SUSTAINABLE PACKAGING PRACTICES IN THE HORTICULTURE SECTOR: SOME INNOVATIVE COMPANIES' INITIATIVES UNDER THE SPOTLIGHT

Ram Roy, PhD
Eastern Institute of Technology, Hawke's Bay, New Zealand
E-mail: rroy@eit.ac.nz

ABSTRACT

Sustainable operations and supply chain are the crying needs of today's global business environment. Governments all over the world are trying to enact laws to reduce or ban plastic products and encourage the use of biodegradable packaging and storage of goods. There is a range of encouraging practices visible in different domains of the business operations including designing, manufacturing, storage, and distribution. This paper has focused on some of the sustainable packaging approaches adopted by some companies in the horticultural sector of New Zealand which grow, pack, and export fruits to the global markets. There are also innovative examples of sustainable packaging from other parts of the world for improving the company's operational efficiency and environmental sustainability towards better profits. The paper is based on a range of articles in the trade journals, newspapers, and journals highlighting the importance of sustainability in the packaging and supply chain domain.

1. INTRODUCTION

Food safety and environmental sustainability have become important issues in today's highly connected global businesses. Consumers are becoming more and more concerned about the quality, safety, and price of the foodstuff they buy and consume. They also attach very high importance to how and where their foodstuff have been produced and supplied from. They are becoming more and more sensitive to some of the operational issues including carbon footprints, industrial emissions and wastes, food packaging, and sustainable supply chain. New Zealand is famous for its clean-green image, its orientation towards the environment, the supply of high-quality food, and its care for premium natural resources. The supply of dairy products, fruits, and meat is not adequate to meet the worldwide demand, so the export of NZ on a range of food products is increasing annually. The Hawke's Bay region is commonly referred to as the 'fruit-bowl of NZ', which grows various types of vegetables and fruits (viz. pip-fruit, stone fruit, and grapes); and the region also enjoys adequate sunshine and rainfall (Hastings, n. d.). As NZ apples and other fruits enjoy a high-quality reputation around the world, their supply through sustainable packaging has become even more important for the companies to maintain their brand image. For example, the company XYZ in Hawke's Bay follows a range of approaches towards the sustainable packaging and supply chain as discussed next.

XYZ Limited is a medium-sized business that was started as a grower and packer of conventional fruits for the domestic and international markets. It began with just 8 acres of land, but now grows, packs, and exports fruits to global markets, and manages over 100 hectares of land, 95% of which is used to grow apples, and the remainder being used for peaches and pears. It has many certificates of compliance for its orchard and pack-house facility from various agencies such as Global Gap; New Zealand Gap, and British Retail Consortium (BRC) for a global standard for

food safety (XYZ *Fruit Company, n. d*.). The company also contracts to pack other growers' fruits in its pack-house facility. In 2002, the company noticed a demand for a dedicated organic packing facility and began to pack for Fresco, and converted one of their blocks to organic certification. In 2010, the company got into organic orcharding in a big way and began exporting directly with overseas clients (XYZ *Fruit Company*, n. d.). Due to the seasonality of demand, the number of workers employed varies from 35 to 100+ during the peak season to get the apples harvested and packed. There are lots of interesting varieties of apples in XYZ including royal-gala, Braeburn, fuji-supreme, pacific-beauty, pacific-rose, granny-smith, jazz, lady-in-red, and red-delicious. The apples they pack and export include both self-grown and contracted from other growers (approximately 40-45% self-grown and the remaining from contract growers). Over 99% of XYZ's apples per month are exported to the international market, and less than 1% is sold in the domestic market. It is estimated that XYZ packs approximately 17,000 bins of apples in a season (1 bin = 400 kg, which means about 6,800 tons of apple are packed every season). XYZ could produce about 350,000 cartons of apples, which include 200,000 cartons self-produced. The company provides '*vertically integrated service'* including growing, packaging, cool-storing, and exporting, which make their apples popular in both domestic and international markets due to their overall control of the operations.

Due to the increasing export footprint of XYZ, it is vital to focus on its sustainable packaging and learn from the global sustainable packaging practices to make their sustainability efforts even better and more effective. With this goal in mind, this paper has done a review of the several articles spanning across business practices, researchers, and consultants.

2. LITERATURE REVIEW

There are lots of articles in trade journals dealing with different types of sustainable practices being followed in different countries. They also deal with a range of operational issues (see Figure 1) including the challenges in pack-houses, the use of modern technology, precision farming, sustainable packaging and biodegradable materials, etc. in the retail and horticulture industries. For example, Reichert et al. (2020) reviewed very extensively the synthetic and non-synthetic materials for packaging and textile applications, and provided a holistic view of bio-based packaging options including processing, evaluation of the sustainability, and options for recycling. They concluded that the bio-based polymers belonging to the polyesters group are generally slow to biodegrade, and their structure needs to be modified through copolymerisation or other techniques to accelerate their biodegradation. Some of the packaging related issues are being discussed under suitable subtopics in the subsequent sections.

2.1 Pack-house Operations

According to Fitzgerald (2003), several smaller pack-houses in Nelson have ceased their operations due to the increasing costs in packaging, increased variety of lines packed (based on size, variety, and colour of fruits). Tight standards and regulations related to hygiene, health, and safety have also resulted in increased costs. Many pack-houses had to invest in colour-graders and labelling-machines to label each apple for export with an ENZA sticker. There was also an increased amount of paperwork related to packing. With the introduction of traceability, an entire paper trail is left behind to enable a supermarket in the UK to receive a carton of fruit to ascertain anything they desired to know about the origins of the fruit. This is very reassuring for supermarkets and their customers, but for those in the industry, the harvest is a busy and stressful time with the increased workload in packing, which means many rarely see their families for these months of the year. Although some growers commented that they would be financially better off

packing their fruits, it simply was not worth the time and stress. It could be argued that the creation of economies of scale through amalgamation or leasing of smaller orchards is necessary for the global market of which New Zealand is a premium but the smaller supplier.

2.2 Lean Operations in Pack-Houses

Doevendans et al. (2015) set out to understand the extent to which Lean elements are applicable, and currently used within the NZ pipfruit industry, and how well Lean can be implemented to pack-houses. Their survey focused on a wide range of stakeholders' activities in the industry including growing, packing, storing, and exporting, and concluded that the industry as a whole is only marginally familiar with Lean principles. However, the pack-houses which are engaged in Lean have made significant operational improvements since 2012. The research on pack-houses indicated that a substantial culture adjustment is required to increase the pace of Lean implementation. Doevendans et al. feel that Lean can be successfully implemented in seasonal pipfruit pack-houses for about 18 months to make significant progress in the effectiveness. The NZ pipfruit industry is technically innovative and internationally competitive (World apple review, 2013), but stakeholders have relatively inadequate awareness of Lean thinking. Although during my recent visit to XYZ Ltd., it was noticed that some of the basic tools of Lean were being applied for minimizing the operational wastes.

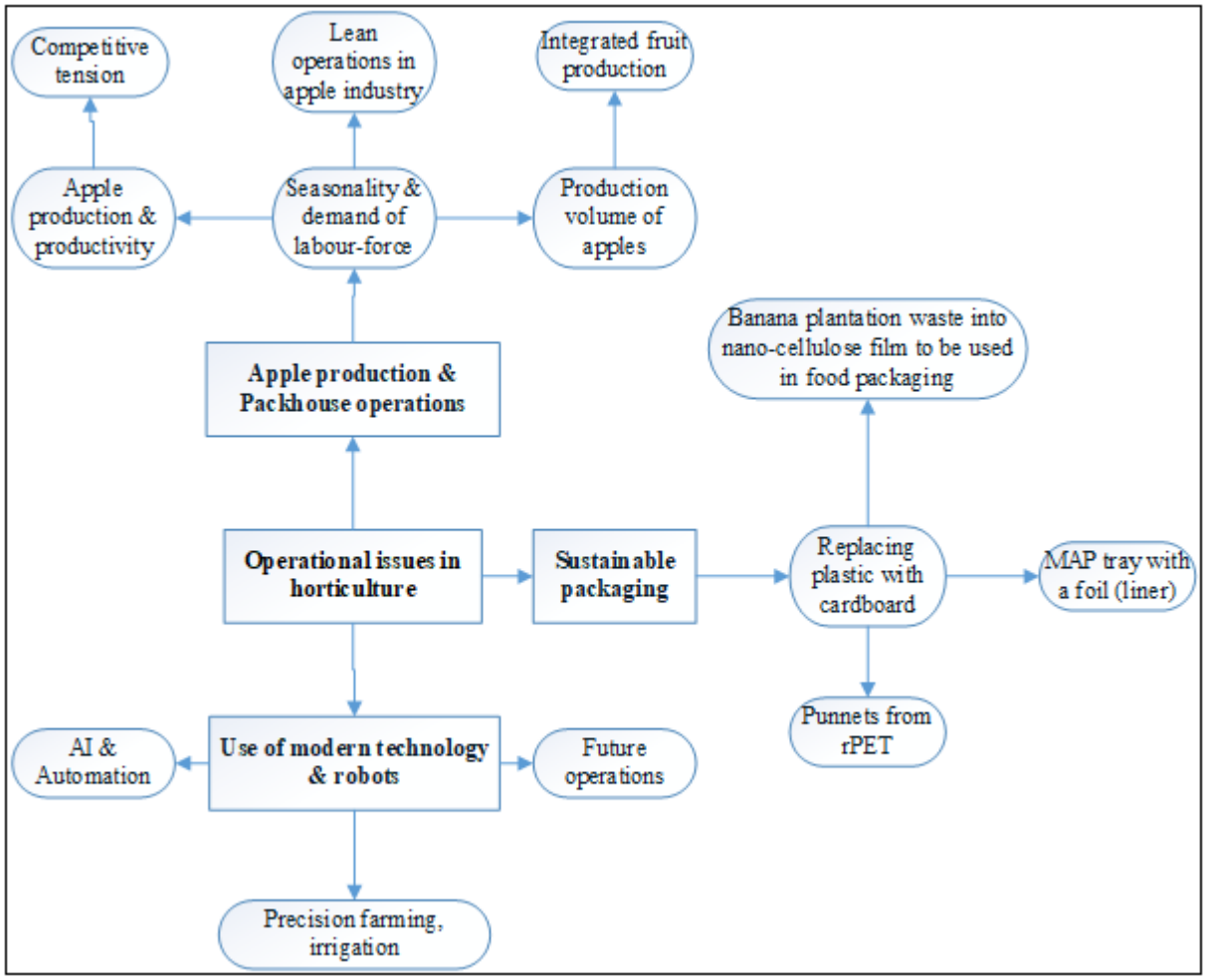

Figure 1. Various issues related to sustainable operations

2.3 Precision Farming

According to Chapman (2019), there are concerns that domestic vegetable supply will not be sustainable with future population growth, and there is a need to grow commercial vegetables for the domestic and export markets. The national environmental standard would apply across the country, overriding individual council rules, and creating one regime to allow for the production of vegetables in a sustainable and environmentally friendly manner. In the short-term, it will include crop rotation and other enablers for vegetable growing, but to match with population growth, production areas will also need to expand to ensure that consumers are getting the fruits and vegetables for their wellbeing. A Ministry of Health survey of over 11,000 participants indicated that only 40% are meeting the 5+ (fruits and vegetable servings) per day, which is the standard. HortNZ encouraged the use of precision irrigation techniques which can control the nutrient application and limit leaching. It also supports irrigation for new farms larger than 10 hectare for fruits and other low intensity growing, and implementation of audited Farm Management Plans to ensure that vegetable and fruit growers follow good practices, and minimise their environmental impact.

2.4 Seasonality and Demand for Labour Force

The fruit industry has seasonality of labour demand, and according to T & G Annual Report (Dec. 2015), the largest group of New Zealand seasonal workers is employed under the recognised-seasonal-employer (RSE) scheme which allows the horticulture and viticulture industries to recruit workers from overseas, mostly from the Pacific Islands, to fill seasonal labour shortages. The RSE scheme is an absolute success story for the apple industry which provides employees with increased income, practical knowledge, and skills that would otherwise be unobtainable in their home countries. This employment income enables opportunities for business ventures (taxi service/local shops), improved housing, and education for the RSE workers, their families, and communities. As per NZ Herald (2018), during the peak season and bumper crop, the apple industry is very concerned about the inadequate number of workforce available to pick the fruits from their orchards. The report adds that those who start in a seasonal job are likely to progress into a fulltime job/career in the exciting apple and pear industry.

HB Fruitgrowers Association feels that meeting seasonal labour demand is always challenging for the apple industry because fruit must be picked within a short timeframe to ensure its premium export quality, freshness, and size (NZ Herald, 2018). According to Tenge-Rietberg (2019), the labor shortage, increase in bureaucracy, and increased labor costs are motivating farmers and traders to look for automation where possible to save manpower or to use them more efficiently. For example, automation is becoming popular in fruit-picking, asparagus-peeling, and other processing areas where it adds more value, and cost efficiency. Currently, New Zealand offers a *working-holiday*-visa (WHV) globally to fulfill its shortage of workers during the peak harvesting season. WHV is a residence permit that allows travelers to undertake employment (and sometimes study too) in the country issuing the visa to supplement their travel expenses. WHV enables workers to experience living in a foreign country, without going through the hard process of finding work sponsorship in advance or going on expensive university exchange programmes (*Working Holiday Visa*, n. d.).

There are also some disadvantages of hiring seasonal workers, because every time they are hired, they will need to be trained, orientated, accommodated, and retaining experienced workers is a challenge. Unfortunately, they can only be employed for a period of 3 months in one enterprise under the present visa conditions, which increases recruitment expenses (or a setup cost) in the hiring of new staff. Besides, hiring unsuitable new staff increases costs because of quality

and rehiring issues.

2.5 Sustainable Packaging and Challenges

According to the National Geographic (Stauffer, 2019), if a retailer shrink-wraps a cucumber in polyethylene, its shelf-life improves from 3 days to 14. However, the same plastic will last more than a century, and will probably make it to the oceans in contamination. Of the 78 million tons (MT) of plastic packaging produced globally each year, a mere 14 % (10.92 MT) is recycled, while 9 MT of plastic escapes the collection annually.

Sustainability and packaging industry are inextricably connected, and the Dutch company, Argos Packaging, has launched a sustainable cardboard packaging that is made from the locally grown elephant-grass with no pesticides, irrigation, or fertilizers. A plot of elephant-grass absorbs four times more CO_2 than the same size plot of planted trees. Argos is also working innovatively for the snack-cups which are made with 80 percent cardboard and offer a more sustainable substitute to the regular PET versions *(Cardboard fruit & vegetable packaging, 2020).*

Figure 2. Recyclable paper packaging

Figure 3. Recyclable cardboard packaging

Recently, a packaging machine was installed in the warehouses of the apple exporter Mylord. The reason? A new cardboard packaging for their organic apple. According to marketing director, Delphine (12 Feb 2020), the plastic era is over, and it is logical to have a 100 percent recyclable cardboard packaging with two advantages: (i) the openings in the cardboard (see Figure 2) make apples visible to customers, and (ii) they are difficult to be removed as long as the packaging remains intact.

McGregor (2019) reports that the battle against plastic in the fresh produce industry has intensified and many companies are looking at reducing plastic use in packaging. Most supermarkets are already charging for plastic bags and are being pressured to remove plastic from fresh produce, but is it that simple?

There are also some points in favour of the use of plastic packaging. For example, many of the plastics used in the fresh produce industry prolong shelf-life of the produce by several days or more, so reducing plastic increases food waste…. so, there is a trade-off here (McGregor, 2019 & Vroode). Supporting the above views of users, Stauffer (2019) says that plastic, not only, protects food from bacteria, temperatures, and light, it also allows growers, distributors, and retailers to reduce food-waste; consumers to see colorful, fresh produce they're purchasing; growers to brand their produce and add additional selling features on the package, and retailers to charge per package rather per kilo and offer the convenience items like ready-made salad bowls and pre-cut veggies.

Companies are focusing on replacing plastic with paper or cardboard which seems to be popular with consumers as one study by Fernández (2019), cardboard is the highest rated

packaging material by Spanish consumers, with the most commonly used being cardboard, plastic, and wood. The study shows that 75.2% of consumers prefer to purchase products in cardboard packaging, compared to only 11% in plastic. Of the total cardboard production in Spain, 15% is used for fresh fruits and vegetables, and this could grow as it can also enhance the presentation of a product (see Figure 3).

Voorde (n. d.) reports that plastic is gradually disappearing from the fruit and vegetable shelves at *Delhaize* which is trying to move to a completely plastic-free shelf, but that is not yet feasible for certain products, including sliced vegetables. According to Voorde, the demand for less plastic comes from the Belgian consumers because for them the plastic issue is very important. However, working without packaging was not always desirable. For example, they trialed with 'pick & mix' tomatoes without packaging, and the sales volume decreased because many customers perceived that it was unhygienic when another customer was able to touch the tomatoes. Surprisingly, the sale of citrus fruits without packaging went up.

Top-Seal packaging offers same quality and freshness but reduces plastic use by 25% from the typical clam-shell lid. It promotes a longer shelf-life with macro-perforated film and its peelable format allows for re-seal of the packaging depending on the need. The *top-seal* also provided suppliers with an opportunity to stack more products atop one another to transport more and reduce transportation costs and environmental impact (Stauffer, 2019). Similarly, Zwager Techniek (6 Feb 2020) provides '*packaging-in-cardboard-tray'* (Figure 4) that can lead to 80% plastic reduction and more sustainable packaging with *paperseal* from a cardboard blank formed into a MAP tray and provided with a foil (liner) with barrier.

According to McGregor (2020, Jan), the packaging industry needs to evolve and adapt as consumers and retailers want more sustainable packaging for fruits and vegetables without compromising on the shelf-life. In this context, AVI Global Plast (India) has been offering a range of sustainable products including punnets with recycled content without compromising on their physical properties. These punnets are made from rPET films containing 90% recycled content. In 2019, AVI helped in recycling 111 million bottles to produce its prime range of punnets in compostable materials providing equal strength and performance. AVI is also redesigning its punnets for reducing the amount of plastic used and has developed various types including open-top, heat-sealed, and flow wraps.

Figure 4. Packaging-in-cardboard tray

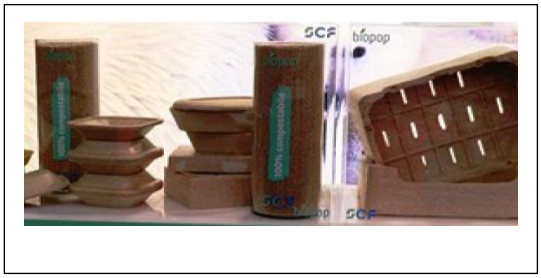

Figure 5. Eco-friendly compostable biopops

2.6 Fruits-for-thoughts Towards Packaging

Dilucia et al. (2020) feel that fruit and vegetable by-products are the most abundant food wastes being contributed by the production processes of edible oil, juice, wine, or sugar. The residues from these processes are generally discarded or used as animal feed or composted, but they are a great source of bioactive compounds including polyphenols, vitamins or minerals. The

amount of residue with their potential application in packaging has been estimated in millions of tons per year. Nora et al. (2017) reported that about 1.3 billion tons per year of food is wasted from the production stage to the consumer domain. They identified the potential utilization of abundance of seasonal crop, crop remains, and the by-products of fruit and vegetable using appropriate technologies for the conversion of food waste into value-added products. According to Doyle (2019), researchers (Arcot & Stenzel, University of NSW, Australia), have developed a process to turn banana plantation waste into a nanocellulose film that could be used in food packaging. The banana fruit only comprises 12% of the plant and the rest is usually discarded after harvesting the fruit. What makes the banana-growing business particularly wasteful compared to other fruit crops is the fact that the plant dies after each harvest. Researchers were mainly interested in the pseudostem (the layered-fleshy-trunk of the plant). Some of it is used for textiles and compost, but the rest is a huge waste. According to Stenzel, it is possible to get nanocellulose from every plant, however, some plants are better than others in terms of cellulose content. Nanocellulose is a material of high value with a range of applications including packaging, particularly single-use food packaging which ends up in landfills. The new material is recyclable, biodegradable, and non-toxic.

'Apeel Sciences' is an innovation company focused on reducing food and plastic waste. They use plant-derived materials that exist in natural peels of fruit and vegetables, seeds and pulp, to create packaging solutions that are both edible and protective enough to replace the need for plastic. They aim to double or triple the shelf life of many types of produce, which promotes sustainable growing practices, better food quality, and less waste! It has begun partnerships to distribute Apeel avocados, asparagus, and limes to the European market. Another alternative the industry is exploring is corrugated packaging boxes made from a high amount of recycled material which can be recycled again after use (Stauffer, 2019). With the increasing demand from consumers for packaging with a minimal environmental impact, *Gruppo-Fabbri* has developed its *Nature-Fresh*, a home-compostable stretch film that combines biodegradability with the transparency, elasticity, breathability, and mechanical resistance of plastic (Mestre, 6 Feb. 2020)

Plastic is sourced from petroleum, consumes lot of energy in manufacturing, and creates a huge plastic pollution damaging waterways, animals, and natural resources. Mushroom and other plant-based packaging, on the other hand, uses a fraction of the energy required to make plastic, produces minimal carbon emissions, and naturally breaks down into the Earth with no pollution. The home décor giant IKEA is extending its commitment to sustainable packaging by using mushroom-based packaging that eliminates the need for other wasteful materials. The mycelium-based material (called Mushroom-Packaging or MycoComposite) is grown in a controlled environment in less than a week, providing a sustainable option for packaging requirement. Mycelium works in conjunction with other plant-based materials including hemp, husk, oat hulls, and cotton burrs (IKEA commits to biodegradable mushroom packaging, 6 Feb 2020).

At a London expo, eco-fabrics of the future that use plants and natural waste instead of artificial fibers were showcased. Some of the interesting ones on the display included cactus-leather, and wool from pineapple-leaves (sourced from the leftovers at juice bars), and innovative sportswear embedded with live bacteria to neutralise the body odour. Millions of good bacteria encased in panels in the key areas such as armpits are activated when the wearer sweats (Cactus leather & pineapple-leaf wool…, 2020).

2.7 Die-hard Terminators of Plastics

The 'plastic problem' globally has been documented throughout the last decade, with 2020 being seen as the year of change. The food industry is often the first in the firing line when it comes to making some of the biggest changes. Packaging over the last decade has achieved a lot, but it is becoming common to neglect some of the learnings already established. In summer 2019, *Morrisons* announced to do away with the plastic wrapping on cucumbers during the British growing season - saving 16 million plastic sleeves. This was even though cucumbers without the plastic wrapping were expiring two days earlier than the wrapped ones. *Morrisons* continued going plastic-free despite protests from the Cucumber Growers Association and environmental groups concerned about an increase in food-waste. Similarly, *Iceland* promised to ditch 97% of its plastic use in Christmas packaging and remove plastic packaging from its products by 2023; *Tesco* is removing 1 billion plastic items from stores by 2020, and *Asda* plans to reduce the amount of plastic in their own-brand packaging by 15% by Feb. 2021 and increase recycled plastic content in packaging by 30%. A survey suggests that consumers are prepared to pay 5-10 pence more per pack for environmentally friendly packaging. While there is an appetite for changes in packaging - shoppers are not fully prepared to pay for such changes (The packaging challenge, 2020).

According to Antoinette Laird (Foodstuffs NZ Head, corporate affairs), stickers have helped staff identify the produce correctly, so they would be introducing fiber-based packaging options for produce, which are home compostable. Further, bananas will also be without wrappings which will save about 19,000 tons of plastic going to the landfill every year (*Cactus leather & pineapple-leaf wool…, 2020*).

2.8 Recyclable-cardboard-containers or Reusable Plastic-ones

Addressing the debate on whether to choose recyclable-cardboard-containers or reusable plastic ones, Santorromán (AFCO-President) stresses that both environmental impact and economic-life-cycle costs are significantly lower for the cardboard container than for the reusable plastic-one. Some exporters reported that cardboard packaging could lose competitiveness in the long-distance refrigerated transport, but Santorromán feels that 'if the rules and quality standards are met, the cardboard-box will be perfectly adequate'. The key is to pick the right packaging, based on product, weight, humidity, temperature, and the distance to which it will be shipped. Moreover, after traveling long-distances, the cardboard-containers can be recycled at the destination, while reusable-plastic has to be returned involving extra shipping and sanitation costs. Cardboard also has other advantages including (i) safety and hygiene from the fact that each fresh product is placed in a new cardboard-box, thereby avoiding the risk of contamination from previous usages, and (ii) cardboard-boxes offer better presentation through customised printing, which may improve brands, convey information, better consumer shopping experience, and improved sales. Boxes made from corrugated-cardboard with common-footprint-quality (CFQ) standards are perfect for the distribution and transportation of fruits and vegetables. According to Ostaijen (Director of Corrugated-Board-Association), 'increasing sustainability was paramount in the development of CFQ boxes by using the minimum amount of cardboard but ensuring sturdiness and efficient loading grade. Other considerations are stack-ability and specific fruit and vegetable sustainability. The CFQ boxes are being manufactured by five corrugated cardboard producers in the Benelux countries.

According to Scurria (Administrator of SCF Packaging, 2020), they are the first company to produce low-thickness packaging solutions called Biopop (Figure 5) that is shock-absorbent and 100% compostable in 4 weeks, thus, a valid innovative and eco-friendly alternative to storing fresh products. Biopop is believed to be the future of disposable options as punnets, trays, and

containers of all kinds can be disposed of with organic waste.

According to Woolf (2019), the Government could ban fruit stickers and polystyrene, but some would like all plastics to be banned at the same time. The Prime Minister of New Zealand announced a target on the 'hard-to-recycle' plastic and polystyrene- potentially banning meat-trays, cups, and takeaway-food-containers. Supporting the PM's move, Hannah Blumhardt (The Rubbish-Trip co-founder) said that the time-consuming process should include all plastic-items playing no role in food preservation.

2.9 Design for Recovery and Recycling (DFRR)

Nemat et al. (2020) argued that material recovery could be enhanced if packaging can be designed to allow easy and proper sorting/separation. They investigated six types of yogurt and cream packaging across 15 households in a Swedish city and revealed that some of the selected packaging waste is not properly separated and sorted. They concluded that the design of food packaging based on user-centered needs could affect consumer decisions for proper sorting of packaging waste, which enables improved material recovery. The design should focus on the package's visual attributes, the material selection, and the package´s waste sorting related functions.

Highlighting the importance of packaging design, Konstantoglou et al. (2020) identified and evaluated packaging elements in the food industry to examine their relationship with consumer behavior in buying food products. They conducted exploratory-factor-analysis (EFA) on a sample of data to examine the factor structure of these elements in the general population. The EFA of the packaging items resulted in seven factors including informational content, content protection and recognition, smart functioning, geometry, environmental friendliness, endurance, and coloration. The findings were informed by the consumer attitudes and predispositions towards packaging, thus having useful managerial applications. Researchers argue that by identifying the importance of key packaging elements, the manufacturers in the food industry should include marketers, logistics experts, food scientists, and environmental managers in the design and development of packaging in the food supply chain.

Nemat et al. (2020), concluded that the proper design of food packaging can enhance consumer decision in separating/sorting packaging waste. Current food packaging does not convey this information adequately and appears to be designed as a container before and during the consumption of the contents, rather than a facilitator for separating and sorting the packaging after the contents are consumed. This can be done by paying attention to its functions, form, texture, color, and recyclable materials that can be separated easily from each other. However, this study reveals that choosing recyclable materials does not guarantee the proper separation and sorting of the packaging. Waste separation and sorting is a process that must be easy and convenient for consumers. Hence, packaging functions including the ease of emptying, cleaning, separating, and folding are the most likely features that can be used to enhance proper sorting.

Based on above illustrative examples, it is fairly clear that there are lots of efforts being focused towards sustainable packaging in the manufacturing, horticulture, and retail sectors. There are also visible policy changes being adopted in the functioning of the Government in different parts of the world including New Zealand.

3. CONCLUSIONS AND RECOMMENDATIONS

It is noted from the discussions and literature review that while there is an appetite for changes in packaging materials towards sustainability, shoppers are still not fully prepared to pay for such changes. So, whose problem is this to solve?

The literature suggests that there are many examples of sustainable packaging practices being undertaken by many companies, researchers, and innovators around the world. Although there are many challenges related to operational and transportation issues, the pack-houses, consolidators, logistics providers, and retailers are all set to deliver the freshest produce to the consumers. However, it is not practical or probably even possible to suddenly do away with all the packaging from all the products, because consumers still want to 'grab & go' and enjoy the convenience of fruit- or food-packaging.

So, while people are shocked to see the frequent imagery of wildlife crippled or killed by discarded packaging, in reality, not every consumer is placing priority of saving the planet ahead of their fresh choice of produce. The challenge ultimately sits with the food industry to innovate their packaging to ensure it is biodegradable, recyclable, sustainable, and affordable. That is easier said than done, but changing consumers' awareness towards sustainable packaging, and perceptions to accept some of the costs in the short-term for the gain in the long-term provide significant amount of optimism.

Boz et al. (2020) stressed the importance of effective communication on sustainable packaging with consumers. They feel that if food packaging suppliers and companies are directed only by consumers' opinion of sustainability, then the most sustainable packaging alternatives will not be implemented because consumers do not always select the most sustainable package. However, if food packaging companies employ proven sustainable packaging and communicate with the consumers effectively about it, then it will be embraced.

4. REFERENCES

Boz, Z., Korhonen, V. and Sand, C. K (2020). Consumer considerations for the implementation of sustainable packaging: A review. Sustainability, 12, 2192, 1-34. www.mdpi.com/journal/sustainability

Cactus leather and pineapple-leaf wool: Eco fabrics we could soon be wearing (2020). https://www.freshplaza.com/article/9185766/eco-fabrics-we-could-soon-be-wearing/

Cardboard fruit and vegetable packaging from Dutch grown elephant grass (2020). https://www.freshplaza.com/article/9186949/cardboard-fruit-and-vegetable-packaging-from-dutch-grown-elephant-grass/

Chapman, M (2019). Calls to improve New Zealand's vegetable security through better freshwater management. HortNZ and Freshplaza. https://www.freshplaza.com/article/9163892/calls-to-improve-new-zealand-s-vegetable-security-through-better-freshwater-management/

Delphine de Baudreuil (2020). Consumers want to reduce their plastic consumption. https://www.freshplaza.com/article/9188927/consumers-want-to-reduce-their-plastic-consumption/

Dilucia, F, Lacivita, V, Conte, A and Nobile, M. A. D (2020). Sustainable use of fruit and vegetable by-products to enhance food packaging performance. Foods, 9, 857, 1-19. www.mdpi.com/journal/foods

Doevendans, H. J. T, Grigg, N. P, Goodyer, J (2015). Exploring Lean deployment in New Zealand apple pack-houses. *Measuring Business Excellence*, 19(1), p. 46-60.

Doyle, A. Turning banana waste into food packaging. The chemical engineer. https://www.thechemicalengineer.com/news/turning-banana-waste-into-food-packaging/

Fernández, J (2019). For now, some cardboard and plastic formats will have to coexist. https://www.freshplaza.com/article/9166895/for-now-some-cardboard-and-plastic-formats-will-have-to-coexist/

IKEA commits to biodegradable mushroom packaging (2020). https://www.freshplaza.com/article/9187322/ikea-commits-to-biodegradable-mushroom-packaging/

Konstantoglou, A., Folinas, D., and Fotiadis, T (2020). Investigating food packaging elements from a

consumer's perspective. Foods, 9, 1097, 1-18. doi:10.3390/foods9081097 www.mdpi.com/journal/foods

McGregor, N (2020). In 2019, AVI helped in recycling 111 million bottles to produce its prime range of punnets. https://www.freshplaza.com/article/9183844/in-2019-avi-helped-in-recycling-111-million-bottles-to-produce-its-prime-range-of-punnets/

McGregor, N (2019). Plastic-free fresh produce? https://www.freshplaza.com/article/9169451/plastic-free-fresh-produce/?utm_campaign=highlights&utm_medium=email&utm_source=06-12-2019

Mestre, F. (2020). Gruppo Fabbri develops a new compostable film in collaboration with Mesfruits. SARL Mesfruits. https://www.freshplaza.com/article/9221537/gruppo-fabbri-develops-a-new-compostable-film-in-collaboration-with-mesfruits/

Nemat, B, Razzaghi, M, Bolton, K and Rousta, K (2020). The potential of food packaging attributes to influence consumers' decisions to sort waste. Sustainability, 12, 2234, 1-22. doi:10.3390/su12062234 www.mdpi.com/journal/sustainability

Nora S M S, Ashutosh S, Vijaya R (2017). Potential utilization of fruit and vegetable wastes for food through drying or extraction techniques. Novel Techniques in Nutrition and Food Science. 1(2), 15-26. doi:10.31031/NTNF.2017.01.000506

Ostaijen, P. V and Vliet, D. V (2020). New quality standard for cardboard fruit and vegetable boxes. FreshPlaza.com.

Reichert, C. L. et al. (2020). Bio-based packaging: materials, modifications, industrial applications and sustainability. Polymers, 12, 1558, 1-35. www.mdpi.com/journal/polymers

Scurria, A (2020). New packaging solution that degrades in 4 weeks. https://www.freshplaza.com/article/9188849/new-packaging-solution-that-degrades-in-4-weeks/

Stauffer, C (2019). Are edible peels the new plastic? https://www.freshplaza.com/article/9170670/are-edible-peels-the-new-plastics/

The packaging challenge - can consumers have it all or do they want too much? https://www.englandmarketing.co.uk/post/the-packaging-challenge

T & G Annual Report (2015). https://tandg.global/wp-content/uploads/2016/07/2015-Annual-Report.pdf

T & G Annual Report (2015). http://tandg.global/wp-content/uploads/2017/03/TG-Annual-Report-2016.pdf

Tenge-Rietberg, C. P (2019). Automated solutions to the labor shortage and increased labor costs. https://www.freshplaza.com/article/9161094/automated-solutions-to-the-labor-shortage-and-increased-labor-costs/

The NZ Herald (2018). More hands needed as bumper crop leaves Hawke's Bay industry 'flat out'. *The New Zealand Herald*, 26 Feb. https://www.nzherald.co.nz/the-country/news/article.cfm?c_id=16&objectid=12001633

Voorde, S.V. D (n. d.). In the future, fresh produce will have just as little plastic as 50 years ago. https://www.freshplaza.com/article/9168635/in-the-future-fresh-produce-will-have-just-as-little-plastic-as-50-years-ago/

Woolf, A. (2019). Ban all unnecessary plastic, not just polystyrene and PVC, advocates say.https://www.stuff.co.nz/environment/118043676/ban-all-unnecessary-plastic-not-just-polystyrene-and-pvc-advocates-say

XYZ Fruit Company (n. d.) http://www.wakes.co.nz/

Zwager Techniek (2020). 80 percent plastic reduction through packaging in a cardboard tray. https://www.freshplaza.com/article/9186944/80-plastic-reduction-through-packaging-in-a-cardboard-tray/