UBC Social Ecological Economic Development Studies (SEEDS) Student Report

Investigating a Replacement for Disposable Chopsticks

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APSC 262

March 30, 2012

Sustainability Project – Investigating a Replacement for Disposable Chopsticks

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Abstract

Forests are overexploited for many purposes (food, medicine, shelter, and commercial use). Every year, 25 million trees a year are cut down in China or around 100 acres every 24 hours. Deforestation has led to environmental crises such as soil erosion, flooding, landslides, foot shortages, carbon dioxide abundance, and the extinction of species.

One of the main contributors to this deforestation is the mass production of disposable wooden chopsticks. An astonishing 57 billion pairs of these chopsticks are produced annually in China alone, the equivalent of about 3.8 million trees. People are using these chopsticks because they are the least expensive option, and they are not recycling them because it costs more to do so than it does to throw them away.

UBC has committed to their vision of sustainability. As a consequence of the new Student Union Building being developed at UBC, there has arisen an opportunity to install a vending machine filled with sustainable products to help UBC students strive towards this vision. Reusable chopsticks are such a product, and it is with this in mind that a triple-bottom line analysis was conducted to determine the expectation and viability of such an endeavor.

List of Abbreviations

SUB: Student Union Building

UBC: University of British Columbia

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1 Introduction

Chopsticks are eating utensils that are used traditionally by the Asian culture (China, Japan, Mongolia, Korea, Vietnam, etc). It is comprised of a pairs of equal length sticks that can vary in length, material, and thickness. Most of the common chopsticks are made with wood, bamboo, plastic, metal, and ivory. Along with the spread of Asian cuisines, the usage and demand of chopsticks became increased. Due to having Asian style restaurants on UBC campus, disposable chopsticks were adopted and extensively used. A solution is needed to replace and reduce the disposable chopsticks because of negative effects analyzed in the report.

In this project report, the triple-bottom line assessments are conducted on the wooden disposable chopstick, reusable plastic chopstick, and reusable material chopstick. For each type of chopstick, an environmental, economic, and social analysis will be carried out. And a comparison will be done on the reusable plastic chopstick and the reusable material chopstick. A conclusion will be drawn on which of the two types of reusable chopsticks will be carried out in the new SUB's vending machine. The environmental analysis will report on the ecological footprint of the product and the effects to the environment. The economic analysis will describe the cost of the production and purchase. The social analysis will be focused on heath and employment issue on the product. For the conclusion, a final recommendation for the most suitable and sustainable chopstick will be introduced and carried out for the new SUB's vending machine.

2 Types of Chopsticks

2.1 Disposable Chopsticks

2.1.1 Environmental analysis

According to statistics from Chinas national forest bureau, 25 million trees go into manufacturing equivalently about 63 billion disposable pairs of chopsticks in China each year. About 45 percent of disposable chopsticks are made from trees such as cotton wood, birch, aspen and spruce, while the others are made from bamboo. Half of the disposable chopsticks are used within China, 77 percent is exported to Japan, 21 percent to South Korea and 2 percent to the United States. Disposable chopsticks are one reason for extensive deforestation.

Deforestation has many negative effects on the environment. According to a 2008 United Nations report, 10,800 square miles of Asian forests are disappearing each year; it plays an important role in climate change because deforestation increases the amount of carbon dioxide being released into the atmosphere. One of the negative effects is that, the increase in greenhouse effect is caused by deforestation because fewer trees are available to photosynthesize carbon dioxide into oxygen for the planet to breathe in. Moreover, deforestation causes the release of carbon dioxide from the soil because forests many of the major carbon sinks on the Earth. Lastly, the most dramatic impact is the loss of habitat for millions of species. 70% of Earth’s land animals and plants live in forests, and many cannot survive the deforestation that destroyed their homes (National Geography, 2012).

2.1.2 Economic analysis

As Asian cuisines spread over the seas, the amount of disposable chopsticks becomes more and more demanding. In order to keep up this demand, Greenpeace China says that 100 acres of trees are sacrificed every 24 hours. This size is equal to 100 American football fields, which is roughly about 16 million to 25 million trees a year.

The productions of the disposable chopsticks are massive, but the abandon of them is even more shocking. China alone trashes about 63 billion pairs of chopsticks every year. Even more, Japan goes through 24 billion pairs of per year, and incredibly discards 63 million pairs per day. The cost of a pair of chopstick is different depending on the factors of the chopstick, such as material, quality and quantity. For a typical pair of wooden disposable chopstick, the costs between 0.11 and 0.13 U.S. dollars. Equivalently, this suggests that at least 87 billion pairs of chopsticks are produced in these two countries and 10.44 billion U.S. dollars are put in to the disposable chopstick industry.

For the past decade, Asian cuisines has rooted and expanded throughout the province. UBC has adapted more and more Asian restaurants as it had never before. Thus, disposable chopsticks are the primary utensil used in these demanding restaurants.

Restaurant	July	August	September	October	Average
1	8000	12000	20000	24000	16000
2	3200	2500	7500	8400	5400

Table 1 Number of chopsticks used in for months

The table above was conducted by the group that completed the economic analysis in November 2011. It shows estimations on the amount of disposable chopsticks ordered for two of the Asian restaurants in UBC SUB (Student Union Building). Clearly from this table, the amount of disposable chopsticks were extensively used and trashed. With each pair costing at 0.12 U.S. dollars, the average cost of the disposable chopstick with the two restaurants combined is $30,816 per year.

2.1.3 Social analysis

Regular manufacturers produce disposable chopsticks by using raw materials and better wood quality, without special processing. However, there are workshops that want to reduce costs by using poor-quality wood, giving these chopsticks "whitening", and using sulfur fumigation for bleaching (Life Tip, 2012).

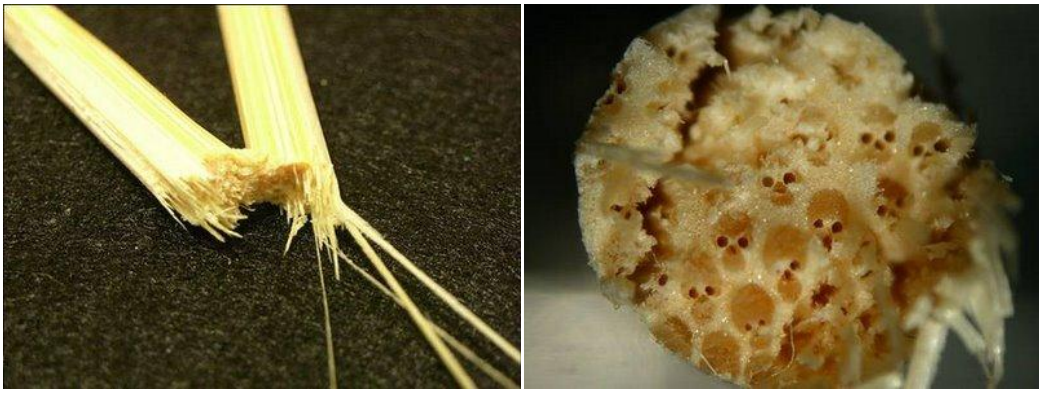

Figure 1 Monkey Face inside the Chopstick

The figure above shows an image of what is inside the chopstick. This chopstick has been bleached using sulfur and hydrogen peroxide, dried, and without any disinfection shipped to the restaurants. It may be unhealthy to use them because leftovers from the chemical may still stay inside these holes until it is being used.

Aside from the economic and health issues of these disposable chopsticks, decreasing the use of disposable chopsticks makes sense from the environmental point of view. From the social point of view, however, the impact will be just as significant. It is estimated that 300,000 people work in the industry, bringing them $200 million dollars of income. Discontinue the manufacture of the disposable chopsticks would have serious consequences in major unemployment.

2.2 Reusable Plastic Chopsticks

2.2.1 Environmental analysis

Melamine resin is the standard choice for reusable plastic chopstick production, as it is cheap to produce and highly durable. Melamine resin is made from the organic compounds Melamine and Formaldehyde. During the melamine production process, a considerable amount of waste water is produced. This waste water can be concentrated into a solid waste consisting of oxytriazines and polycondensates, which can then further be broken down into ammonia and carbon dioxide (Nitrogen+Syngas, 2008). Ammonia and carbon dioxide also make up the large majority of the gas byproducts. Conveniently, the production of urea (another compound) requires high amounts of ammonia and carbon dioxide, so melamine is often produced in the same facility as urea as to use those byproducts as reactants instead of dumping them out to the environment. In this way, melamine can be produced without significant environmental damage. The addition of formaldehyde to produce the final melamine resin product also involves insignificant environmental damage (Nitrogen+Syngas, 2008).

Melamine resin poses a threat to the environment if it gets broken back down into its base products of melamine and formaldehyde. Both products can be harmful to the environment and humans (International Agency for Research on Cancer, 1999). The temperatures at which this is possible and the possible repercussions are discussed further on.

2.2.2 Economic analysis

Historically, melamine has been sold for 10,000 yuan/ton, which is approximately $1,500 US after conversion (Reuters, 2009). According to search results obtained on the global trading site Alibaba.com, $1,500/ton appears to be the approximate value of melamine today, although prices were observed to be as low as $1,150/ton and as high as $1,850/ton due to various factors. Additionally, many suppliers would only reveal their prices in private business communications rather than leave their information only to the public. Nevertheless, $1,500/ton will be used as a market average. With the average weight of a melamine chopstick being around 14g (0.5oz), this means a single melamine chopstick costs approximately 2.3 cents to produce.

Figure 2 Reusable Plastic Chopsticks

Using Fedex's online shipping calculator to determine a rough estimate of the expected shipping costs, it was determined that a ton of chopsticks would cost approximately $20,000 to export from China. This raises the single chopstick price significantly to around 66 cents.

If not put through extreme physical wear or heated to high temperatures, a pair of melamine chopsticks will last a lifetime.

2.2.3 Social analysis

An informal survey was conducted by Apple Gong and Li Zhi of 46 UBC students. One question in this survey asked students for their preferences about different chopstick materials (viz. reusable wooden, reusable metallic, reusable plastic). 17 students (37%) reported that their preferred material of the three was reusable plastic, over double the 8 students (17%) that preferred reusable metallic. Additionally, there was a clear preference among the students surveyed to shift to reusable chopsticks in some form, showing that a positive social impact would indeed be made for UBC students.

Ethically speaking, it does not appear realistically possible to make reusable plastic chopsticks without going through sweatshop labour in some way. According to Alibaba.com search results, 98% of all melamine (all forms) comes directly through companies based in either mainland China or Pakistan with a very high risk of being sweatshop produced. Various sellers in the remaining 2% were explored (including every seller based in North America), but their information pages invariably stated that their melamine was indeed a product of China. Similar findings were found when alternate types of plastic were explored (such as polyethylene). Additionally, the actual

manufacturing of the chopsticks does not appear to be possible without going through sweatshops either; searches consistently yielded only a single chopstick manufacturer outside of Eastern Asia, with that manufacturer being solely a producer of wooden chopsticks for export.

Safety-wise, reusable plastic chopsticks can cause potential safety hazards if brought into contact with internal food temperatures of 70° Celsius, as that is the decomposition point for melamine resin (Bundesinstitut für Risikobewertung, 2011). At this temperature, melamine resin can release into the food its base melamine as well as formaldehyde, the latter chemical of which is a known carcinogen and the former of which is a presumed one. (U.S. Environmental Protection Agency, 1999; World Health Organization, 2008). Alternative plastics such as polyethylene have slightly higher temperature resistances (European Journal of Scientific Research, 2009), but come at the cost of durability and cost.

2.3 Reusable Metal Chopsticks

2.3.1 Environmental analysis

Figure 3 Reusable Metal Chopsticks

Stainless steels are steel alloys with a minimum of 10.5% chromium content by mass. Based on the applications of the stainless steel, different alloying elements are added to achieve certain properties and specified structures (British Stainless Steel Association, 2012).

High oxidation-resistance is the main characteristic of stainless steel products. This property is achieved by adding chromium into the steel and forming a passivation layer of chromium (III) oxide (Cr_2O_3). The layer can prevent water and air from penetrating and corrupting the metal (Ashby, MF).

Besides the excellent durability, stainless steel is 100% recyclable. “Generally, stainless steel is made up of 25% old scrap such as end of life products, 35% new scrap which is returning from production and 40% new raw materials added” (British Stainless Steel Association, 2012).

Due to this desirable durability and recycling property, stainless steel is great material for cookware, especially suitable for chopsticks. Once the stainless steel

chopsticks are made, they can be used for several decades and can be recycled for other uses. This practice significantly reduces the need for wood and avoids waste of materials.

2.3.2 Economic analysis

Stainless steel is the most common and widely used material for metal chopsticks. The cost of a normal pair of stainless steel chopsticks is in the range of US$ 0.2 – 1.5, depending on the quality and appearance of the chopsticks (alibaba, 2012). According to the previous research paper, in UBC SUB (student union building), chopsticks are mainly used in two Asian restaurants. The following table is the monthly chopsticks usage for two restaurants

Restaurant	July	August	September	October	Average
1	8000	12000	20000	24000	16000
2	3200	2500	7500	8400	5400

Table 1 Number of chopsticks used in for months

From this table, we can estimate that a total of 1500 pairs of chopsticks are needed for both restaurants in the SUB. Thus, the total cost of these chopsticks will be US$1200 (assume the price is US$ 0.8 per pair and shipping fees are not included).

We assume that the average life expectancy of stainless steel chopsticks is 5 years. If both restaurants use disposable wooden chopsticks, they will need 1284000 pairs in total for 5 years. The average price for disposal wooden chopsticks is US$ 0.006 and the total cost will be US$7704, which is more than 6 times of that of stainless steel chopsticks.

Besides, we can assume 90% depreciation rate for the stainless steel chopsticks. In this case, the SUB can get US$ 120 back for recycling stainless steel chopsticks.

2.3.3 Social analysis

Stainless steel products are very common in North America. Many hardware and cookware are made of stainless steel. It is inexpensive, long-lasting and safe comparing to other materials. The elements added in stainless steel which may have effects on health are iron, nickel and chromium (Health Canada, June 2006).

Iron is the main element in stainless steel. In human body, iron is used to synthesize many kinds of compounds, such as hemoglobin and cytochrome. These compounds are responsible for transporting oxygen, building enzymes and catalyzing some biochemical reactions in human body. In North America, people tend to be lack of iron and stainless steel cookware can only provide limited amount of iron. Therefore, the stainless steel products are very safe in terms of iron element intake.

Chromium is not essential for people and has no significant biological functions. According to FDA (U.S. Food and Drug Administration 2011), the daily intake value of chromium is about 120 micrograms (U.S. Food and Drug Administration. May 2011). Using stainless steel cookware will add very little amount to the diet, which is much smaller than 120 micrograms.

Similar to iron, nickel is very important for human bodies. It is mainly found in nucleic acids, particularly RNA, and is essential for synthesizing protein and activating some enzymes. The daily intake value of nickel for adult is around 150 micrograms. Stainless steel cookware can provide about 45 micrograms for one meal, which is less than 1/3 of the daily value (Health Canada, June 2006).

3 Survey

In this section, we will investigate consumers' preference for different types of chopsticks and materials used for reusable chopsticks. Then we can analyze the results and propose a plan for the reusable chopsticks sold in the new SUB.

Results

In this survey, 46 people have involved; 23 students are from applied science, 3 students are from commerce, 5 students are from science and other 10 people are UBC staff.

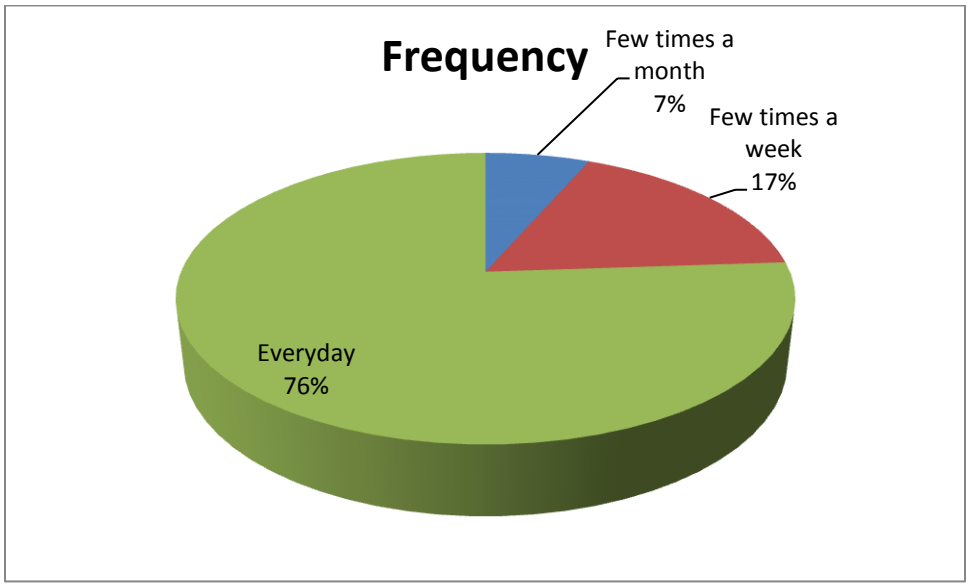

Figure 4 Frequency of chopsticks used

According to the results, 76% people use chopsticks everyday and 17% people use chopsticks few times a week. Only 7% people do not use chopsticks very often.

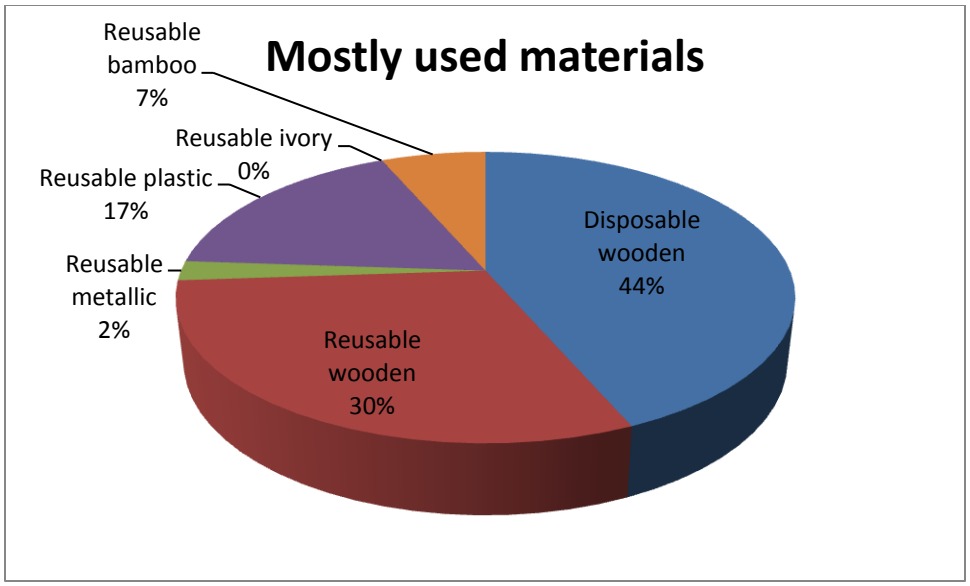

Figure 5 mostly used chopsticks

In terms of materials of chopsticks they use, more than 70% people use wooden chopsticks and 17% people use plastic chopsticks. Very few people use metal or bamboo chopsticks.

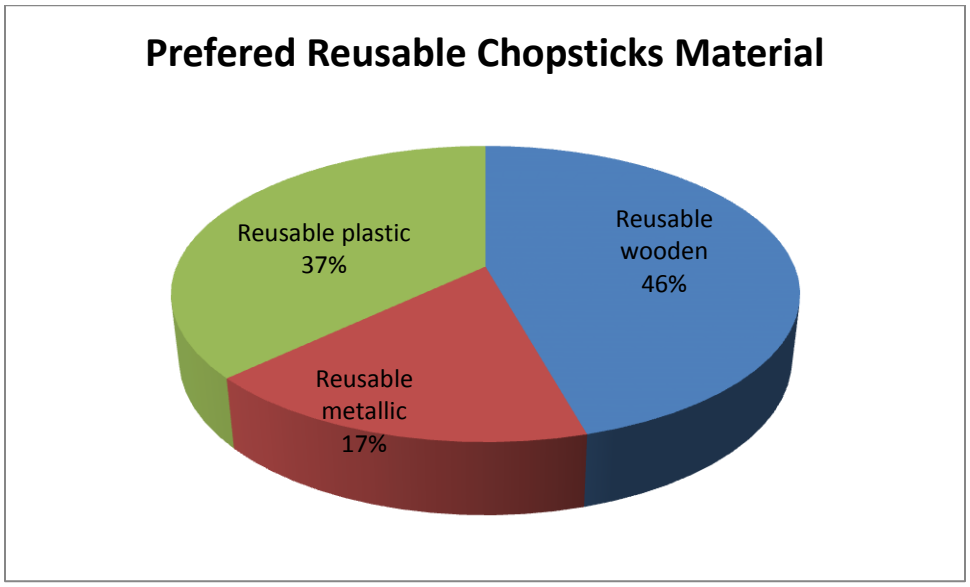

Figure 6 Preferred chopsticks' material

For the preferred reusable chopsticks material, 46% people tend to use wooden, 37% people favor plastic and metal chopsticks attract the least 17% people.

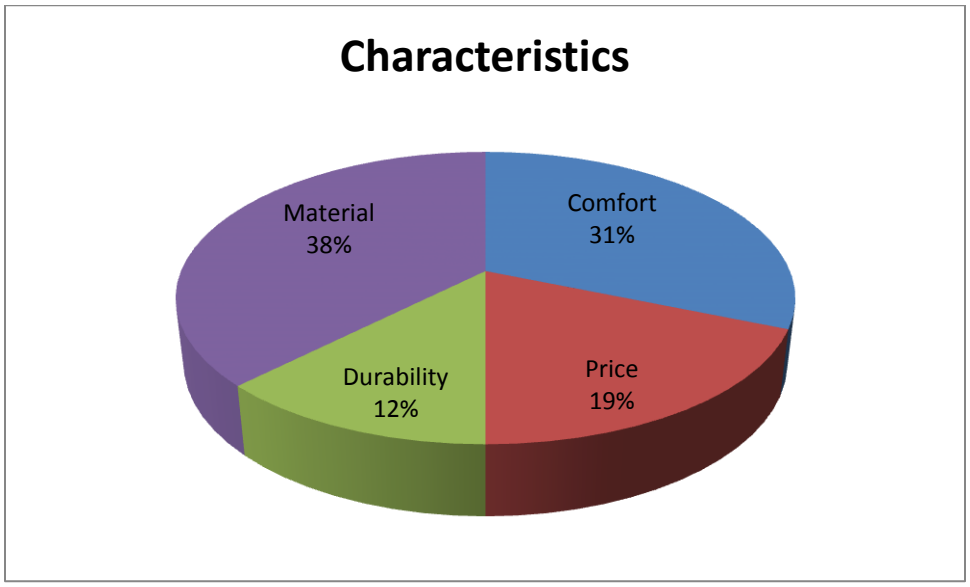

Figure 7 Preferred characteristic of chopsticks

For the characteristics of the reusable chopsticks, 38% and 31% people choose material and comfort as their priority, respectively. 19% people care about the price more than other factors and 12% people think durability should come first. The following figures are results from the survey.

4 Conclusions and Recommendations

The triple-bottom line analysis showed that reusable metal chopsticks are not only a viable option, but the superior option amongst the different reusable types. Therefore, it is recommended that reusable metal chopsticks be sold in the vending machine in the new SUB. Care must be taken, though, to make the product appeal to UBC students; as the survey results showed, metal is the least preferable choice for reusable chopstick material. While this result does not necessarily indicate that metal reusable chopsticks would be ill-received, it would bode well to ensure that they met the qualities desired by students (as per the survey results). In this way, UBC can make strides towards its ultimate goal of sustainability while the university's students can continue to enjoy their meals with the added benefit of being a part in the sustainability process.

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6 Appendix A - Survey

Survey on disposable and reusable chopsticks

1. Which faculty are you currently in?

☐ Arts

☐ Applied Science

☐ Commerce

☐ Education

☐ Forestry

☐ Life Science

☐ Science

☐ Other : _____

2. How often do you use chopsticks?

☐ Never

☐ Few times a year

☐ Few times a month

☐ Few times a week

☐ Everyday

3. Which type of material chopstick do you use mostly?

☐ Disposable wooden

☐ Reusable wooden

☐ Reusable metallic

☐ Reusable plastic

☐ Reusable ivory

☐ Reusable bamboo

4. Do you use disposable wooden chopsticks?

☐ Yes

☐ No

5. Why do you use disposable wooden chopsticks? (Can choose more than one)

☐ Convenient to get rid off

☐ Hygienic

☐ Readily available

☐ I don't use disposable chopsticks

6. Are you aware of the environmental issues caused by the disposable wooden chopsticks?

☐ Yes

☐ No

7. Did you know that more than 40million pairs of disposable wooden chopsticks are produced every year?

☐ Yes

☐ No

8. Did you know that disposable wooden chopsticks can be harmful to human body?

☐ Yes

☐ No

9. Do you use reusable chopsticks?

☐ Yes

☐ No

10. Would you bring your own reusable chopsticks to eat at school?

☐ Yes

☐ No

11. Which material would you prefer to use?

☐ Reusable wooden

☐ Reusable metallic

☐ Reusable plastic

☐ Reusable ivory

☐ Reusable bamboo

12. What do you care most about reusable chopsticks? (Choose one)

☐ Appearance (length, style, color, decoration, etc.)

☐ Comfort

☐ Price

☐ Durability

☐ Material

13. Will you purchase a pair of chopsticks if they are sold available on UBC campus?

☐ Yes

☐ No

14. What condition raises your interest in bringing your own reusable chopsticks to use?

☐ Discount at campus's food outlet when presenting your disposable chopstick

☐ Reusable chopsticks sold at low-price

☐ I do not want to bring my own reusable chopstick

☐ Other: _____

15. Other comments:

_____

_____