

Fruit and Vegetable Waste



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Abstract

One downside of globalization is the increasing size of food waste throughout the world which negatively impacts the environment. This report observes the researches in the past that study the causes of food waste, especially regarding fruits and vegetables waste. Based on the researches that have been reviewed, it turns out all stages in the food supply chain in both developed and developing countries are active contributors of food waste. In Australia, although suppliers and consumers are partly responsible for this issue, some studies address the crucial role of the duopoly situation and its inevitable contribution to the whole problem. From various studies, this report then analyses the ways to eliminate fruit and vegetable waste in each stage of food supply chains, including presenting both advantages and disadvantages of each solution. At the end, recommendation is provided and concentrates on the use of technology innovation and government's role to reduce and prevent fruit and vegetable waste.

Keyword: fruit and vegetable waste, food waste, retailers, suppliers, consumers, Australia

1. Introduction

In the ever-increasing process of globalisation, many companies are finding more opportunities to expand their businesses. One market that takes advantage of this is the industries in the food supply chain. As the food supply chain gets bigger and longer, the suppliers and retailers all around the world are presented with opportunities to work together to expand their business by offering more diverse selection of products (Depta, 2018). Fresh Mandarin oranges can be sold in a sub-Saharan Africa country, while Singapore durians are available at the nearest supermarket in Sydney. However, globalisation is also linked to one major problem in a food supply chain that people in the past would not have thought would arise, food waste and loss.

Unfortunately, it is a problem that many developed and developing countries are facing right now and it turns out to be one of the biggest environmental problems that brings unavoidable negative impacts to the environment. As much as one third of all food produced in the world is either lost or wasted in the food supply chain. That number equals approximately 1.3 billion tons of variety of food such as meat, grains, dairy products, fruits, and vegetables (Food and Agriculture Organisation of the United Nations, 2011). This wastage ends up wasting around US \$172 billion for one fourth of water supply which has been used to process uneaten food. In the United States, over US \$220 billion is spent in agriculture and distribution for nearly 70 million tons of food that go to waste. Besides water supply, around 19% of cropland, fertiliser, and landfill volume also go to waste due to this problem. Meanwhile in Australia, around AU \$20 billion are spent because of food waste (Food Waste Roundtable, 2017).

Another ugly impact food waste brings is the greenhouse emissions. When wasted food ends up in a landfill it decays and turns into a source of methane - a powerful greenhouse gas which is 21 times stronger than carbon dioxide. Carbon pollution as much as 37 million vehicles also released into the air due to growing and distributing the food that goes to waste. All these materials released into the air will surely heat up the atmosphere that makes climate change and global warming worse (Simon, 2018).

1.1 Food (Fruits & Vegetables) Waste and Loss around the World

In 2011, the Food and Agriculture Organisation of the United Nations (FAO) released a report that shows where and when the food produced is lost or wasted in various parts of the world. In terms of fruit and vegetables, every stage of the Food Supply Chain (FSC) in both developed and

developing regions contributes wastes and losses. Europe, North America, Oceania and Industrialised Asia are part of developed regions, while Sub-Saharan Africa, South and Southeast Asia, North Africa, West and Central Asia, and Latin America are developing regions (Gustavsson et al., 2011).

Based on the report, losses in agriculture level are dominant in all three developing regions which are caused by pre and post-harvest and fruit and vegetables grading required by retailers. Consumers who are part of the last stage of FSC also contribute to around 15-30% food waste from all food they purchased but ended up discarded.

Meanwhile, in developing nations, food losses are dominant throughout agriculture until the processing level. These losses occur because of warm and humid climate that can deteriorate the produce. Another factor such as seasonality also causes excessively abundant supply of produce that are unsold.

2. Roots of the Problem

2.1 Suppliers

To delve deeper into the roots of the problem, it is fitting to start by identifying the causes of the problem that occurs from the top of the supply chain. The first root of the problem happens at the top of the supply chain – the suppliers. Many times, the production quantity that the growers produce goes beyond the required demand. This mostly occurs in the industrialised nations since most farmers in these regions have the required capacity to grow more produce. To anticipate the unpredictable bad weather, climate as well as pest attacks, the farmers come up with a detailed strategic plan to produce bigger quantities. It is also done as a precautionary measure to ensure product quantities meet with the retailer's demand.

Besides the excessive produce, fruits and vegetables are lost to the pre, during, and post-harvest process. During pre-harvest, food is lost because of certain agriculture practices and unpredictable environmental conditions. While during harvest period, unwanted loss can occur when fruit and vegetables manufacturers miss the right time to harvest their produce. This is a lesson that farmers must learn many times since the produce from one crop to another have varying harvest time. When the crop is harvested and ready to process, farmers also lose food through several post-harvest stages. These stages mostly deal with keeping the produce under correct temperature, maintained humidity as well as controlled atmosphere. When the harvested produce goes through improper handling, the texture, taste, appearance, and vitamins in fruits and vegetables can be affected negatively and will not pass the grading process, hence will end up wasted (Nunes, 2008).

2.2 Retailers

When the produce is ready to be distributed, it will be graded according to retailer's standards. However, these strict standards mainly focus on cosmetic appearance instead of the quality the produce has. For instance, if the grapes are too small or the apples' colors are too red, they will be rejected, even though the taste and quality they produce are still good. Many fruits and vegetables are also wasted in this stage because of the unreasonable grading standards retailers have.

In Australia, this issue has become prominent since most of the market (around 70% share) is controlled by only two major retailers, Coles and Woolworths (Devin & Richards, 2016). Retailers argue that the standards they create are the response to customer's demand. However,

since what Australia currently has is a duopoly situation, these major retailers have the power to control the products in the market and the customers will have to buy whatever is available on the shelves. If the retailers keep implementing this unwise decision in their plan, the food waste problem will never end. This policy also puts the fruit and vegetable suppliers in a hard position where they will lose access to the majority of the markets if they do not follow the standards.

To make the problem worse for the supplier, the major retailer duo will only take ownership of the produce that have passed the standard grading in their distribution centre. Meanwhile, the retailers will ‘ask’ the suppliers to contribute to their corporate social responsibility project by donating the rejected produce to organizations at their own cost, and if the suppliers refuse to join, they have to pay for the transportation cost (Richards & Hurst, 2016).

Besides the strict criteria they have, the giant retailers’ price control policy also ends up creating more food waste. Firstly, since under their legal contract they do not have a minimum purchase limit, they control the price by purchasing certain quantities of produce, so they do not have to lower the price of the produce. For instance, even when mangoes are in season and the growers produce can supply much more mangoes than previous season, the retailers can decide to buy the same quantity as they had before, so they can keep the price the same or just slightly lower.

Other marketing strategies such as “buy one, get one free” is also a factor that contributes to food waste since it indirectly encourages consumers to purchase more food that will end up discarded. Another cause of food waste in the retailer level is poor storage facilities. In developing countries this problem occurs because many retailers cannot afford a proper storage infrastructure. In developed countries this problem still exists and it results from inadequate storage humidity and temperature level as well as overstocking (Gustafson, 2019). When it comes to storage, perishable produce such as fruit and vegetables rely much on temperature management, therefore facilities like a refrigerated and atmosphere-controlled storage is important to keep the quality of produce (Dunn, 2011).

It can be concluded that the obstacles that retailers have will be harder to solve, since most of them are related to marketing strategies that were designed to generate as much profit as possible for the business.

2.3 Consumers

Food purchased by consumers at supermarkets also ends up as food waste in houses, restaurants, and business places. However, based on the data provided by Gustavsson (2011), the food waste

figure in developing countries is small compared to the quantity found in developed countries. People in developing countries cannot afford to waste and normally purchase just enough food for consumption on the day of purchase.

Meanwhile, in developed countries food waste level is high because of certain factors. In Australia alone, Pearson et al. (2013) come up with some worth noticing consumer behaviours that lead to more food waste on household level. Firstly, unawareness and lack of concern of householders regarding food waste. Secondly, people in Australia can afford to waste food because they generally have higher income compared to people in developing countries. Australians also have high quality standards that contribute to more food waste since they will discard food whose quality no longer looks 'perfect'. Householders also tend to purchase too much food since they do not plan how the food will be used. Moreover, people tend to cook too much food and it is mainly because they lack the information on how to measure the right portion of food to cook for the household. Based on these behaviours alone, we can conclude that food waste in household level is a luxury problem.

3. Solution to the Fruit and Vegetable Waste Management

After the extensive research done worldwide and in the context of Australia, it is identified that there are two major sources of fruit and vegetable waste that need attention. Those are the wastage from a household and the supermarket waste. Household sector contributes the most in fruit waste with 34% of wastage followed by other sectors such as manufacturing and retail (Foodbank, Australia). There are various solutions to control this wastage in terms of household and supermarket which are explained as below:

3.1 Household Waste

- Turning waste into a compost manure for the plants

One of the facts presented by International Compost Awareness Week Australia (ICNW) is that almost 50% of garbage from Australian households can be used in a better way than throwing it in a bin. Among all the rubbish that households release, 33% of them are food residues such as peelings, roots of the fruit and vegetable and 10% of them are vegetable (EC Sustainable, 2011). One of the alarming issues regarding organics is that when they are buried in the landfill, they can cause greenhouse emissions. This garbage can be turned into compost and used in agriculture which reduces the amount of wastage that goes into a bin and improves the soil quality. Also, use of compost manure into land reduces the need for water in crops for up to 30%. Hence, composting of fruit and vegetables can be one of the convenient solutions that not only control the wastage but also improve the soil quality and stops greenhouse emission.

- Increasing the shelf life of the product

There are some measures that can double or increase the life of fruits and vegetables and prevent them from spoiling. Many retailers and consumers discard the product if they are out of dates which still tastes and looks good. This happens when consumers buy products looking at the 'best before' date rather than 'use by' dates. In such cases, retailers and households can keep fruits away from the moist to keep them fresh and good to use for a longer period of time. Similarly, fruits and vegetables can be stored in the freeze for future use rather than throwing away.

- Animal feeding organic waste

For those who have pets at their home, they can feed organic fruits and vegetables to it. It not only controls the household wastage but also saves money from buying pet food. This solution

can also be applied to the farms. Farmers can feed the wasted fruit and vegetables to the livestock which consists of a large volume of food as 25% of fruit and vegetables are wasted in the farm before they reach the wholesaler (Food bank, Australia). This solution can benefit the household and the farmers in two ways.

3.2 Supermarket Waste

- Anticipating the need for the product

The wastage of the fruit and vegetables are determined by the volume of product ordered. Aldi, one of the largest supermarkets of Australia, uses sales data to anticipate the need for the product and orders according to that for next time. The demand for the product can vary as per season, geographical regions and group of people living around. ALDI's buying team identifies the demand for the product observing the buying behaviour and manages the volume of the order. This significantly reduces the wastage and prevents fruits and vegetables from spoiling due to over stacking.

- Introducing new product line of 'ugly looking' fruits and vegetable and selling them in a cheaper price

Supermarkets give priority to the cosmetic appearance of the product along with its taste and nutrition. Some products do not meet the standard of the retail store in terms of its shape and sizes which does not mean that they are bad in taste or have less nutrition in it. In such cases, they are thrown away and never displayed on the shelf. In this scenario, supermarkets can launch a different product line for such fruit and vegetables and sell them at a cheaper price. For instance, Coles has introduced 'I'M Perfect range' and Woolworths has similar product line 'The odd bunch' for the waste management purpose, which also leads them towards sustainability.

- Donating fruits and vegetables to the charities and food banks

The Food Bank in Australia is playing a vital role in managing food waste. They manage wastage worth AU \$20 billion in terms of reuse and recycle that would end up in landfill releasing harmful carbon dioxide gas every year. In the case where supermarkets end up ordering more fruits and vegetables than needed, they can donate it to a food bank and charities before they are spoiled. Food banks and charities help feed poor people in need and prevent wastage from occurring.

- Converting fruit and vegetables into a nutrient rich powders and supplement

Fruits and vegetables are extraordinarily rich sources of antioxidants, vitamins, and other nutrients. Rather than throwing mass amounts of fruit and vegetables, supermarkets can use it to make nutritious powder and supplements and make money out of it. Although, it can be costly solutions but is worth a try for supermarkets to manage and control their organic wastage. There are some companies who are already producing supplements and powders such as Honeyville, North Bay Trading, Wise foods and so on.

4. 11 practical ways you can reduce food waste and save money

Food waste is a worldwide epidemic, and its well past time the average person started fighting back.

More than one-third of all food produced globally is wasted or spoiled. Americans throw away up to 40% of the food they buy, and organic matter in landfills provides 20% of all methane emissions, a potent greenhouse gas that contributes considerably to climate change.

And yet in 2013, 49.1 million Americans lived without sufficient access to safe and nutritious food.

"There are three main factors: abundance, beauty and cost," says Jonathan Bloom, author, activist and creator of *Wasted Food*.

The overall food supply is far too abundant — about twice the necessary amount per person, he says — and we want that food to look perfect, with the "right" shapes sizes and colors.

"Food prices have certainly been rising for the last five years, but when you look at our household spending that goes toward food, no other nation spends less on its food supply. We simply don't value things we don't spend much on," Bloom says. We're very careful about getting deals and discounts at grocery stores and at big-box retailers like Costco, but those values don't mean anything when half of that food goes in the trash."

Becoming more connected to your food will help you avoid waste," Bloom says. Whether you grow your own food you're simply more conscious while you shop and cook, you're less likely to waste.

We talked to Bloom about the various ways the average person can "connect" more with their food and food supply. Check out the extremely easy and practical tips below.

1. Shop smart and realistically.

It sounds simple, but this is one of the most important things you can do. When you go food shopping, make sure you don't buy too much food. This may mean going to the grocery store more often and buying less food each time. If you live far away from the store or you hate shopping, you should be thoughtful and careful about what you purchase.

"Plan out your meals and make a detailed shopping list with the ingredients you'll need, and when you're in the store really stick to that list," Bloom says. He admits that's easier said than done but being disciplined is helpful.

You should also try to purchase locally sourced produce and other food from places like your local farmer's market.

2. When cooking, don't over-serve food.

The idea of massive portions is partly driven by restaurant culture, but it's started to trickle into our homes, Bloom says. Fight against that, and don't over-serve friends and family when you're cooking meals. Using small plates can help with that.

3. Save – and actually eat – leftovers.

In the same vein, make sure you save uneaten food when you either cook too much or you get too much food at a restaurant. Label your leftovers so you can keep track of how long they've been in your fridge or freezer and incorporate them into your daily or weekly routine.

4. Store food in the right places.

"Storing food in the right place is really underrated," Bloom says. "It's often surprising what kinds of fruits and vegetables want to be at room temperature versus in the refrigerator."

Food Republic has a [fantastic infographic](#) to help you pinpoint where your various foods should go, while [Heart.org](#) [breaks down](#) where to put your fruits and veggies to make them last longer.

5. Avoid clutter in your fridge, pantry and freezer.

Bloom says out of sight is out of mind when it comes to storing food, too. If we forget something's there until it's no longer good to consume, that's a huge waste. Keep things neat and visible, and use the "first in, first out" principle: After you buy new groceries, move the older products to the front so you consume them first.

Also remember that things don't last forever in your freezer. Freezing can be a great asset in extending food's lifespan, but it will eventually dry that food out.

6. Treat expiration and sell-by dates as guidelines.

When it comes to expiration and sell-by dates, Bloom recommends not paying much attention to them, as they identify food quality, not food safety.

"Trust your senses instead of the date on the package. Trust your sense of smell and sight and taste," he says.

7. Keep track of what you throw away.

Manage a waste log to keep an eye on what you're throwing out, so you can prevent doing the same in the future. Bloom even suggests adding dollar signs to each thing you throw away. "That tends to get our attention," he laughs.

The other side is to keep track of what's already in your fridge before you go shopping; that way, you won't double-up on products and fail to use them before they go bad. As obvious as that sounds, we all forget to do it from time to time.

8. Donate to food banks and farms.

Before you throw away excess food, look into food banks and charities where you can bring items you know you're not going to consume before they go bad, and give them to people in need. You can find local food banks through [Feeding America](#) and [WhyHunger](#).

You can also donate scraps and other types of food to farms and companies to feed livestock.

9. Try canning and pickling.

Canning is a great way to preserve food (especially fruit) and increase its shelf life for months.

10. Use helpful apps and gadgets.

There are various tools and apps that aim to help people avoid food waste. [PareUp](#) gives discounts to New Yorkers who buy excess food at local businesses and restaurants. [Handpick](#) helps you plan meals around ingredients you already have. [Ample Harvest](#) points gardeners to food pantries where they can donate excess food, and [Food Cowboy](#) makes it easy for wholesalers and truckers to find charities where they can donate unsold food.

There's even a small gadget called the Green Heart raising funds on Kickstarter, which contains a small packet of potassium crystals that absorb the gas fruit release when they ripen. The creators say fruit can last up to three days longer.

But don't assume these tools will do all the work -- it's all still up to us.

"No app is going to have as large an impact as us paying more attention to our food consumption habits, but I'm certainly all for any kind of help in getting people to change their ways," Bloom says.

11. Try composting, but don't focus on it.

Rather than discarding scraps, you can compost certain foods and turn it into nutrient-rich fertilizer.

But composting shouldn't be top-of-mind when first getting started on reducing food waste. The EPA has a food recovery hierarchy on how we use our food, stating first that we should reduce the waste we create, then donate food, try to feed livestock, use waste for industrial energy and *then* compost.

Bloom says composting is really valuable -- it's part of the whole equation -- but it shouldn't be anyone's priority.

"It's a nice safety net to keep food out of the landfill, because we're never going to completely eliminate food waste. We're always going to have some excess food, so having a process for that ... is a nice solution," he says.

5. Positive and Negative of the Solutions

The food is wasted across different phases of the food supply chain which has become a global issue. There is increasing concern about the social, economic and environment problem associated with such waste. Among the food supply chains, the retailers, consumers and food businesses are responsible for significant numbers of food waste. The reason behind the waste differs as it may not be appropriate for human consumption, doesn't meet the quality standards and often relates with human behaviour towards food.

However, there are several initiatives and policies stated by government and organizations on both global and local level that counteract the problem of food waste. Fruits and vegetables are among the highest wasted at household and retailers as compared to other foods as they are more perishable, require more care while handling and have short product lifetime (L. Mattson, 2018). The consumption of fruit and vegetables are very less, and waste is more compared to animal-based products. The fruit and vegetable waste have been a global issue which shows the problem in our food system around the world where half of the population is suffering from malnutrition, un-nourished and half of them are obesity due to overeating.

The qualities of fruit and vegetable according to size, texture, ripeness used by the retailers as well as the expectation of consumers to see fully stocked shelves are also reasons for food surplus which are simply disposed (Kendrick, 2020). Therefore, it clearly shows that household and wholesale or retail waste generates most of the food waste and needs serious attention.

5.1 Household Waste

The food waste in the houses arises while shopping, planning, preparing and eating which is done by consumers on a day to day basis. The factors such as consumer knowledge, attitudes towards food are influenced on the basis of demographic factors, their lifestyle, and management of food. The perception of food waste differs from person to person as it is not measurable and continues to affect the environment. However, many countries are taking initiatives to control household food waste by understanding consumer behavior and their information about that waste.

According to CRC (2019), the survey conducted in Australia shows that consumers lack the knowledge about food waste on a personal level. As, they lack knowledge on their personal contribution towards the food waste with a certain gap between actual quantities and volumes of

food wasted. Likewise, the consumers were provided with some motivating factors to encourage them to reduce waste and they are saving money, creating a safe environment by reduction of harmful gases, individual ethics and awareness programs (CRC, 2019). The individual can reduce waste by bringing changes to daily habits such as purchasing the food that gets digested which saves money. They need to be familiar with storage methods for different food products as well as prepare food with minimum waste. The method known as composting is also effective when it comes to using food waste which is easy and applicable as well for any household (Regina, 2018).

Sometimes consumers are misunderstanding the labels in the package such as "best before" and "use by " which might result in more losses as best before represent the time products have quality whereas use by represents the date it must be consumed. It is important for the individual to understand such labels even if they easily get the food. The solution to provide education or awareness to people may not be viable as some consumers have already perceived information about what shape, size it should look like and some retailers are unwilling to buy or sell those products.

Composting waste into the landfill is difficult for working people and students because it takes time and money. The government has state regulation regarding feeding to livestock as they require proper nutrition and diet in their food, so farmers need to consult with nutritionists before feeding it to them (Depta, 2018). The increased globalization has made it easier for people to get food from anywhere which possesses the positive and negative factors to both individual and environment. Therefore, the consumers must be able to understand their relationship with food and how it can be managed in the coming future.

5.2 Wholesale and Retail

The rise of food waste in wholesaler and retailers is creating financial losses and affecting the environment. The wholesale and retail in the food supply chain plays huge roles as they have the ability to influence both farmers and consumers. The food products when it reaches wholesale and retailers create huge losses which need to be identified so that a proper waste management approach is applied. The huge mass of waste is created by fruit and vegetables as they are rejected during delivery, sometimes purchase, short shelf-life, storage condition and even low due to low demand (Eriksson, 2015).

There is not one solution to such a problem of waste in retail and wholesale. The products which are disposed of due to the appearance can be sold using promotions such as "buy one get one free", the surplus food can be provided to the food charity. The management can provide training to the staff regarding the inventory check, stock food according to the date and handle logistic work. The continuous planning and system to meet the needs of the consumers in the market require huge cost in the Research and development. The wholesaler and retailers also ensure that the farmers produce fruit and vegetables including other food products according to the safety and quality standards to avoid waste. The challenges to communicate with farmers and consumers regarding food waste are minimized through awareness programs on a national or global level. Retailers are committed to reducing such gaps by encouraging consumers to take part in such initiatives, increasing their knowledge on issues of waste as well as addressing them towards the benefit of lifestyle change (EuroCommerce, 2017).

Some of the initiatives adopted by wholesale and retail in Australia are introducing new product standards for odd looking fruit and vegetables, forecasting and inventory management using improved software, day to day review about the product life. Major supermarkets such as Woolworth, Coles and Aldi have good relationships with food charities known as Second bite, Food bank and OZ Harvest (Lewis, 2017). The retailers in many parts of the world are not fully aware about advancement in technology to help in reducing waste as it can help in forecast, remove the gap between estimated sales as well as avoid food waste in the early stage of supply chain. The food wholesale and retail are introducing a framework to reduce, recycle and reuse food waste and adapt in the company business plan with strategy. Most of them have already applied food waste management policy and approach in day to day operation (Long, 2019).

Most of the waste in Australia is waste during the time of transit as the production is based on rural parts of Australia. This issue in Australia needs attention from the government and needs action plans to target those foods with short shelf life and including fruits and vegetables that need proper handling with storage systems. Businesses such as retail and wholesale have realized the importance of waste management in the operation to remove the gap between waste in the early stage of the supply chain and even waste in the household (Foodmag, 2020).

6. Role of Government, food industry and businesses in waste management

The problem of food waste is around the world which affects the economy, social and environment factors. The government, food industry and business are vital to tackle the food waste on a national as well global level. Government is setting policy that implements a long-term plan as well as initiating awareness campaigns to provide information to the food industry and businesses. For instance, Australia is targeting to reduce the waste by 2030 where the government is already investing a huge amount to help organizations involved in such food reduction and rescue programs. Australian government is challenging food industries to be more proactive to contribute to design and innovation that leads to reduction of food waste with low cost (Iemos, 2019).

Small businesses are making their way into the market by positively involving themselves in issues such as food waste which has an effect on climate and environment. Likewise, in Australia many start-ups are engaged in managing food waste that helps the community and help in awareness programs. The businesses based in Australia are using tactics to fight against food waste such as the start-up with an app named "Bring me home" based in Melbourne is using leftovers from restaurants and cafes to sell at discounted prices to the customers (Derrien, 2019). The hospitality industry is mostly suffered by huge losses due to food waste. This food industry must have certain planning in place and strategies to manage the waste such as donating surplus food to the charities, the discrepancy between supply and demand must be recognized and create planned menu that use ingredients with less waste and manage portion in the plate with leftovers packed to take home (Solo, 2020). The government can assess the policy regarding food waste management in the community with the help of organizations or businesses that incorporate these policies in their strategies and aware employees about its use.

Business or investors can generate methodologies that concentrate sustainability of the food system with design and innovation that deals with fundamental research in business models. The stakeholder's interest and goals must be collaborated in the model considering the future that helps to change society and bring digital revolution with change perception. The global leader's addressing such issues of food waste must reflect socially responsible habits, be transparent in their work, target every part of the supply chain, know the data and analytics and always involve in providing related solutions.

Lastly, people are prioritizing food and adapting trends which quantify globalization. For instance, people are currently purchasing food which are locally available rather than those travel several miles which is known as "localism", consumers who are purchasing more fruit and vegetable products than meat based products and turning into vegetarian known as "veganism" and even individual are mindful of their buying habit by purchasing minimal ingredient for preparing food items known as minimalism in food.

7. Recommendations

In the era of sustainability, innovation, and a unique approach to deal with waste management is preferred. The waste management solution not only should solve the present problem but also helps bring sustainable and long-term solutions that can be used in the future. Based on the design thinking approach, here are some list of recommendations for the management of fruit and vegetable waste in Australia:

- Conducting educational campaign on educating waste management

Educational programs can be one of the effective solutions that aids in raising awareness in public. People can be made aware on how to separate waste from the household or the retail and ways of recycling it. People are still not well known about waste collection centres and the way that waste can be managed. About half of the waste produced can either be recycled or re-used. Hence, education and knowledge play an important role in managing waste in an effective way.

- Raising awareness in terms of fruit and vegetable waste management throughout the supply chain

The solution to any problem starts from raising awareness about it. Government should take initiative in educating all the stakeholders regarding the current situation of waste, its management, and measures to prevent it beforehand. They should be aware of different types of waste disposing methods along with its consequences and the intensity of the problem that poor waste management is causing around the world. Similarly, training and equipment should be provided to the supermarket, farmers, wholesaler, and the individual on managing the waste on their level. When all the people throughout the supply chain are aware of the wastage scenario, they can make a wise step in preventing it throughout all the processes right from the farmers to the end users.

- Implementation of at source reduction program

A source reduction program refers to prevention of wastage before it occurs or at source. It includes managing the amount of fruits needed or volume of fruit produced, making reuse of them and increasing the life of the product for prolonged use. This is a measure to prevent wastage to zero because it focuses on the source. This not only helps eliminate the wastage but also cuts the flow of wastage throughout the various levels of the supply chain.

- Use of waste monitoring inventory system and databases

Supermarkets can use the waste monitoring system to analyse and track the waste and its pattern to understand the wastage behaviour and manage it in future. When the wastages are identified, they can be managed in various ways such as ordering less quantity of product, reusing them and donating it into the food banks.

- Meal planning and composting of organic waste

In one of the researches done by Deakin University, it is found that one serving size of vegetables is equivalent to ½ cup of cooked vegetables, 1 cup of salad and 1 potato. Similarly, one serving size of fruit is 1 apple, 2 small fruits such as oranges, 1 cup of chopped fruit, ½ cup of fruit juice and 1 spoonful of dried fruits (Morgan, Emily). This serving may vary as per the mass of a person. Every household can make an efficient meal planning and make a purchase according to that to avoid the excessive purchase and wastage. In the case of excessive purchase those products can be turned into compost manure for the plant rather than just throwing away.

- Reuse of fruits and vegetables for new product development

The fruits and vegetables can be used as a raw material for new product development. Fruits can be used to make jam, juices, natural colour, deserts and lollies whereas vegetables can be used to extract the oil, stocks, make dips, chips and spreads. It is a very scientific and relevant way of managing waste in various supply chain processes.

- Enforcement of penalties to the households

Council or government can define the limit on household wastage and charge them in the case of households exceeding that limit. For this, the council can put separate bins for the organic and non-organic waste and put a restriction on the volume of organic wastage. Whenever this limit exceeds, every household should pay a certain amount to get rid of it. This penalty system can discourage households from making impulsive purchases of fruit and vegetables, facilitates in making proper purchase planning and manage their waste at home on an individual level.

8. Food waste facts in the World and Australia

The World:

- There is enough food produced in the world to feed everyone. ¹
- One third of all food produced is lost or wasted –around 1.3 billion tons of food –costing the global economy close to \$940 billion each year.
- One in nine people do not have enough food to eat, that's 793 million people who are undernourished.
- If one quarter of the food currently lost or wasted could be saved, it would be enough to feed 870 million hungry people.
- Almost half of all fruit and vegetables produced are wasted (that's 3.7 trillion apples).
- 8% of greenhouse gases heating the planet are caused by food waste.
- If food waste was a country, it would be the third biggest emitter of greenhouse gases after USA and China.
- Eliminating global food waste would save 4.4 million tons of CO² a year, the equivalent of taking one in four cars off the road.
- Throwing away one burger wastes the same amount of water as a 90-minute shower.

In Australia:

- The Government estimates food waste costs the Australian economy \$20 billion each year.
- Over 5 million tons of food ends up as landfill, enough to fill 9,000 Olympic sized swimming pools.
- One in five shopping bags end up in the bin = \$3,800 worth of groceries per household each year.
- 35% of the average household bin is food waste.
- Nearly four million people experience food insecurity each year, one quarter are children.
- Over 710,000 people rely on food relief each month, one quarter are children.
- Regional and remote communities are being hit the hardest and are a third more likely to experience food insecurity than those living in capital cities.

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