stringent to avoid food contamination. Farms are audited by these organisations annually and are also spot-checked randomly to ensure products are being produced in the correct manner (Australian Farmers' Markets Association, 2020). Furthermore, fresh food producers are also required to have Hazard Analysis and Critical Control Points Certification (HACCP), certification from the Harmonised Australian Retailer Produce Scheme (HARPS), and/or various on farm and supply chain certifications from Freshcare (*Freshcare*, 2020).

### 1.1.6 Implications of COVID-19

At the time of the writing this report, COVID-19 was declared a global pandemic by the World Health Organisation (WHO) and most countries around the world are in a 'lock-down'. There has been great media attention to the 'perception' that fresh produce might easily become infected with COVID-19 due to touch, coughing or sneezing around the food. Dr Hayriye Bozkurt from the ARC Training Centre for Food Safety in the Fresh Produce Industry, stated that:

Coronaviruses are thought to be transmitted through respiratory droplets, contact with infected secretions, and fecal-oral transmission. We know through experience with SARS and MERS that people are not infected with these viruses through fresh produce and it is unlikely 2019-nCoV is passed on through fresh fruit and vegetables. As with other viruses, Coronaviruses need a host (animal or human) to grow in, so they cannot replicate in fresh produce. It is not clear if a person can contract 2019-nCoV by touching a surface or fresh produce with 2019-nCoV on it and then touching their mouth, nose, or possibly their eyes. As always, good personal hygiene along with good agricultural practices should be followed strictly (Bozkurt, 2020).

Since it was declared, many consumers at local farmers' markets have been asking for the produce to be packaged, more than ever before, in order to reduce the risk of the virus potentially being present on their food (*Peninsula Fresh Organics*, 2020). In any case, all fruit

and vegetables are recommended to be washed before use, regardless of this pandemic, unless the packaging states that produce has already been washed and is ready for consumption.

### 1.2 Summary

Consumer demands and perceptions dominate the need for packaging of some kind, and the demands from the retail and wholesale sectors around ease of purchasing and to some extent food safety also drive this requirement to find cost effective and sustainable packaging. The implications of COVID-19 and the need for increased hygiene standards demonstrate that the "war on waste" will have to wait, as consumers demand protection from handling and contamination of their fresh food in supermarkets and other settings.

# **Chapter 2: Alternatives**

### 2.1 Overview

This chapter discusses current plastic packaging challenges by examining the structure of the economy and providing a discussion of circular economy benefits over the predominant linear structure to packaging and goods. The plastic alternatives such as bioplastics are discussed, as well as the issues around 'compostability' including home and industrial composting. Recycling facilities and the issues surrounding consumer comprehension of the processes will also be discussed in relation to requirements for labelling and verification.

### 2.2 The circular economy

A circular economy is a system that aims to promote the continual use of resources thus eliminating waste. It is a material shift away from the current 'linear economy' which involves making products, using them, and then disposing of them. Circular systems involve a closed-loop that focuses on re-using and recycling in order to "reduce the consumption of virgin materials and the generation of waste", as depicted in Figure 5 below (Otter, 2018).



Figure 5: Circular Economy Source: Otter, 2018, p. 2

A report released by the 'Senate Environment and Communications Reference Committee' (<u>https://www.aph.gov.au/Parliamentary Business/Committees/Senate/Environment and Communications/WasteandRecycling/Report</u>, June 2018), described Australia's recycling

system as being in 'grave danger' due to China's ban on the import of some recyclables, along with the underinvestment in the domestic industry. The report pointed to the "enormity of problems created by plastics" with for example, many municipal recycling systems unable to sort food wrappers from other harder plastics including bottles and containers (Senate Environment and Communications Reference Committee, 2018). This Committee made a number of recommendations to meet the challenge of these problems. Prior to this, an Agreement was made with Environment Ministers in Australia whereby they "endorsed a target of 100% of Australian packaging being recyclable, compostable or reusable by 2025 or earlier. Governments will work with the Australian Packaging Covenant Organisation (APCO), representing over 900 leading companies, to deliver this target" (Department of Agriculture, Water and the Environment, 2018). The 2025 National Packaging Targets are:

- 1. 100% reusable, recyclable or compostable packaging.
- 2. 70% of plastic packaging being recycled or composted.
- 3. 50% of average recycled content included in packaging.
- 4. Phase out of problematic and unnecessary single-use plastics packaging.

#### According to APCO,

The National Packaging Targets will require a complete and systemic change to the way we create, collect and recover our product packaging, and will apply to all packaging that is made, used and sold in Australia. ... the Targets are in line with broader sustainable packaging shifts that are taking place globally to reduce the volume of material entering landfill, improve recycling rates, and increase the use of recycled material in future packaging.... APCO has developed a coordinated, whole-of-supply chain approach to promote the avoidance, reduction, reuse, recovery and recycling of packaging materials (APCO, 2025).

The role and responsibility for the fresh food producers in this supply chain to find affordable alternatives to plastic packaging is important.

In Australia, there is a dedicated Assistant Minister for Waste Reduction and Environmental Management, the Hon. Trevor Evans, who is working in conjunction with the Australia Packaging Covenant Organisation (APCO) on these targets. According to the Chief of Staff for the US Department of Agriculture, the solutions to these issues are expected to come from consumers and not government, as the former will advise retailers what they want to purchase and how they want their fresh produce packaged (Walker, 2020).

A recent report found that Australia will require "significant investment in domestic recycling infrastructure" to meet these targets (APCO, 2020). While recycling infrastructure is needed in every community to encourage and manage the processes, there is much confusion in the community about what can be recycled. Kerbside recycling schemes can be thwarted by households contaminating the products that can be recycled, with those that cannot be (which is of concern globally among recyclers). For example, 'soft plastics – those items that can be scrunched into a ball – need to go in the designated recycling bins provided in Australia's supermarkets' (Topsfield, 2020), and are not recycled by these other schemes. Furthermore, due to 'lockdowns' introduced to control COVID-19, there has been a 10% increase in the amount of household waste and recyclable materials being discarded. According to APCO (2020, cited in Topsfield, 2020) "If no action is taken to address the plastics issue, other than to implement the proposed export bans and the current system is maintained, the recovery rate for plastic packaging will drop from the current 16% to 13% in 2025."

Dr Carol Kilcullen-Lawrence the national president of the Australia Institute of Packaging pointed out that "we need to better understand how we can really achieve this and how different this target is compared to the packaging waste streams that are in place today. The first step is to understand the difference between compostable [including home compostable] and biodegradable packaging" (Kilcullen-Lawrence, 2018). These alternatives to traditional plastic packaging will be discussed further in this report. Nonetheless, whatever the packaging available, the Australian Council of Recycling has called on the federal government to make recycling labels mandatory (Topsfield, 2020) which is an important topic to be researched and discussed but nonetheless beyond the scope of this report.

Overall, all of these initiatives and alternatives are important aspects of a 'circular economy'. Creating a Circular Economy from a Linear based model is a challenge for the world as a whole. Australia appears to be willing to tackle this problem nationally but there are many challenges ahead. Notwithstanding political will, until there are adequate recycling facilities on Australian shores, alternatives need to be considered.

### 2.3 Plastic alternatives

Looking for viable alternatives to single-use plastics is a challenge. As noted by Dora and Lacovidou (2019), "Until a sustainable packaging alternative is developed, big retailers will continue to rely on plastic to protect food from going to waste. Plastic itself is a very useful material. We need to use it more effectively and more sparingly in some cases, but we shouldn't get rid of it altogether" (Dora & lacovidou, 2019).

Grounded Packaging has suggested the following ways to encourage a more circular approach to packaging of food:

- 1. Removing unnecessary packaging and/or plastics.
- 2. Looking to reduce the amount of material used in existing packaging formats or 'downgauging'.
- 3. Moving to fully recyclable materials.
- 4. Introducing recycled or bio-based content into the current materials to move away from virgin petrochemical resins.
- 5. Moving into more interesting and innovative solutions like home compostable films and/or laminates where appropriate (Grounded Packaging 2018).

However, a panel discussion on 'packaging and sustainability' at the Fruit Attraction Conference in Madrid, Spain (2019), concluded that countries such as the UK, tend to consider recycling, but "there is no global solution. Every country, supermarket and retail store has its own ways" (Daly, 2019).

#### 2.3.1 Bioplastic recycling

As noted, bioplastic recycling can provide the system to 'close the loop' by creating the materials and technology needed to transform the typical 'linear supply chains' into more 'circular supply chains'. According to *Bioplastic Recycling, Inc*, California, they have created 'ground-breaking technology' which sorts and upcycles discarded bioplastics into new products, which lessens the reliance on traditional plastics. The upcycled materials produced here are compatible with standard plastic manufacturing equipment, allowing for rapid market adoption (*Bioplastic Recycling*, 2020).

One type of bioplastic that is 'recyclable' is Bio-derived polyethylene, which is the same material as traditional polyethylene made from fossil-fuels but is made from ethanol which can be produced from sugarcane, corn or bamboo for example (Wikipedia, 2020). However, these crops typically require land and water that could otherwise be used in food production, and production usually requires chemicals and genetic engineering. The look and feel of bioplastic is much like conventional plastics, however the moisture barrier is less. Recycling can be compromised if mixed with conventional plastic. Disposal is more specific such as industrial or home composting. Figure 6 illustrates how bioplastics can close the loop in a circular economy through an organic recycling process starting with biodegradable and compostable plastic products, which can then be recycled back into the same product. However, according to De Belder (2019) "bioplastics is not sustainable. We have to pay attention to mass production and cost. They have not found a competitive way to manufacture this [bioplastic] yet." Furthermore, De Belder (2019) concluded that "many people like to buy their food daily as they perceive that the food is fresher, rather than buying in bulk quantities". Thus, the option to sell in bulk to reduce the amount of packaging is also not a complete solution.



Figure 6: Bioplastic Recycling Source: European Bioplastics (2020)

#### 2.3.2 Home compostable

When considering that some of the most difficult items to recycle are the "sometimes vacuumsealed, packaging around meat, produce, and bakery products" it is welcome news to hear companies are "developing a compostable version of this sort of plastic that can be composted in your own garden by simply burying it" (Corbley, 2020). For example, in Ireland, O'Hanlon Herbs at Glenealy have started using compostable packaging from Mediane Flexible Packaging Solutions (Cullen, 2019), which produce 100% home compostable sleeves for fresh produce, such as herbs, sold in supermarkets in Ireland (see *Mediane*, 2018).

Thus, one viable suggestion is the use of 'Certified Home Compostable' packaging and products which can be recycled with cardboard and paper, or they can be placed into compost heaps and home gardens without disruption to any other recycling systems (Australasian Bioplastics Association, 2019). Packaging labelled as home compostable means the customer can place the packaging in their home compost bin or garden along with fruit and vegetable scraps. Home compostable packaging means that any component or material used in the packaging – including the printing ink and adhesives – decomposes into organic soil. Nutrients are found in Certified Home Compostable packaging, therefore putting nutrients back into the soil when breaking down (Figure 7).





#### 2.3.3 Industrial compostable

The difference between home compostable and industrial compostable materials is the requirement to collect, sort and process the industrial compostable packaging to ensure that it can "biologically decompose and disintegrate in a commercial composting facility". The composting process must be at set levels and within a defined period of time. Industrial composting facilities treat the packaging with high temperatures (over 55 degrees Celsius, much higher than can be achieved in the backyard) to encourage the breakdown of the material where it will become organic rich soil that can be on sold. To be classified as compostable packaging, the packaging must also meet specific quality criteria relating to its ecotoxicity and other characteristic (Haywood, 2018).

#### 2.3.4 Recycling facilities

Plastic films and soft plastics should be recyclable, but the reality is that this does not always happen. Overall, the Australian consumer is generally confused due to inconsistent council collection services and inconsistent labelling (Shields, 2019). Some councils and municipalities are beginning to offer compost collection (which would indicate that industrial compostable packaging items would be accepted), however this is reliant heavily on the consumer placing the correct items in the correct rubbish bins. Some of these services accept compostable cardboard type products such as zucchini trays made from sugar cane pulp, but not compostable plastic made from sugar cane starch. Unless the packaging is clearly labelled with

the product it is made for, and whether it is home compostable or recyclable, the consumer will be even more confused.

Australia has 150 commercial composting facilities available but not all packaging placed in recycling bins will go to these facilities due to their locations outside of major cities. Currently, South Australia is the most successful for this process. Their local councils provide kerbside collection of composting material, including food scraps and compostable packaging (Haywood, 2018).

#### 2.3.5 Labelling and verification

There is substantial misinformation around compostable or bio-degradable plastics. According to Deby Fapyane "*Biodegradable has no measurement and no certification. Yes, it can break down, but perhaps not for 100 years or more*" (Fapyane, 2019). Nonetheless, with new technologies products labelled as Compostable and Certified Compostable and Certified Home Compostable do break down. There are two main types of Compostable Certification:

- Industrial; and
- Home Compostable.

Home Compostable is harder to achieve as it is dependent on climate. To be certified Home Compostable, 95% of the plastic needs to be broken down within 90 days and 100% broken down in 180 days. There can be no more than 1% residue from the packaging, including ink and glue used on the packaging (*European Bioplastics*, 2016). To ensure this is clear for consumers, the Australasian Bioplastics Association has developed a verification program for Home Compostable products which businesses can apply for and use their logo (Figure 8) to symbolise their products claim of biodegradability and compostability (*Australasian Bioplastics Association*, 2019).

However, while there is this nationally recognised logo for Certified Home Compostable in Australia, there are no universal internationally recognised standards (at the time of this publication) In Europe for example, the "OK Compost Home" logo (Figure 9) belongs to their "certification system to guarantee complete biodegradability in the light of specific requirements, even in your garden compost heap", but "it does not explicitly refer to a certain standard, but lists all technical requirements a product has to meet to obtain certification" (TŪV Austria, 2020). This logo is recognised in the EU, UK, and USA. Therefore, labelling will need to be more user-friendly and consumers will need better education on how to understand and treat these products and understand any logos.



ABAX 9999

*Figure 8: Home Compostable Verification Logo Australian Standard* (AS 5810-2010) *Source: Australasian Bioplastics Association, 2019* 



Figure 9: OK Compost Home Logo - TŪV Austria Source: TŪV Austria, (2020).

In the EU, it appears that there still needs to be a lot of work carried out in consumer education on the various packaging in use and how to recycle it, if at all. While retailers are seeking packaging that allows them to sell more produce that is both sustainable and more attractive, consumers are demanding fresh produce in daily quantities (*Packaging and Sustainability Conference*, 2019). Fresh food producers nonetheless require packaging that is cheap and keeps food fresh for longer.

### 2.4 Summary

The benefits of a 'circular economy' have been highlighted and the need for plastic alternatives such as bioplastics are central to achieving this. The issues around home and industrial composting demonstrates need for increased recycling facilities and public awareness and comprehension around the processes involved in effective recycling. The important first step is the need for international standards in labelling and verification.

# **Chapter 3: Current Market Alternatives**

### 3.1 Overview

This chapter provides an analysis of five examples of new technologies that are currently available in the global market as alternatives to traditional plastic packaging. These examples are based on the data collected during this research.

### 3.2 Alternatives to traditional plastic packaging on fresh produce

#### 3.2.1 Misting systems

There are several retail stores and supermarkets around the globe who are using misting and watering systems. It is well known that fresh produce, when on display in stores tends to deteriorate quickly due to the low humidity. Lettuce leaves can go limp within an hour, which makes it appear less fresh. Fruit and vegetables also tend to lose weight in these environments, which results in a lower price at the checkout if the item is sold by weight.

*Contronics* in The Netherlands have come up with a Dry Mist technology which helps to counteract the effects of typical store conditions. The inspiration for this design was the morning mist hanging over crop fields. The system has been designed to use ultrasonic technology to make a fine mist from pure water. As the mist evaporates around the produce, humidity rises, and the temperature drops, just as in nature. Testing has proven that produce will stay fresher for longer without getting wet. Produce such as leafy greens are rehydrated using this technology as the moisture is absorbed through their pores (stomata). This compensates for the water loss occurred during harvest.

Additional benefits for retailers using this system by *Contronics* include higher revenue due to superior quality of produce. The natural cooling effect of the system saves on energy in the store and in storage. The misting system can help eliminate the need for plastic packaging on produce, especially leafy greens. The dry misting also contributes to sustainability by reducing both food and packaging waste, energy and carbon dioxide (CO2).

*Contronics*' Mission Statement is "to do our share in the battle against food waste. Our ultrasonic 'dry mist' technology has helped us do this for decades" (Contronics, 2020). Rogier Sprokkelhorst, the International Sales Manager stated that *Contronics* currently supply their systems to over 30 countries and believe their systems will alleviate 25% of food waste when used on fresh produce. They have won various awards and are finalists in the 2020 Food Waste Awards (*Food Waste Awards*, 2020).

Aside from the benefits of reducing both packaging and food waste, the author believes the Dry Mist system looks really good and does produce a bit of a 'wow factor' with the "show of mist above the produce" in the many stores it is installed in as illustrated in Figure 10.



Figure 10: Contronics Dry Mist System Source: Author

There are several competing misting systems and various supermarkets and stores within Australia are starting to embrace this technology. However, it remains to be seen whether this will continue given the current concerns about spreading viruses such as COVID-19 which suggests a move back to plastic or alternative packaging.

#### 3.2.2 Cellugy

*Cellugy* is a company which initially formed at Aarhus University in Denmark. It was started in a living room in 2017 by two researchers exploring the potential use of nanocellulose for bioplastics. The start-up received two prizes equating 45,000 Euros as well as a further 50,000 Danish Krona due to their innovative ideas, as well as being a finalist with National Geographic in 2019 for Innovation and Design. See Figure 11 (*National Geographic*, 2020).



Figure 11: EcoFLEXY Source: National Geographic, 2020

The product is a cellulose derived from food waste – primarily fruit pulp which turns into sugars when fermented. *Cellugy* lodged a Patent on their Ecoflexy flexible packaging in October 2019. The co-founder of *Cullugy*, Deby Fapyane stated that "*This product is very good for the garden and takes four weeks to break down, even in a 20° Celsius environment*" (Fapyane, 2019). Furthermore, because it is thin, it can be recycled with wood or paper, and if burnt, becomes a biogas. The biproduct of the production process can be used as a salad dressing or probiotic, so the whole process is being utilised without waste or damage to the environment. Fapyane declared that to be truly compostable, it must put nutrition back into the soil and this is what *Celllugy* products do. Many compostable plastics are a cloudy-transparent look. Compostable plastics are generally more expensive than the alternative chemical plastic. However, there is the same profit margin on any volume regardless of type.

#### 3.2.3 Grounded Packaging Company

The author met with Nathan Graham of Grounded Packaging who have manufacturing plants in the USA, Germany, Israel, China and Malaysia. Their product is a compostable film or flexible sleeve made from rice, potatoes, corn and copolymer. This product is Certified Compostable and Certified Home Compostable (European Standard). The main goal of Grounded Packaging is to educate and help make change to better the environment. The biggest issue they are finding is that the Australian supermarkets believe this form of packaging is irrelevant because the consumer still puts the wrong products in recycling (Graham, 2019). Graham stated that there has been very successful use of this product in the meat and poultry industry to date. Laboratory testing has showed no issues to date with regards to bacteria. Graham also discussed the many 'traditional' plastic companies around the world that are now looking to diversify and branch into compostable plastics using existing infrastructure. If this is successful, this would bring the price of compostable plastics down, therefore making it more affordable to purchase and integrate into their businesses.

#### 3.2.4 Nativia by Taghleef Industries

The author met with Olivier Nickel whilst attending Fachpack in Nuremberg. Nickel was keen to explain the processes involved in manufacturing their product, Nativia Bio Based Films. Nativia is a bioplastic made primarily from Corn starch and/or sugar cane or cellulose. Due to the bio-based content and lower energy consumption, Polylactic Acid (PLA) delivers a lower carbon footprint. They deliver additional end of life options compared to many oil-based plastics. He was also proud to boast that their Nativia films have passed the European certificate for Industrial Composting. Nickel re-iterated that bio-based "does not mean biodegradable". The author was told that Nativia film complies with the EU and USA Food and Drug Administration (FDA) regulations, meaning that they are approved for use with food. "It is important to note that this product cannot be home compostable as it cannot degrade in the time frame specified by the home-compostable standards" (Nickel, 2019). Industrial Composting options for Nativia Film takes six months to disintegrate. They can also be mechanically or chemically recycled as well as incinerated. They cannot biodegrade in landfill conditions. The transparent option of Nativia was remarkably clear and it was easy to see through compared to some of the other compostable products on the market. Storage of this product should be at a temperature of less than 30 degrees Celsius. Deterioration may occur if not stored in ideal conditions.

#### 3.2.5 Jonatura – Biodegradable packaging

Patrick Stumel of Jonatura stated that "Many people around the world think that compostable or biodegradable packaging is made from food products which otherwise would go to feed the world, however the fact is that many of the options available are actually made from starch, which is derived from food waste" (Stumel, 2019). Stumel declared that the aim of Jonatura is to replace conventional packaging made from fossil fuels to that of raw materials from renewable sources. The company believes that this is what forms the basis of an ecological packaging industry.

#### 3.3 Summary

These examples provide alternatives to plastic packaging that Australian producers, retailers and consumers can consider as comfortable solutions to the current impasse in single-use plastics and waste management. The challenge lies in the major retailers and their willingness to look at either recyclable packaging or finding a way to effectively handle compostable packaging and educating consumers on the correct way to deal with the packaging chosen. Another factor to consider is the availability of plastic alternatives in Australia, and the cost of this to the producer.

# Conclusion

The issues and challenges surrounding plastic packaging on fresh produce are ongoing in Australia and globally. This report creates a better understanding of the 'war on waste' in Australia, by analysing the issues facing producers of fresh food. There are alternatives to plastic packaging being used in the global market, and most of these are economically viable options to keep produce fresher for longer.

Consumer perceptions, retail demands, different needs of wholesalers and issues around food safety – in particular during COVID-19 and the need for increased hygiene standards – have all indicated that alternatives to traditional plastic packaging are needed. While these may enable a more 'circular economy' in relation to produce and packaging, ultimately the results will depend on consumer awareness and understanding, and the requirement for labelling and national and international standards to ensure a competitive and level market. The innovations and solutions examined above, including misting and various bioplastics and compostable packaging are all part of the solution.

During and after COVID-19, it is likely that some form of packaging will be required by certain retailers, particularly the supermarkets, on all fresh produce, and not just on organic produce (to demarcate it from other products for the purposes of scanning). Whilst the misting systems are a proven, effective way to retain weight and freshness of produce, there is still a perceived risk by consumers that other consumers are handling the produce or spreading droplets, therefore potentially transmitting disease. Thus, food is going to be more widely accepted by consumers if it is in some form of packaging, whether it be a PET plastic sleeve/film, compostable sleeve/film or bio-degradable sleeve/film. It will be the consumer who ultimately makes the final choice. The consumer determines which products they purchase, and then what happens to the packaging on their produce once it is no longer required.

While consumer demand is the driver for change, national and international standards will be needed to ensure alternatives complete 'the loop' for a fully recyclable economy that minimises waste. While there appears to be some alternatives to plastic packaging on the market today there is no one simple solution – no 'magic bullet'. In most cases it seems each country, state or municipality has its own problems and is identifying solutions. Various new alternatives and technologies researched for this study could all be useful in different contexts. With further evaluation, education and training, plastic alternatives could be taken up in the Australian economy, and this would help meet the current, ambitious 2025 targets.

Overall, this report has shown that in the current market climate, taking into consideration the stakeholders and the implications of a global pandemic, any solution needs to include some kind of plastic packaging for fresh produce which is recyclable. However, the reliance on recycling is limited until further infrastructure is built in Australia. Nonetheless, this report contributes to a better understanding of the 'war on waste', because each stakeholder in the process from farm to fridge, has to consider changing their practices, and nothing can be achieved by one person, or one producer, simply by changing one step in the process, for example, converting to 'home compostable' bags. Unless the bag is composted as per instruction by the end user, the problems of single-use plastic remain.

### Recommendations

- Further research is needed to better understand the economic impact of COVID-19 restrictions and short and long—term future preferences for wrapped or packaged food for fresh produce.
- 2. Further investment is needed by government into creating more standardised labelling and verifications.
- 3. Further investment is needed to research plastic alternatives in Australia as outlined in Chapter 3.
- 4. For compostable packaging to be a future consideration, the cost would mostly likely need to be reduced, and the easiest way to do this would be to increase demand (bulk buying by multiple producers), thus bringing the cost or production down.
- 5. Major retail chains need to be consistent with their fresh food packaging preferences, to eliminate the need for growers to have multiple types of packaging.
- 6. Local government needs to play a greater role in sustainability and enforcing either recycling or composting options to consumers.

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# Plain English Compendium Summary

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Objectives	<ul> <li>The overall objective of this study is to investigate and share the knowledge and practices within the supply chain from 'farm to fridge' that are occurring around the world.</li> <li>Other objectives include: <ul> <li>To find alternatives to plastic packaging for fresh produce.</li> <li>Find packaging options to keep produce fresher for longer.</li> <li>Seek economically viable alternatives to plastic packaging on fresh produce.</li> <li>Search for compostable/biodegradable packaging for use on fresh produce.</li> </ul> </li> <li>Better understand the "War on Waste", including better environmental alternatives.</li> </ul>
Background	This report is based on a study conducted into the issues facing fresh food producers in Australia, and the requirements for them to use plastic packaging to maintain produce freshness and ensure food safety and hygiene standards, as well as meet retailer and consumer expectations. The focus is particularly on the current alternatives to traditional plastic packaging available in the global market.
Research	The research for the study was undertaken in Australia, the USA, the UK Ireland and throughout the European Union in 2019-20. The focus is particularly on the current alternatives to traditional plastic packaging available in the global market.
Outcomes	While consumer demand is the driver for change, national and international standards will also be needed to ensure the alternatives complete 'the loop' for a fully recyclable economy that minimises waste. While there appears to be some alternatives to plastic packaging on the market today there is no ONE simple solution – no 'magic bullet'. In most cases it seems each country, state, or municipality has its own problems, and is trying its own solutions.
Implications	Overall, this report has shown that in the current market climate, taking into consideration the stakeholders and the implications of a global pandemic, any solution needs to include some kind of plastic packaging for fresh produce which is recyclable. However, the reliance on recycling is limited until further infrastructure is built in Australia. Nonetheless, this report contributes to a better understanding of the 'war on waste', because each stakeholder in the process from farm to fridge, has to consider changing their practices, and nothing can be achieved by one person, or one producer, simply by changing one step in the process.