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# Origami Food Packaging Based on Sustainable Concepts

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# RIT

## Origami Food Packaging Based on Sustainable Concepts

by

Can Wang

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Industrial Design

School of Design

College of Art and Design

Rochester Institute of Technology

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# RIT

College of Art and Design

## Thesis Approval

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The School of Design | Industrial Design

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## Abstract

This paper discusses food packaging based on sustainable design concepts. Firstly, it gives a brief overview of packaging, including functions and commonly used materials. Besides, this paper introduces the present situation of the packaging industry, combined with the actual condition of the importance of sustainable packaging in contemporary society. The necessity of sustainable design is emphasized by packagings' large market, its negative impacts on the environment, strong connection with food waste, and people's, especially millennium's attitudes towards sustainable packaging. A large amount of waste has polluted the environment and consumed much energy, and food is high on the wastage list, which is a result of inadequate packaging. People are willing to improve the situation. Also, this paper discusses the connotation, 4R1D principles, drivers, and barriers to sustainable packaging. Sustainable design is not limited to the material, unique structures and additional functions can also be interpreted as a part of sustainable design. Last but not least, design for sustainable food packaging to protect the contents in it is given. The supply chain of food is analyzed, from farming to disposal, to explore design opportunities. Process of design, including ideation, mock-ups, prototypes, storyboard, and comparison of current products, and this design is shown. The study aims at introducing the current situation of the packaging and food industry and comes out a sustainable food packaging that could protect the content in it to protect the environment.

## Keywords

**Food packaging; Sustainable; Food waste; Origami**

## Introduction

The need for packaging and the development of packaging is a result of different production and consumption locations. Therefore, products need to be transported, which makes packaging being a connection between production and consumption. Different materials are used based on different contents, including metal, wood, glass, plastic, and paper. On the one hand, packaging has negative impacts on the environment, including resource and energy use, air and water pollution, and a large amount of solid waste. On the other hand, packaging satisfies human needs efficiently and devotes to reducing food waste.

Consumers, corporates, and governments want to and are trying to reduce packaging's impact on the environment. Governments have published laws and regulations about packaging. Besides, a trend of packaging design named sustainable packaging design arose, which aims to lighten the burden on the environment. Except for benefits to the environment, sustainable packaging also does good to corporates and consumers. However, sustainable packagings which are on the market now are mostly focusing on material usage, instead of the design.

After analyzing the food chain of food waste, a reusable food package to reduce food waste is shown at the end of this paper. The idea is based on origami, a Japanese folding paper technology. Minimalist design philosophy "less is more" is applied to the design, including the material, structure, and visual simplicity. Users have been interviewed to prove its feasibility and effectiveness. Since origami is foldable, it may be used in other design which is related to transportation, such as tents for homeless, in the future.

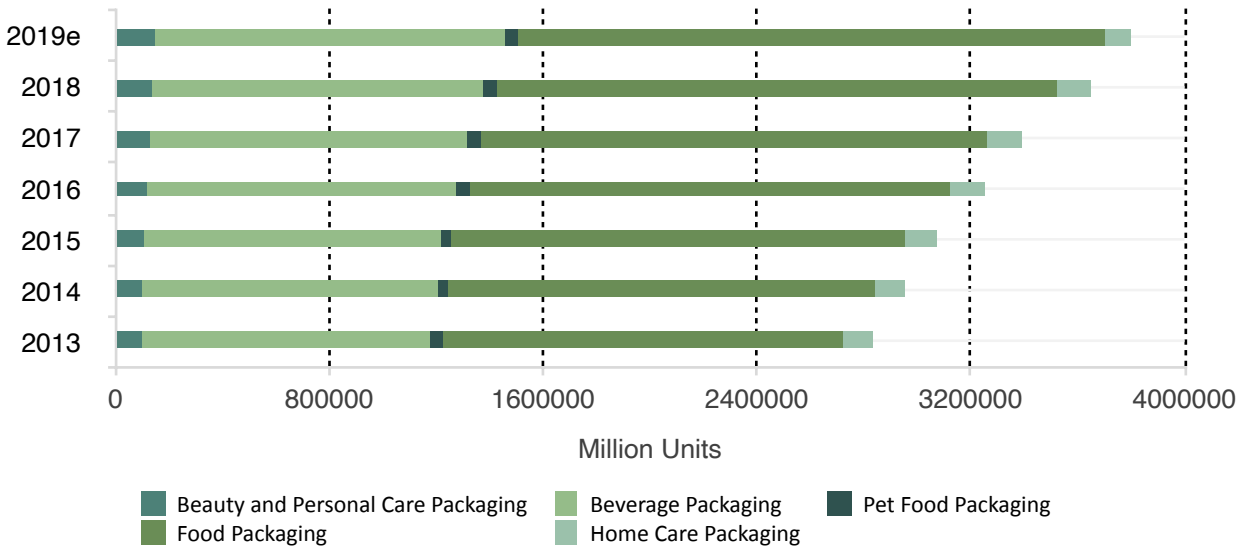
## Current situation

With the continuous progress of technology and the rapid development of the economy, people are enjoying better living standards nowadays. While consumer's demand is changing from physical benefit to getting the satisfaction of aesthetics, the natural environment has been severely damaged as a result of over-exploiting natural resources. Packaging and food waste are both significant sources of it. The market is brisk, and almost all products are sold in packages. Therefore, it is reasonable to redesign food packaging to protect the environment. Firstly, it will cause great harm and pollution to the environment if food is waste and food packagings are damaged. Besides, the prohibitive cost of disposal is a burden on the social economy. Food and packaging generate a large amount of solid waste that needs to be disposed of. Therefore, it is necessary to design packaging that could protect the contents in it to reduce food waste.

### 1. Food packagings' huge market

From wrappers of chocolate bars to film covered a birthday card, the packaging is all around us. The whole packaging industry generates about 900 billion dollars in 2019 and keeps growing at a rate of 3.1% annually from 2019 to 2022. The American packaging industry was valued at 183.9 billion in 2019 and is forecasted to grow at a rate of 4.1% until 2015. As for food packaging, it made up about 60% of the whole industry in 2019. Chart 1.1 shows the Global Retail Packaging Volumes by Industry. The packaging is indeed an enormous global industry. Then here comes the question — what is the packaging?

**Chart 1.1 Global Retail Packaging Volumes by Industry 2011-2019e(established)**




Source: Euromonitor International, 2019

### 2. Definition of packaging

The packaging is an integral part of products. It plays a vital role in transportation, storage, display, and sales of products. Definitions of packaging are different in different countries. According to *GB/T*

*4122.1-1996*, the Chinese government defines packaging as the general term that refers to containers, materials, and aids which are made based on specific technical methods, convenient for storage and transportation, protect products and promote sales or processes which are for achieving the above goal. In JIS101, the Japanese government defines packaging as the technology and state, which is implemented to maintain the value and ensure the state of goods.

In general, food packaging is interpreted as a tool that is for protecting and selling the food.

### 3. General materials

Different packaging materials are used based on the characteristics of different foods to improve the quality and sales of products effectively. Four types of materials are currently commonly used for food on the market (Photo 1.1-1.4) :

- Plastic. Plastic is not only the most common packaging material but also the material that is most difficult to dispose of in natural circumstances, causing severe white pollution. Plastic is widely used for lightweight, excellent corrosion resistance, and easily moldable.
- Glass. Glass is a popular packaging since it is inert, sterilizable, the barrier to moisture and gas, pressure-resistant to a degree, reusable, and transparent, which makes the contents visible. However, glass is fragile, and broken glass is dangerous to users.
- Paper and board. Paper and board are widely used because of lightweight, low cost, easy processing, diverse structures, and renewing, which could save resources by reducing raw material consumption. Packaging produced using paper and board includes cartons, labels, leaflets, tubes, corrugated cases, rigid boxes, and pulp packs.
- Metal. Compared with other packaging materials, metals perform good in protecting the products, since it is durable, rigid, pressure-resistant, temperature-resistant, corrosion-resistant via coatings, and sterilizable. The disadvantages of metals are in weight and shape achievable.


Photo 1.1 Plastic packaging

Photo 1.2 Glass packaging

Photo 1.3 Paper packaging

Photo 1.4 Metal packaging

### 4. Basic functions

The functions of packaging have developed a lot and are closely related to its history. Until Medieval, packaging was simply a means of containment since people lived near the source of their food. In the 18th century, permanent stores were becoming well established in the towns. Most of the goods sold in ships

were wrapped in parcels or wooden boxes and displayed around the shop walls, except for expensive commodities. Consequently, shop assistants had to unwrap everything, weigh or measure it, and re-warp it for their customers. In the 19th century, people gravitated away from living near their sources of food to the rapidly expanding towns, and therefore the role of packaging expanded to protecting products. Because of the increase in labor costs, self-service stores called supermarkets emerged towards the end of the 19th century. These stores need to remove any roles for the shop assistants to save their costs; Thus, packagings had to carry much more information on the labels to help the products to sell themselves and compensate for the lack of knowledge.

In summary, the packaging provides three functions. Firstly, the most basic and essential role of packaging is containment and protection, which ensures the value and quality of the products. Based on the varying characteristics of the packagings, the protective function of packaging comprises damp-proof, corrosion-proof, shock-proof, and breakage-proof. Secondly, it should preserve the products. The packaging should protect the foods from germs, heat, moisture loss, or moisture pick up to preserve the contents. Thirdly, packaging should communicate with consumers to increase sales. Packaging could offer product information through words on illustrations on it. Excellent packagings even make it stand out among similar products and attracts the attention of consumers, increasing the possibility of consumers to buy the products.

### 5. Negative impacts on the environment

Though packaging plays a crucial role in every humans' life, it indeed has done increasingly significant harm to the environment (Photo 1.5-1.8). It has been a more and more expensive problem for our society.

Photo 1.5 Soil Degradation

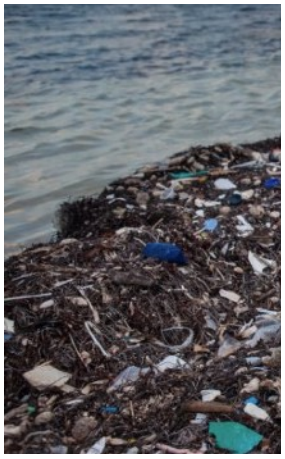


Photo 1.6 Water Pollution

Photo 1.7 Resource Reduction

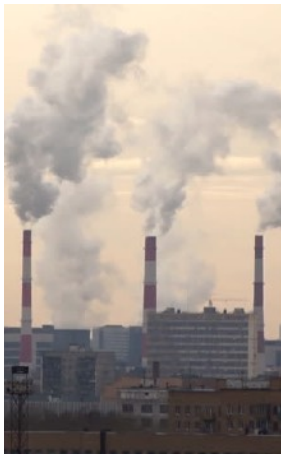


Photo 1.8 Chemical Pollution

Firstly, packaging manufacture requires a significant amount of material. All materials used for packaging goods are from natural resources, such as trees. The average household buys products packaged in 190kg of packaging, of which packaging is about 9% in America. Table 1.1 indicates the availability of raw material.

Packaging, which is about 80 million tons in 2017, consists of 29.9% of the total municipal solid waste (MSW).

| Table 1.1 Availability of raw material | | | | |
|---|---|---|---|---|
| Packaging material | Raw material | Fossil resource | Renewable resource | Overall resource |
| Paper/Board | Wood, natural fibers, auxiliary chemicals | Nil | All | Very abundant |
| Metals (eg:iron) | Iron ore, scrap iron | All | Nil | Limited |
| Glass | Sand, soda | About half | About half | Severely limited |
| Plastic | Crude oil, biomass, auxiliary material | some, but abundant | Some | Very small factor, no limitation |
| Source: The Future of Sustainable Packaging to 2020 | | | | |

Secondly, transportation, manufacture, and distribution of packaging require energy. Energy is used to convert raw materials into packaging materials, and then into packages. Generally, transportation is needed since different stages happen in different locations. The packaging process of household buys goods consumes 7 GJ energy annually.

Thirdly, packaging manufacture causes water pollution. The basic water-pollution activities include paper production, cooling water discharge from electricity generation, and manufacture of miscellaneous materials, for example, adhesives and coatings. Other polluting sources can be landfill leachate and historical packaging.

Fourthly, the packaging is the primary source of air pollution. Direct-related emissions are from decomposition and manufacture. For example, $CO_2$ is released from wood decomposition and glass manufacture. Emissions can also arise from indirect-related sources like waste-incineration activities and transportation. Litter from packaging is also a widespread concern, although it is not a significant part of total waste. It can harm humans' health and the marine environment. In Ireland, packaging litter constitutes about 12% of all litter in 2006, which is just behind the cigarette and food-related litter.

Fifthly, packaging-related solid waste is a problem. It mostly arises at the extraction and processing of raw materials, and unrecyclable part of packagings. Materials, like slag, for producing the electricity also results in solid wastes.

### 6. Packaging and food waste

Beyond that, packaging plays a vital role in reducing food waste in the supply chain. A considerable amount of food waste is produced every year. For example, over 33 million tons of food reached landfills in the United States. Besides, wasting food costs roughly 100 billion dollars annually to dispose of them. It also has negative environmental impacts.

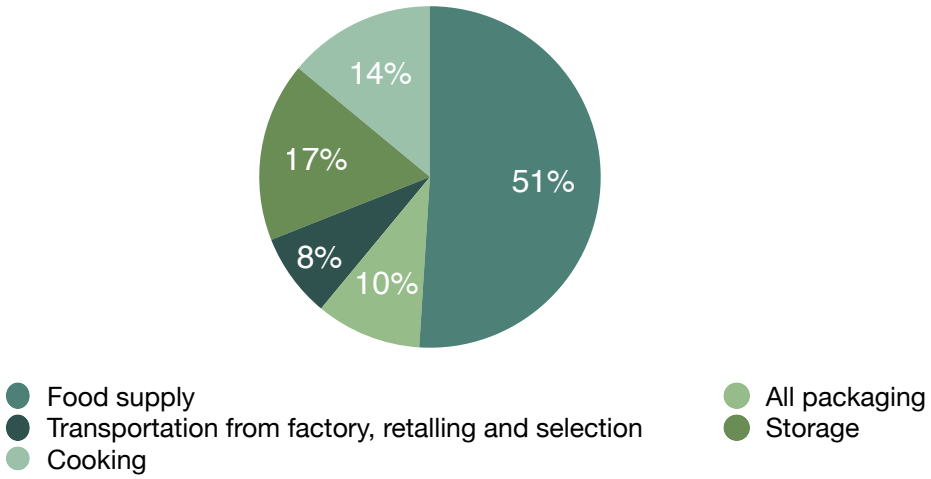
The important thing is that most of the food loss and waste occurs in transportation and handling. The fruit has been lost 20-25% in circulation, while 25-30% of vegetables in China. In other words, packaging's primary task is minimizing food waste, since it relates to food's life cycle. Some examples of packaging design to reduce food waste are shown in Table 1.2. For instance, packaging approximately accounts for 10% of the total energy inputs for weekly consumption of food, which means the packaging needs to ensure the rest 90% energy is not wasted. Chart 1.2 shows the energy for one person's weekly consumption of food.

**Table 1.2 Examples of packaging design to reduce food waste**

| Design feature | Description | Potential impact on food waste |
|---|---|---|
| Reclosable packs | Examples include zip-lock bags, reusable cereal bags. | Keep food fresh for longer |
| Smaller packs | Examples include half loaves of bread and single serves of yogurt. | Allow smaller households to only buy what they need |
| Subdivided packs | Packs decided into portions, like sliced meat in separate compartments. | Allow consumers to use what they need and keep the remainder sealed in the packaging. |
| Detailed storage advice on the label | Examples include where to store food, such as whether or not it should be stored in the fridge. | Improve food storage practices and extend shelf life in the home. |

Source: The Future of Sustainable Packaging to 2020

**Chart 1.2 Energy for one person's weekly consumption of food, MJ/person/week**




Source: INCPEN and Verghese et al.69,29

Therefore, the packaging is of great importance in our life, and it indeed deserves good design to realize its value.

## Sustainable packaging

Due to the increase of public awareness of the adverse effects that packaging has on the environment, an uptrend that recently has come under significant study is that packaging should also consider the

environment. In other words, a good package design not only needs to perform traditional functions now. Some critics hold the belief that sustainability will be one of the most popular trends in packaging design.

### 1. Definition of sustainable packaging

Sustainable packaging has been defined by several organizations, including SPC in the United States and SPA in Australia. The definition of sustainable packaging should illustrate both organizations concerned about it, including consumers, corporates and governments, and the role of packaging. In conclusion, sustainable packaging:

- Is designed based firmly on the product to achieve the maximum efficiency in environmental performance;
- Is made from environmental-friendly materials;
- Is designed to be safe in its lifecycle;
- Meet criteria for performance and cost;
- Meet consumers' expectations.

### 2. Market research

Most of the food packagings in the market now made up of plastic or paper. It seems to fall short in the design, though the paper packagings are designed based on sustainability. Photo 1.91-1.95 show some examples of current environmental-friendly food packagings.

Photo 1.91 Food Box

Photo 1.92 Reusable Bag

Photo 1.93 Food Box

Photo 1.94 Multi-function Packaging

Photo 1.95 Food Box

### 3. Consumer's attitudes

Sustainability is being more and more important in consumers', corporates', and governments' relating decisions.

First of all, consumers are concerned about the effects of packaging on the environment, and they expect to change it. In the United Kingdom, a study in 2008 found that 51% of British consumers express their concern about the amount of packaging, and 82% think the packaging is a major environmental problem. A 2017 published study has similar results. More than half of American consumers consider packaging waste as one of the top five of all ecological concerns. Besides, in the same study, more than 30% of respondents prefer

sustainably packaged products, and about 25% of respondents are willing to pay 21%-30% more for a sustainable packaged product. As for millennial consumers, the numbers are twice as big as what is listed above. At the same time, it is necessary to know what consumers are willing to trade for sustainable packaging and what they are not to guarantee that they want to trade for the new sustainable packaging. Table 2.1 indicates what consumers willing and not willing to trade for sustainability. Essential functions, such as production, preserve, and promotion selling, are needed in the new design.

**Table 2.1 US consumer attitude towards sustainable packaging**

| Features that consumers are willing to trade for sustainable packaging | | Features that consumers are not willing to trade for sustainable packaging | |
|---|---|---|---|
| Features | Percent of consumers | Features | Percent of consumers |
| Easy stacking/storing | 58 | Packaging designed to keep products clean and untouched | 26 |
| Packaging that can be used for cooking or re-sealing | 55 | Packaging designed to keep products in good condition | 31 |
| Packaging designed for easy transport | 53 | Packaging that preserves products to make them last longer | 31 |
| | | Packagings with information relative to ingredients, cooking instructions, shelf life, etc. | 33 |

Source: QSR Magazine

What is more, the packaging industry began to seek competitive advantage by addressing ecological concerns to respond to this consumer demand. However, actions taken by companies, such as the use of biopolymeric material and renewable energy, are generally not visible to consumers. Walmart has a principle named seven Rs of packaging: remove, reduce, reuse, recycle, renew, revenue, and read, which could contribute to more efficient packaging designs, less transportation cost, and more disposal options. Some other common actions include providing reusable containers for consumers, encouraging consumers to use canvas bags for packaging food. Table 2.2 shows the general company's efforts to address sustainability. Most companies address sustainability to some degree, and packaging is the most common way. Therefore, sustainable packaging design is needed by the industry and has a bright prospect.

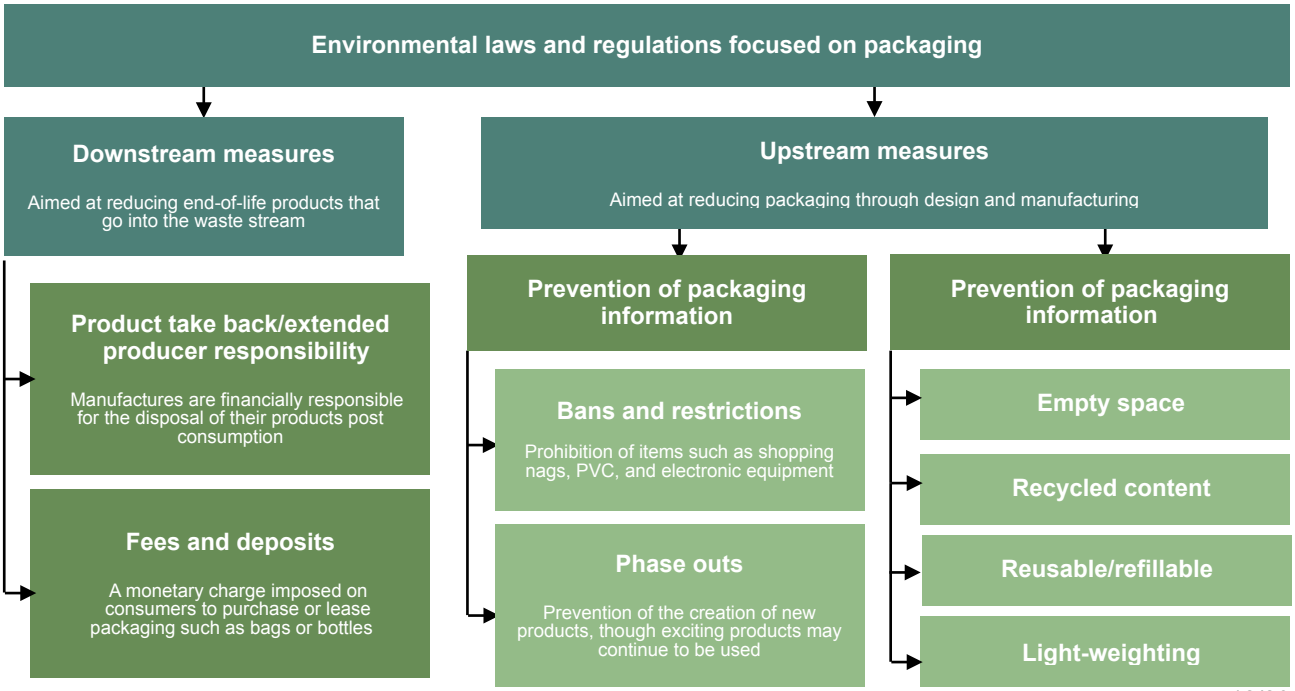
**Table 2.2 General company efforts to address sustainability**

| Effort | Companies responding (%) |
|---|---|
| Reduction of packaging waste | 76 |
| Improvement in energy consumption | 68 |
| Reduction in the consumption of natural resources | 62 |
| Changes in the return process for recycling | 47 |
| Shrinking the supply chain | 3 |

| Table 2.2 General company efforts to address sustainability | |
|---|---|
| Effort | Companies responding (%) |
| Reorganization/reduction of overheads | 2 |
| Nothing | 2 |
| Source: AMR Research | |

Last but not least, governments in many countries have proposed regulations and laws for sustainable packaging because of pollution and waste caused by packaging. Figure 2.1 shows environmental laws and regulations focused on the packaging. On the one hand, developed countries which have relatively mature packaging industry, such as the United States and German, have strict requirements with packaging and packaging waste. In the 1960s, the United States has begun to target packaging waste harms. Several states legislated packaging production and disposing of waste properly. Resource reclamation regulation was established in 1970. In 1993, the California government established the ransom system for beverage containers and stipulated that hard plastic packagings recycling should reduce 10% raw material usage, or contain 25% recyclable material. On the other hand, there is a particular gap in the development of sustainable packaging in relatively developing countries like China, compared with developed countries. However, these countries have published regulations and laws to regulate packaging production in recent years. For example, the Chinese government issued a notice in 2007, which states that the production, sale, and use of plastic shopping bags with a thickness which is less than 0.025mm will be banned nationwide since June 1st, 2008. Free plastic shopping bags shall not be provided in all supermarkets, shopping malls, trade markets, and other commodity retail places."

**Figure 2.1 Environmental laws and regulations focused on the packaging**



### 4. Advantages of sustainable packaging

Besides, there are definite advantages to promote sustainable packaging. For the environment, it could reduce the use of scarce resources, materials, and energy, and eliminate toxic and unsafe substances. For the business, cooperates could save costs, set up a competitive advantage, and precipitate relationships between consumers and suppliers to be closer. For society, it could minimize packaging waste issues and enhance community well-being.

### 5. Drivers and barriers for sustainable packaging

According to a survey taken in 2007, the rank of drivers for sustainable packaging is noted below (Table 2.3):

**Table 2.3 Ratings of respondents regarding drivers for sustainable packaging (%)**

| Drivers | Not at all relevant | Relevant but not important | Of some importance | Very important | Principal barrier | Rating |
|---|---|---|---|---|---|---|
| Customer perception | 0.0 | 0.0 | 19.0 | 81.0 | 0.0 | 3.81 |
| Regulation | 0.0 | 0.0 | 28.6 | 42.9 | 28.6 | 4.00 |
| Reduced costs and improved profit | 0.0 | 0.0 | 23.8 | 57.1 | 19.0 | 3.95 |
| Source reduction (energy and materials) | 0.0 | 0.0 | 38.1 | 33.3 | 28.6 | 3.90 |
| Corporate commitment | 4.8 | 14.3 | 19.0 | 52.4 | 9.5 | 3.48 |
| Others | 0.0 | 0.0 | 0.0 | 66.7 | 33.3 | 4.33 |

Source: Pira International Ltd

Similarly, the ranking of importance of barriers is shown below (Table 2.4):

**Table 2.4 Ratings of respondents regarding barriers for sustainable packaging (%)**

| Barriers | Not at all relevant | Relevant but not important | Of some importance | Very important | Principal barrier | Rating |
|---|---|---|---|---|---|---|
| Cost (materials, energy, etc.) | 4.8 | 4.8 | 9.5 | 52.4 | 28.6 | 3.95 |
| Materials technology | 4.8 | 0.0 | 9.5 | 52.4 | 33.3 | 4.10 |
| processing/converting technology | 4.8 | 4.8 | 28.6 | 57.1 | 4.8 | 3.52 |
| Customer needs and requirements (poorer quality than non-sustainable alternatives) | 5.0 | 5.0 | 30.0 | 50.0 | 10.0 | 3.55 |
| Corporate culture | 19.0 | 9.5 | 42.9 | 23.8 | 4.8 | 2.86 |
| Others | 20.0 | 0.0 | 20.0 | 20.0 | 40.0 | 3.6 |

Source: Pira International Ltd

It is not hard to see that the most challenging part of developing sustainable packaging is the cost, which may be a result of consumers' contradictory behaviors. Some consumers say they are willing to do something for the environment. As is discussed above, however, when it comes to giving up a benefit, they will not make the green decision.

There are mainly two reasons for the contradiction between consumers' behavior and attitudes:

- A lack of communication of the meaning of sustainability;
- A suspicion that sustainable packaging will have a higher price.

Therefore, consumers may be encouraged to use sustainable packaging more if the meaning of sustainability is delivered better, and costs are controlled in a reasonable price range.

### 6. 4R1D principles for sustainable packaging design

The most basic instructional design principle to follow when designers design sustainable packaging is referred to as 4R1D principles. R stands for Reduce, Reuse, Recycle and Recover. D is the abbreviation of Degradable.

- Reduce: Reducing the material packaging used under the precondition of assuring consistent compliance to package integrity and function. It does benefit saving resources and reducing the generation of waste in the future.
- Reuse: Packaging is used more than one time.
- Recycle: Packaging waste is recycled and processed to cycle use the resources.
- Recover: Energy and fuel can be derived from packaging waste processing. Using packaging for other purposes could also be considered as recovery.
- Degradable: Packaging can be decomposed in the natural circumstance by sunlight and micro-organisms, and finally return to nature in a non-toxic form.

## Methodology

This paper is based on field research, interview, and literature research to develop designs and test concepts.

- Field research: Features of various grocery packagings on the market are identified through field research, including materials, scale, and location.
- Literature research: This paper is developed through in-depth research on relevant literature about packaging, present situation of packaging, packaging design, grocery packaging design, and sustainable packaging design.
- Interview: Attitudes towards the current grocery packaging situation and sustainable packaging could be obtained through interviews, as well as using experiments of products designed in this paper.

## Process

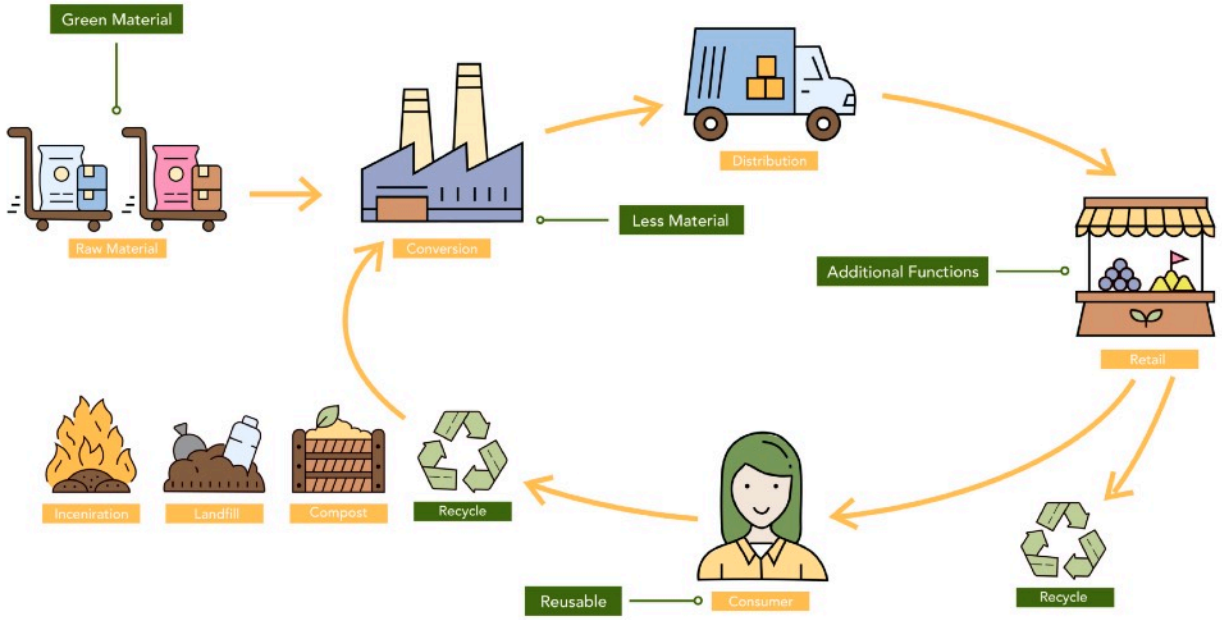
Sustainable food packaging will be designed to reduce food waste and its negative impact on the environment.

### 1. The material flow of food packaging

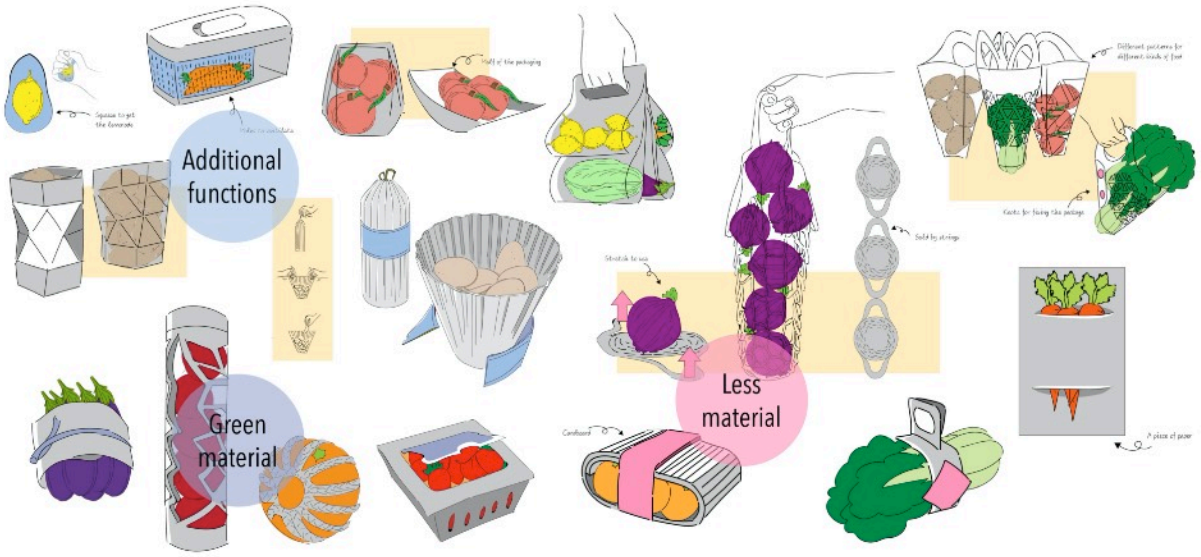
Sustainable packaging design must be considered in the context, which is the entire supply chain. The framework offers design opportunities for reducing the environmental impact of packaging waste and product spoilage.

The packaging supply chain involves many stakeholders ranging through manufacturing to purchasing. The material flow and design opportunities in the packaging supply chain are illustrated in Figure 4.1.

**Figure 4.1 Material flow in the packaging supply chain**




Then, sketches are drawn concerning these four aspects.



## 2. Origami

After drawing these sketches, a special way to fold paper was found, which is called origami. It not only has an elegant form but has a unique structure that could protect contents in it (Photo 4.1-4.2). Thus, I folded some papers to observe and test, which has both the aesthetic and structural features I want. Photo 4.3 shows origami with different patterns.

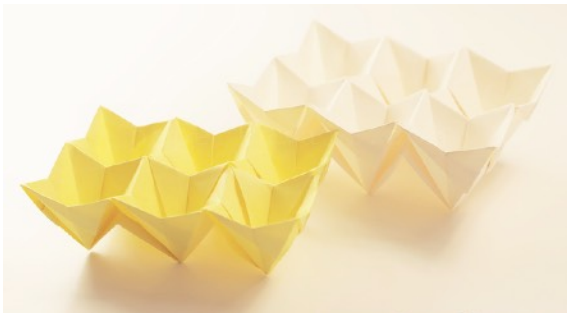


Photo 4.1 Origami Egg Packaging

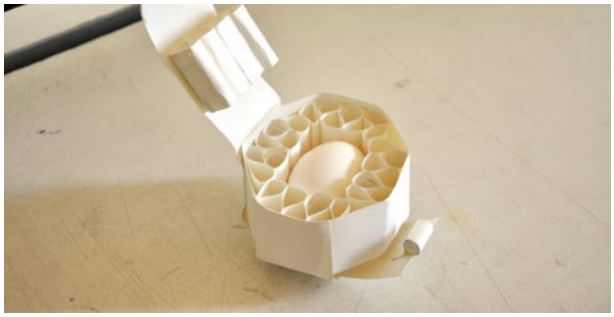


Photo 4.2 Origami Egg Packaging

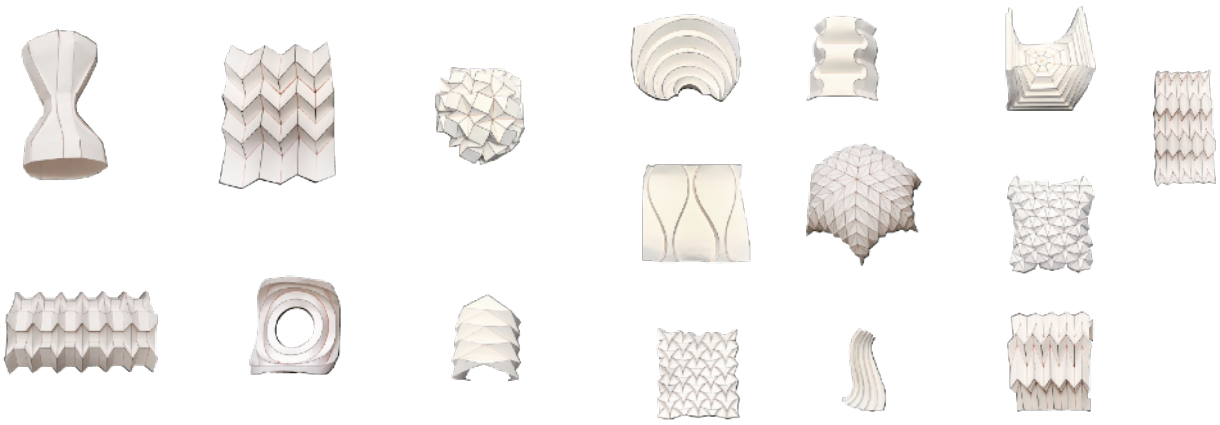


Photo 4.3 Origami

Then I made the first mock-up (Photo 4.4); it is a fabric stretchable food packaging. It could be put in the pocket when it is folded, and it can stretch while foods are put in it. Since it has the origami structure, it is fancy and also protects food in it.

Photo 4.4 First mockup

After testing a full-size mock-up, I found that the packaging uses much material, and has a low space utilization rate. Besides, there are also many out-of-sight covers that are hard to clean.

### 3. Further refinement and development

Therefore, I start to refine the shape of the design. At first, I moved the origami structure to the sides of the packaging. I made a round one and a cuboid one (Photo 6.11-6.14) and found that the space in cuboid packagings could be used more efficiently. Thus, I decided the shape of the packaging would be like a cuboid.

Photo 6.11 Round Mockup

Photo 6.12 Round Mockup

Photo 6.13 Cuboid Mockup

Photo 6.14 Cuboid Mockup

Then, I made the base having an origami structure to protect the contents better and simplified the structure of the sides. I used Bristol boards to make the origami structure instead of paper in these mock-ups (Photo 6.21-6.24).

Photo 6.21 Mockup

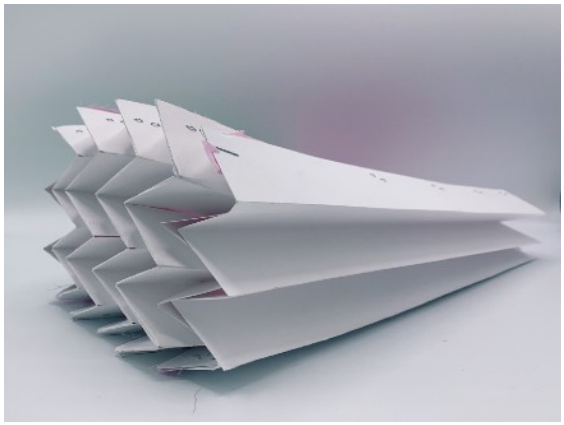


Photo 6.22 Mockup

Photo 6.23 Mockup

Photo 6.24 Mockup

Then, I began to explore the detailed shape of it (Photo 6.31-6.39) and posted a questionnaire to gather feedback from respondents on the look and feel of them.

Photo 6.31-6.32 show the structure of a packaging, which could be easily opened for users.

Photo 6.33-6.34 show a packaging that is divided into three parts for different contents. Users could also put small products in the middle section, making it easier for them to find.

Photo 6.35-6.36 show a packagings, which are like ordinary shopping bags but with the special structure. There is a zip on Mockup 3 to seal the bag.

Photo 6.37 show a packaging with yellow strips, which are made up of stiff material to keep the shape of the packaging and make it easier to open and close.

Photo 6.38 shows a packaging that has a stick at the top part, making it more convenient for users to carry and open it.

Photo 6.39 shows a packaging consisting of 2 parts. The outer part is made up of stiff material and transparent. It can also be used alone.

Based on the result of the questionnaire, the one users think best is Mockup 6. The top three reasons are that its shape is attractive; it is easy to open; its appearance is clean and simple.

Thus, I chose the Mock-up 6 to develop further.

Photo 6.31 Mockup 1

Photo 6.32 Mockup 1 Detail

Photo 6.33 Mockup 2

Photo 6.34 Mockup 2

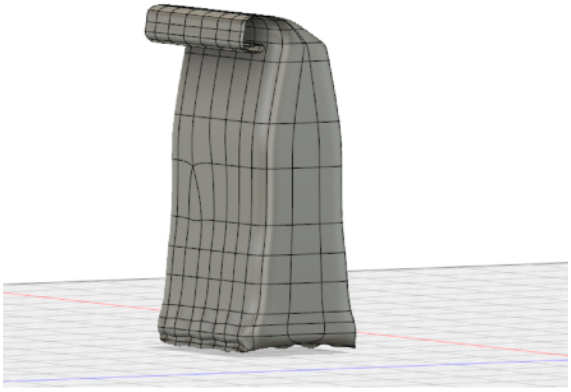


Photo 6.35 Mockup 3

Photo 6.36 Mockup 4

Photo 6.37 Mockup 5

Photo 6.38 Mockup 6

Photo 6.39 Mockup 7

## Final design

What is shown above is the final design.

The dimension of it is 12” x 8” x 15”.

It is a reusable food packaging which is made up of neoprene, which is a synthetic polymer resembling rubber, resistant to oil, heat, and weathering, and frequently used for making liquid products’ carriers. The neoprene packaging is insulated and keeps inside contents at the desired temperature.

The unique accordion design creates a protective cushion for what is in the packaging. Both of the sides and the bottom part of the packaging consists of the origami structure, which could be compressed down for easy storage.

A wood stick is at the top part of it for users to hold the packaging.

A pattern is on the packaging to decorate and show that it is a reusable bag. Users can also color it to create their unique bags.

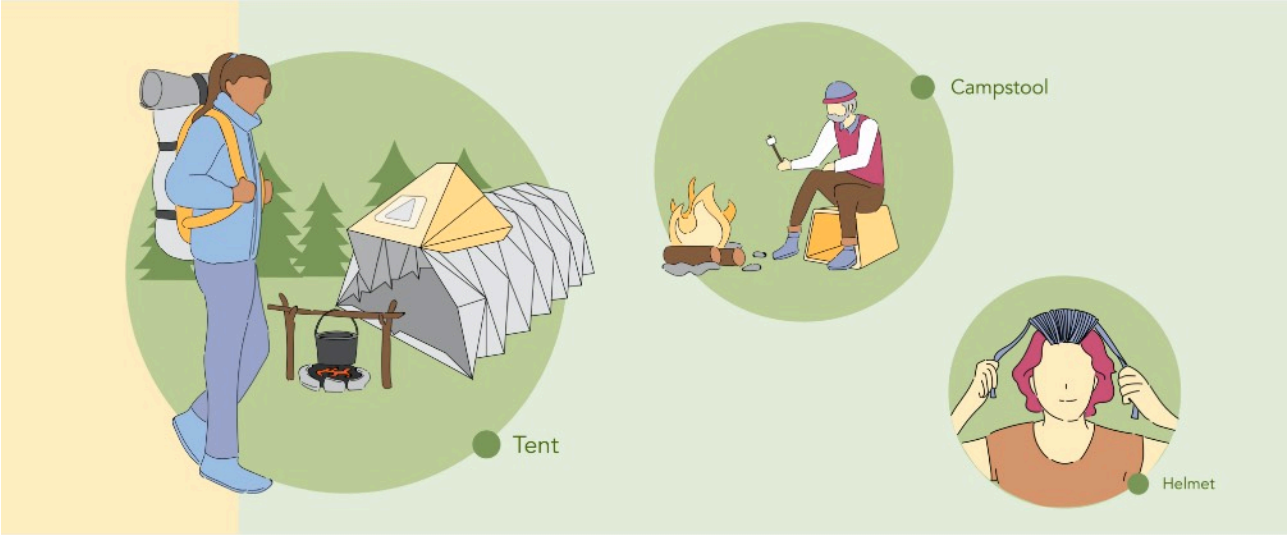
The packaging is hand washable and drip dry.


In conclusion, it is a reusable packaging, which is made up of one simple material and could protect the food in it to reduce the food waste to do good to the environment.

## Next steps

Since it is fordable and has a unique structure that is stable enough to protect the contents in it, it could be used in other scenarios like tents for the homeless, emergency houses, and helmet.

Therefore, I want to make it into a series in which all products share the same unique origami structure.


Campstool
Tent
Helmet

## Conclusion

With social progress and ideology promotion, environmental problems have attracted more and more attention. People find that severe consequences caused by the excessive use of natural resources are directly related to the future of humanity. As a considerable industry, packaging should cultivate and develop sustainable production and sustainable consumption, promote and enlarge the sustainable supply and green demand. Thus, it is of great importance to developing sustainable packaging. As a significant part of the whole packaging industry, food packaging deserves much more attention.

Through the research of sustainable packaging and design of sustainable food packaging, this paper summarizes the following conclusions:

The sustainable food packaging should instill the concept of simplicity into packaging design; it should use as fewer materials and structures as realizing the primary function of packaging. None-toxic sustainable materials should be used, and the packaging should be able to be recycled or reused. Minimal design elements should be used to convey maximum information.

Function expansion, which makes the packaging being used for multiple purposes but not increases the cost of packaging, could also effectively prolong the lifecycle of packaging, which is good for protecting the environment and saving energy.

Nowadays, more and more designers devote themselves to sustainable packaging, more and more consumers choose green consumption, and governments attach importance to protecting the environment while developing economics and take actions accordingly. Therefore, it is not hard to conclude that sustainable packaging is an inevitable trend now and will be widely used in the future.

## Appendix

### Interview Statement

These are some food packagings which are designed to replace the current plastic packagings in stores. Could you please share your feelings with me while you are using It? May I ask you some questions about your experience?

**Question:**

1. Is there a design that you prefer? Why?
2. Which one do you think can protect the contents in it better? Why?
3. Which one do you think has the most interesting pattern? Why?
4. Compared with the current plastic bags in the stores, which one do you think will protect the contents in it better? Why?
5. Compared with the current plastic bags in the stores, which one do you think can protect the environment better? Why?
6. Is there anything else you want to share with me?
7. There are some questions based on users' feedback while using them.

### Questionnaire

1. What is your first reaction to the product?

Very positive Somewhat positive Neutral Somewhat negative Very negative

2. How would you rate the appearance of the product?

Very high quality High quality Neither high nor low quality Low quality Very low quality

3. How innovative is the product?

Extremely innovative Very innovative Somewhat innovative Not so innovative Not at all innovative

4. When you think about the product, do you think of it as something you need or don't need?

Definitely need Probably need Neutral Probably don't need Definitely don't need

5. How would you rate the sustainability of the product?

Excellent Above average Average Below average Poor

6. If the product were available today, how likely would you be to buy the product?

Extremely likely Very likely Somewhat likely Not so likely Not at all likely

7. How likely are you to replace your current product with the product?

Extremely likely Very likely Somewhat likely Not so likely Not at all likely

8. In your own words, what are the things that you like most about this new product?

9. In your own words, what are the things that you would most like to improve in this new product?

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