

# Edible Cutleries as Sustainable Substitute for Plastic Cutleries

By

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A thesis submitted to the Department of Brac Institute of Governance and Development  
in partial fulfillment of the requirements for the degree of  
Master in Procurement and Supply Management

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## **Declaration**

It is hereby declared that

1. The thesis submitted is my own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.

**Student's Full Name & Signature:**

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## **Approval**

The thesis/project titled “Edible Cutleries as Sustainable Substitute for Plastic Cutleries” submitted by

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## **Ethics Statement**

This is to testify that this research, has not been published in whole or in part elsewhere.

All the various sources that has been used to support this research, and its findings, have been properly cited to the best of my knowledge.

## **Executive Summary**

The research paper has been intended to inspire the readers to think of alternative and sustainable ways for consumption, act responsibly towards the environment and minimize waste and pollution as much as possible. The research is aimed to prove that there are various functional, sustainable and alternative means out there, instead of plastic, which has become one of the biggest threats to the world's ecosystem.

Edible Cutleries, is a brand new dimension and solution to fight against the plastic pollution. The paper investigates the plastic and its cutlery industry, and how it is collapsing the global ecosystem, while further delving into the product: edible cutlery, as a sustainable and meaningful solution for combating plastic pollution in Bangladesh.

The research also highlights how edible cutleries converges directly with some of the United Nation's Sustainable Development Goals, while also focusing on the demand and viability of the product for Bangladesh target markets.

**Keywords:** Edible Cutleries; SDGs; B2B; B2C; Sustainable; Sorghum.

## Literature Review

Edible cutlery is relatively a new concept and a variation of biodegradable cutleries with no research found in context of Bangladesh and various major markets internationally. While there is no extensive research made on edible cutleries for its market viability, consumer behavior, etc, there are various published news articles and media discussing about the product and popularizing it amongst the mass consumers.

The concept was first initiated in India by a company called Bakey's as a commercial product since 2010 (Reddy, 2016). The product has been further developed and the company is able to produce 50,000 units a day from 2016 and has received orders of 25 million units across the globe (Reddy, 2016). While various research are published on bamboo-based, sugar-based and corn-based spoons, this research would solely focus on sorghum-based cutleries.

Sorghum is an ancient African crop that uses little water for cultivation and it has super absorbent properties (Rajah, 2018). According to Mr. Narayana Peesapaty, a former researcher of ICRISAT claims sorghum takes 60 times less water than rice (Four, 2018), while a research by UNESCO on 'The green, blue and grey water footprint of crops and derived crop products', between 1996-2005 showed that sorghum accounted for only 2% of the global water footprint of crop production, compared to rice having more than 13% of the total 7404 Gm<sup>3</sup>/year (Mekonnen & Hoekstra, 2010). In Bangladesh farmers waste 800 liters of water to make 1 kg of rice paddy (Hasan, 2019), and with an average annual production of 19.5 million metric tonnes of rice (Hoque, 2018), the number of water wasted is a mammoth 15.6 trillion liters every year. According to a recent survey by Bangladesh Agricultural Development Corporation, farmers are using 75 percent of groundwater while 25 percent from surface and it was only 20 percent for groundwater while 80 percent from surface water in 1960-70 (Hoque, 2018).

Sorghum-based edible cutleries are also a potential competitor to the single-used plastic cutleries that are plaguing the earth's ecosystem. According to statistics presented by the European Commission in 2016, single-used plastic cutleries contribute to 4.24 percent of the marine litter on European beaches (Deutsche Welle, 2018). There is a huge demand for one-time cutleries; United States for instance, consumes annually 40 billion plastic cutleries (Munir, 2016), while India throws away 120 billion pieces of plastic cutleries every year (Reddy, 2016). The global demand is 640 billion per year and the global plastic cutlery market was worth US\$ 2.62 billion in the year 2017, according to the data published by the Digital Journal, and expected to reach around US\$ 3 billion by 2025 (Digital Journal, 2019).

It based on the above information that this paper is being written, to see whether there is evident demand for edible cutleries in Bangladesh market and provide a basis as to why sorghum-based edible cutlery is a far better alternative to be established in the market.

## **Dedication**

This research is dedicated to my beautiful wife, who have been extremely supportive throughout this journey. She is my inspiration and constant motivation.



## **Acknowledgement**

First and foremost, Alhamdulillah and All Praise is due to Allah, the Almighty and Ever Merciful. It is for His Will and Mercy, that I had been able to complete this research without any major interruption.

Secondly, I share my gratitude to my parents, my younger brother, my relatives, friends, teachers and mentors whose love, support and guidance have shaped me into what I am today.

Third, to my wife who encouraged me to take the Masters in Procurement and Supply Program and her constant motivation helped me to reach the final stage of the program.

I would also like to thank Mr. Narayana Peesapaty, whose concept and journey on edible spoons inspired my research on the product.

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## List of Acronyms

SDG	Sustainable Development Goals
UN	United Nations
B2C	Business to Consumer
B2B	Business to Business
EBO	Environmentally Friendly, Biodegradable and Organic
BPA	Bisphenol A
PVC	Polyvinyl Chloride
ESDO	Environment and Social Development Organization
PLA	Polylactic acid or Polylactide
IPS	Inter Press Service
CO <sub>2</sub>	Carbon dioxide
US\$	United States Dollar
BDT	Bangladesh Taka
QD	Quantity Demanded
PED	Price Elasticity of Demand
KFC	Kentucky Fried Chicken
UNESCO	The United Nations Educational, Scientific and Cultural Organization
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics

## **Chapter 1: Introduction**

Environmental Friendly, Biodegradable and Organic or EBO (for short) are the words to define the product, Edible Cutleries. The product is aimed to enhance the lives of the people of Bangladesh by eliminating the need and use of plastic cutleries and protecting the ecosystem. The research would discuss and analyze the demand for the product in Bangladesh market, while also addressing some of the directly converging Sustainable Development Goals (such as Clean Water and Sanitation, Affordable and Clean Energy, Decent Work and Economic Growth, Industries Innovation and Infrastructure, Responsible Production and Consumption, Life below Water and Life on Land), and its feasibility.

### **1.1 Rationale for Proposed Research**

“Enhancing lives around the world”, is the main objective of United Nations (UN) Sustainable Development Goals (United Nations, 2019). It is being pursued by world leaders around the globe since 2015, with the target set at 2030. In order to achieve the goals and ensure sustainable livelihood for future generations, the action towards climate change is one of the most important initiative. As organizations lean towards sustainable innovations and technologies, it is important to realize the elimination and reduction of an Anthropocene led substance- Plastics. In order to address this issue, this research would emphasize on the usage of edible cutleries as an alternative to one of the plastic products- single use (one-time) plastic cutleries.



## **1.2 Research Aims and Objectives:**

The objective of the research is to:

1. Ascertain the demand for edible cutleries in Bangladesh market.
2. Propose a business case for the Bangladesh market.

## **1.3 Methodology:**

The methodology includes both primary and secondary research. The primary research contained surveys such as questionnaires to draw an estimated demand using ordinal and numeric data.

The survey population consisted of both Business to Business (B2B) and Business to Consumer (B2C) market segments.

The B2B population ranged between nine organizations in six industries (such as Passenger Airlines, Bakery Chain, Coffee Chain, Fast-Food Chain, Ice-Cream Chain and Restaurant Chain) using systematic random sampling.

The systematic random sampling was also used for B2C survey, and the population consisted of educated and affluent working population, such as, white-collar employees in various organizations and university faculties. While they are not the main buyers, their taste and preference on the edible cutleries would dictate the B2B customers to be interested to purchase the product. A total of 317 respondents has been taken in consideration to the research.

Secondary survey is based on various websites and electronic media, and the success story of businesses found in neighboring country India, Bakeys.

#### **1.4 Limitations of the Research:**

There is no research published regarding edible cutleries, in context of Bangladesh. Most of the ground work has been carried from scratch. There have been various challenges in approaching B2B customers for the survey, as many companies have shown resistance to partaking in the survey, thus limiting the number of the B2B respondents to only nine organizations. Furthermore, the sample population for both B2B and B2C surveys are concentrated in Dhaka city and further research in the future may be required to ascertain a more comprehensive understanding of the demand and buying behaviors.

The research focuses mostly on the demand side and positive externalities, whereas, the supply side issues such as cost of raw materials, transportation, cost of labor, rent, etc., has not been considered for which, the product's actual price cannot be determined in context of Bangladesh. However, with the help of secondary data on the cost of edible spoons made in India, we have made an assumption on the pricing to be 3.5 times more than the plastic substitute.

#### **1.5 Research Hypothesis:**

Based on the above scenario, the Null Hypothesis therefore, assumes that there is no demand and acceptance for edible cutlery in the market, and the demand needs to be created.

The Alternative Hypothesis would be testing that, if we introduce an edible cutlery as an alternative to the single-use plastic cutlery, there is a demand and acceptance of at least 70 percent amongst the B2C and B2B market.

## **Chapter 2: Plastic-An Invention Gone Horribly Wrong**

Plastics; It is an invention that has seen more than half a century of innovation, provided smart practical solutions that paved the way for an industry, which has made since 1950, a total of 9.2 billion tonnes till date (Parker, Plastic or Planet?, 2018). It has become an integral part of our lives and is found everywhere. An industry with a global market value of US\$ 611.9 billion in 2017 (The Business Research Company, 2018), plastics are found in the clothes we wear, the houses where we reside, the toys children play with, the vehicles we use for travelling, in our computers and televisions, to the shopping bags and cutleries.

In December 2018, Great Britain's Royal Statistical Society gave a shocking revelation to the world. A meager 9 percent of plastic ever produced has been recycled, while astonishingly, 6.3 billion tonnes of these never made to the recycling plant, and found itself in both landfills and the vast ocean, a staggering number that has stunned scientists all over the world (Royal Statistical Society, 2018).

### **2.1 Problems with Plastics:**

According to the aforementioned statistics, 91 percent of plastic waste does not get recycled and with only a few being incinerated, most of these plastic wastes remain in form or another and may remain for hundreds or thousands of years. While most of the plastics produced now inhibits our ocean, a recent study by the National Geographic states that a mammoth 18 billion pounds (9 million tons) of plastic waste flows into the ocean every year (Parker, Fast Facts About Plastic Pollution, 2018). These inedible and harmful substances are then being consumed by the marine life, who, are then being consumed by people around the world. Thus, eventually the plastics are entering our bodies as micro plastics. Some researchers also point out that plastics contain harmful substances called carcinogens such as bisphenol A (BPA) and polyvinyl chloride (PVC) which may be linked to cancer (Breastcancer.org, 2019).

Moreover, as they do not easily biodegrade into the environment and take hundreds or thousands of years to do so, it is limiting the usage of natural resources for the future generations. As a result, reduction of plastics must be one of the top priorities, especially the tools and utensils being used directly for food consumption.

## **2.2 Global Presence of Plastic as a Cutlery:**

There is huge demand for one-time cutleries; United States for instance, consumes annually 40 billion plastic cutleries (Munir, 2016), while India throws away 120 billion pieces of plastic cutleries every year (Reddy, 2016). The global demand is 640 billion per year and the global plastic cutlery market was worth US\$ 2.62 billion in the year 2017, according to the data published by the Digital Journal, and expected to reach around US\$ 3 billion by 2025 (Digital Journal, 2019). In another study published by the National Geographic in 2018, half of the world's plastics being produced come from Asia, while 29 percent of the entire production volume is being contributed by China (Parker, Fast Facts About Plastic Pollution, 2018).

## **2.3 Plastic Cutlery Market in Bangladesh:**

A research conducted by Environment and Social Development Organization (ESDO) showed, approximately 250 tonnes of single-use plastic cutleries are sold every month in Old Dhaka, Bangladesh (Environment and Social Development Organization, 2018).

Various businesses ranging from fast-food restaurants, bakery chains and airlines buy plastic spoons and fork to serve to their customers. In the research, we surveyed nine organizations in six industries and found their average monthly demand of plastic cutleries, the detail of which has been shown in the table below:

List	Organization	Monthly Demand of Plastic Cutleries
1	Café Crème Du La Crème	3,000
2	Gweebarra (Coopers)	15,000
3	Movenpick	10,000
4	Nandos	5,000
5	North-End Coffee Roasters	6,000
6	Novo Air	50,000
7	Peyala	6,000
8	Presley the Bakers	3,000
9	Tasty Tibet	30,000

**Table 1:** List of organizations surveyed and their demand for plastic cutleries

These are but a few of the well-known companies operating in Bangladesh who rely heavily on plastic cutleries, with a combined total demand of 128,000 units per month.

Various articles and research has shown that in Bangladesh, around 85 percent of the single-used plastics does not get discarded properly (Environment and Social Development Organization, 2018), that end up clogging drains and waterways, eventually transported to the Bay of Bengal, all the while polluting the ecosystem throughout the journey.

Therefore, in order for a cleaner, safer and greener future, this research would focus on a sustainable and biodegradable utensil substitute, which would act as a primary functional leap forward towards zero plastic consumption and wastage.

## **Chapter 3: Insight to the Edible Cutlery Industry**

### **3.1 Global Edible Cutlery Market:**

Sustainable cutleries, especially Edible Cutleries, have created a storm of interests in various countries who are looking to adopt smarter, safer and cleaner substitutes of plastic cutleries. The product has received strong promotion by various media networks such as The Wall Street Journal, Forbes, The National Geographic and The Guardian. It now has a huge market in many countries such as the European Union, where they recently agreed to ban the usage of single-use plastic spoons by the year 2020 (Deutsche Welle, 2018). These highlight a very strong market scope for edible cutleries in many of the developed nations.

### **3.2 Introduction of Edible Cutlery in Bangladesh:**

Edible cutleries as mentioned previously, are going to be an environmentally friendly alternative to the present single-use plastic cutleries. It is going to be made from edible ingredients such as rice, wheat and sorghum (millet or jowar), which serves as the core elements.

### **3.3 Availability of Raw Materials:**

The main ingredient being used is sorghum. It takes 60 times less water to cultivate sorghum compared to rice (Four, 2018). The crop has the ability to grow in 95 percent of the world's arable land (Munir, 2016). Given Bangladesh's climate conditions and rich soil density, it is possible that this crop can be grown almost anywhere and might require less arable lands for higher yields. As for the rice and wheat, they are one of the major crops in Bangladesh.

### 3.4 Application and Manufacturing Process:

Sorghum has a super absorbent ability which makes the usage of edible cutleries extremely versatile, that is, it will not only be suitable with rice or wheat-based cuisine that is common in Bangladesh, it might however, compliment well with ice cream, yogurt, and variety of soups, as it does not degrade within hot or cold liquids (Munir, 2016). The process of baking and transforming an edible spoon is shown below.

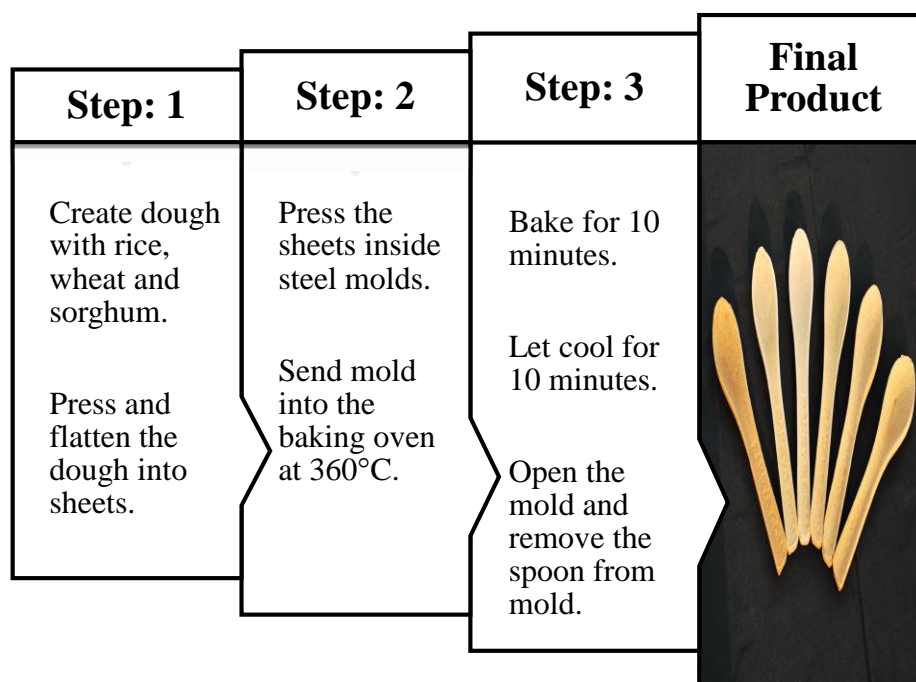


Figure 1: Baking process of edible spoons (Source: Twentie Four, 2018)

As the step provided above suggests, the heating process evaporates all the moisture from the dough, resulting in the final product being a hard cookie-like spoon.

### 3.5 Economic Impact:

Kickstarter, an American crowd-funding organization, conducted a research in 2016 on the energy consumption and wastage made when making sorghum-based sustainable spoons, and

its comparison to corn-based and plastic counterparts, and their result indicated sorghum has been the most efficient of the three.

<b>Manufacturing 1lb of Material</b>	<b>Energy Used (kWh)</b>	<b>Water Used (gals)</b>	<b>Solid Waste (lbs)</b>	<b>CO<sub>2</sub> Emissions (lbs)</b>
Plastic (Polypropylene)	9.34	5.12	0.029	1.67
Corn/PLA Based	5.37	8.29	0.042	1.3
Sorghum Based	0.18	1.15	n/a	0.19

**Table 2:** Energy used, wastage and emissions per one pound of material produced (Source: Kickstarter)

The values indicated for sorghum, had been taken from water usage in producing and generating sorghum crops as well as transforming the crop into spoons. Kickstarter deduced that the energy which takes to produce 1 plastic utensil, 100 units sorghum based spoons can be produced, while in comparison to Corn/PLA, 50 units. It also found that the low water usage in making the spoon also enhanced the shelf-life to 2 years, without compromising the spoon’s crispiness (Munir, 2016).

### **3.6 Social Impact:**

According to the statement of IUCN’s Director General, Inger Andersen, “plastic pollution is undermining our progress towards healthy oceans (SDG 14), food security (SDG 2), sustainable production and consumption (SDG 12), as well as many other global goals”, (International Union for Conservation of Nature, 2018). As the cutleries are EBO, they create positive impact to the environment. The importance of this product can be further highlighted with respect to the United Nations’ Sustainable Development Goals.



### a) Clean Water and Sanitation:

As mentioned earlier, the core ingredient sorghum saves 60 times the water used during rice cultivation. It also saves more than 77 percent water when producing one pound of sorghum-based spoon compared to the plastic counterpart. Recent news shared by the Dhaka Tribune and Inter Press Service (IPS) News Agency says, farmers in Bangladesh waste 800 liters of water to make 1 kg of rice paddy, and with an average annual production of 19.5 million metric tonnes of rice, the number of water wasted is a mammoth 15.6 trillion liters every year. Not to mention the dependency of ground water is currently 75 percent and rest is relied on surface water (Hoque, 2018). A shift from rice-based cultivation to sorghum-based would help to eliminate wastage of valuable water of 63.54 trillion liters per annum.

Total unit in Metric Tonnes	Total unit in Kilogram	Liters of Water Wasted/Kg	Total Liter of Water Wasted
19,500,000	19,500,000,000	800	15,600,000,000,000

**Table 3:** Summary of Water Consumption on Rice Production per annum

Annual Production in Kilogram	Water Consumed in Liters/Kg	Water Wasted in Liters/Kg	Total Water consumed in Liters	Wastage Eliminated
19,500,000,000	2,500	800	64,350,000,000,000	
19,500,000,000	42		812,500,000,000	63,537,500,000,000

**Table 4:** Comparison of sorghum production being astronomically efficient than rice production

Bangladesh being a riverine country, many of the single-used plastic cutleries finds its way in the rivers and lakes, thus affecting their ecosystem, while also harming the surrounding forests and wetlands. Introduction of our edible cutleries tackles these issues and aims to preserve the ground and surface water and would help to reduce the water scarcity.

### **b) Affordable and Clean Energy:**

Plastic cutleries are made from non-renewable resources such as petroleum and natural gas while edible cutleries use renewable resources such as sorghum, rice and wheat. Sorghum-based edible cutleries saves 100 times the energy needed to create a single unit of plastic spoon (Munir, 2016). If production of plastic cutleries is substituted with edible cutleries, it might significantly save non-renewable resources, and divert the surplus resources for generation of universal access for affordable and reliable energy services.

### **c) Decent Work and Economic Growth:**

There is a huge scope of development and growth in the entire value-chain of edible cutleries. For instance, dependency of sorghum would allow farmers to cultivate the crop more and the production of edible cutleries would require labor intensive jobs. We aim to follow a combination of democratic and team leadership approach that would allow our employees a sense of belongingness in the company and a positive mindset that they are directly involved in reducing pollution and tackling climate change. If edible cutleries are successful in competing and eliminating plastic cutleries in Bangladesh, we would then take the next step of exporting our products to meet the global demands, tapping the US\$ 3 billion market, thereby being one of the top contributors of export earnings in the country.

### **d) Industries Innovation and Infrastructure:**

Production of sorghum-based edible cutleries saves more than 88 percent CO<sub>2</sub> emissions when compared to plastic cutleries. Many plastic cutlery manufacturers use vaseline-like substance on the spoons so that it does not get stuck with the mold during production (Four, 2018). When the final product reaches the market, the oil film in the cutleries remain unwashed and contaminates the food and beverages thus compromising the health and safety of the

consumers. Sorghum-based cutleries have no preservatives, are completely organic, suitable for vegetarians, non-toxic and completely environmentally friendly (Munir, 2016), thus making the product highly competent and ahead of the curve.

#### **e) Responsible Production and Consumption:**

The edible cutleries fully aim to eliminate the need for plastic cutleries, while also seeking on promoting sustainable agriculture, by harvesting more of sorghum to significantly reduce water wastage of minimum 15.6 trillion liters of fresh water that is being robbed from the country every year. Edible cutleries would be a responsible product that would significantly reduce electricity and water consumption and CO<sub>2</sub> emissions during manufacturing, while creating zero wastage to the environment, thus creating a positive spillover effect onto the economy. It would also act as food for the people after they are finished with their meal and even when the cutleries are not disposed correctly, they would still be food materials for the animals, birds, plant and marine life.

#### **f) Life below Water:**

As the earth's rainwater, climate, temperature, shorelines, majority of food supply, and even the oxygen needed for survival, are all ultimately provided and regulated by the sea and ocean, preserving life on sea is a top priority and a major SDG. According to statistics presented by the European Commission in 2016, single-used plastic cutleries contribute to 4.24 percent of the marine litter on European beaches (Deutsche Welle, 2018). The edible cutleries biodegrade within 10 days when exposed to the environment (Munir, 2016) or eaten by animals or fishes without harming the ecosystem, unlike the plastic substitute which may take hundreds of years to decompose.

### **g) Life on Land:**

Preservation of inland fresh water and reduction of plastic landfills can only be obtained by using environmentally friendly alternatives, instead, of the existing unsustainable solution-plastic cutleries. Successful implementation of edible cutleries would create a market for sorghum cultivation, and farmers can shift from excess water guzzling rice cultivation to more of water conserving sorghum. The conservation of ground water and surface water would reduce the rate of deforestation and elimination of plastic cutleries would safeguard animals and birds from negative externalities of plastic.

Edible cutleries, therefore if implemented successfully and made commercially feasible, would ensure to realistically achieve the SDGs 6, 7, 8, 9, 12, 14 and 15 while also having possibilities of achieving the rest 10 for Bangladesh and rest of the world.

## **Chapter 4: Research Findings and Analysis**

### **4.1 Research Findings:**

The questionnaire consisted of various multiple choice questions (appendix: 3 and 4), ranging from gender, age, product reaction, product innovativeness, product necessity in the market, price acceptance or expectations, purchase frequency and product recommendation. It should be noted that when taking the survey, we went to each individual of the sample population explaining them about our product before they answered the respective questions.

### **4.2 Findings for B2B:**

The B2B customer segment for edible cutleries, comprise of customers (intermediaries) who require the product when serving food to their customers (the end users). These are markets ranging from fast-food restaurants, ice-cream parlors, cafes, catering companies, airlines, etc. For instance, when we go to Movenpick, we order the ice-cream. The waiter serves us the ice-cream along with the plastic spoon. We being the end user, use the plastic spoon to consume the ice-cream. Although we are not directly paying for the plastic spoon, the cost of the spoon has been included with the price of the ice-cream.

#### **a) Population Demographics:**

When taking survey of B2B customers, we surveyed individuals who are involved in the position for decision making and purchase of the single-use plastic spoons, such as Marketing Manager, Procurement Manager, Head of Supply-Chain, etc.

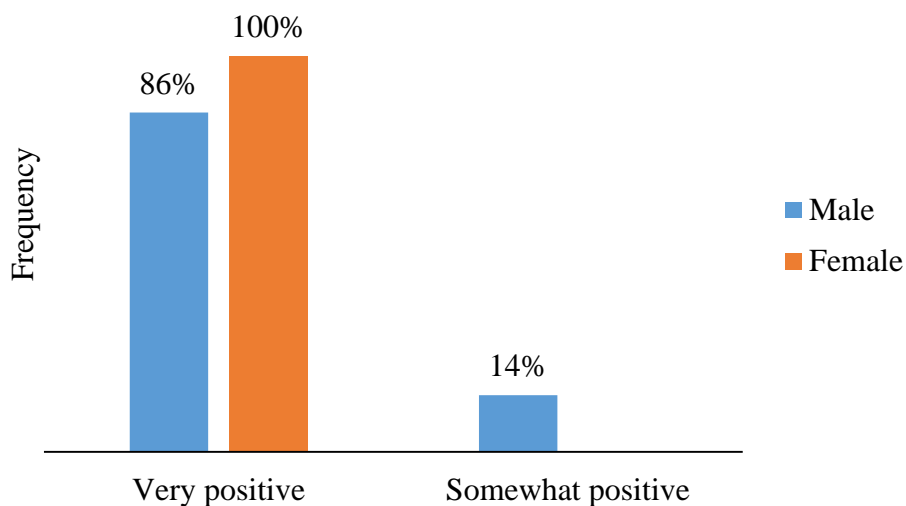
Gender	Total	Percentage
<b>Male</b>	<b>7</b>	<b>78%</b>
24-27	1	11%
28-30	2	22%
31 and above	4	44%
<b>Female</b>	<b>2</b>	<b>22%</b>
28-30	2	22%
<b>Grand Total</b>	<b>9</b>	<b>100%</b>

**Table 5:** Population demography of the respondents

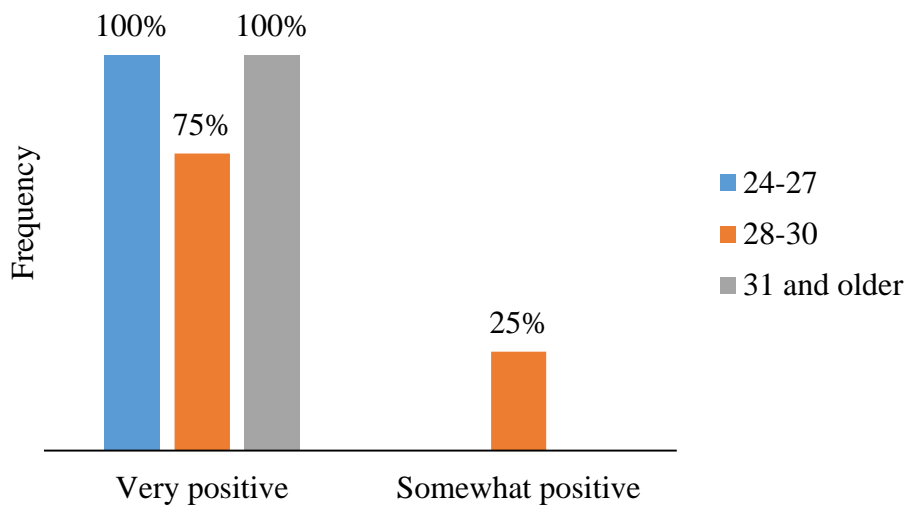
We have found 78 percent of the decision makers who use single-used plastic cutleries to be men with 85 percent of them falling in the age bracket of 28 and older.

### **b) Product Reaction:**

Product reaction has been measured based on the product descriptions, benefits and features summarized in the questionnaire.



**Figure 2:** Reaction of the respondents towards edible cutleries



**Figure 3:** Reaction and Age Bracket of the respondents for edible cutleries

The product has received very strong positive reaction from the potential customers with 89 percent of the population voting for ‘Very positive’ with 14 percent of men within the age bracket of 28-30 voting for ‘Somewhat positive’.

**c) Product Innovation:**

Similarly, product innovation has been measured based on the product descriptions, benefits and features summarized in the questionnaire.

Product Innovation	Gender		Count of Total Population
	Male	Female	
Innovative	100%	100%	100%

**Table 6:** Count of respondents who found the product to be innovative

All the respondents found the product to be innovative.

**d) Product Necessity:**

When measuring product necessity, the respondents were asked whether they believe edible cutleries are necessary and should be available in the market as opposed to plastic cutleries.

The below table summarizes their responses.

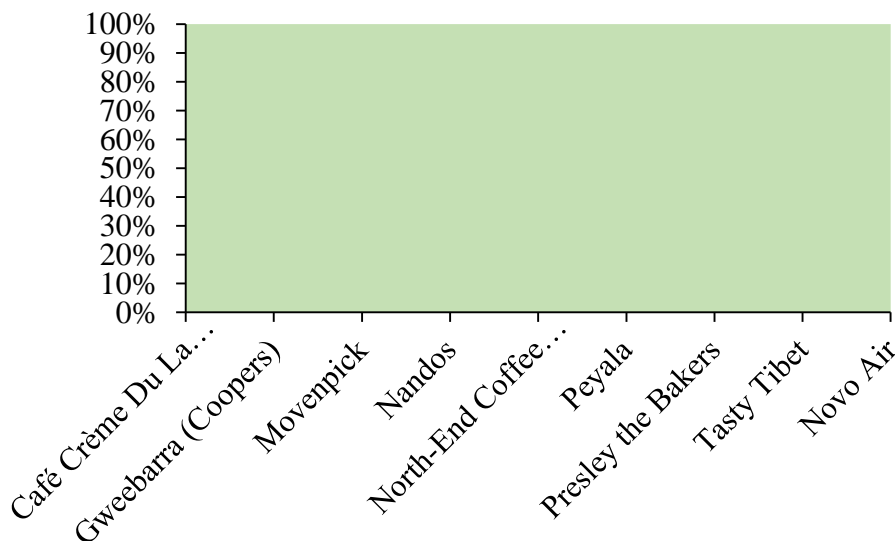
Product Necessity	Gender		Count of Total Population
	Male	Female	
Definitely need	100%	100%	100%

**Table 7:** Count of respondents who agreed that the edible cutlery should be available in the market

The above table proves that the market is ready to accept edible cutleries as opposed to plastic cutleries. The only question remains is whether they agree to purchase the product at a given price.

**e) Product Recommendation:**

The respondents showed strong interest on the product and all agreed to recommend the product to their various stakeholders.



**Figure 4:** List of Organizations who agreed for product recommendation



The green shaded area in the above chart represents the count of votes for acceptance of product recommendation. As all the organizations agreed to recommend for the product, the entire area is covered in the shade of green. This is extremely important for the product when launched, as this would significantly reduce the marketing costs, and the product can rely on word of mouth alone to gain significant share in the market.

**f) Demand for Edible Cutleries:**

The respondents were asked whether they would purchase the edible cutleries at a higher price in comparison to the existing plastic cutleries. The price of edible cutleries is assumed to be ±BDT 3.5/unit against the plastic cutlery costing at BDT 1/unit.

Organization	Type of Industry	Agreed to pay ± 3.5/unit		Count of Total Population
		Yes	No	
Café Crème Du La Crème	Bakery Chain	11%		11%
Gweebarra (Coopers)	Bakery Chain	11%		11%
Movenpick	Ice-cream Chain		11%	11%
Nandos	Restaurant Chain		11%	11%
North-End Coffee Roasters	Coffee Chain		11%	11%
Peyala	Fast-Food Chain		11%	11%
Presley the Bakers	Bakery Chain	11%		11%
Tasty Tibet	Fast-Food Chain	11%		11%
Novo Air	Airlines		11%	11%
Count of Segmented Population		44%	56%	100%

**Table 8:** List of organizations who agreed to pay higher to save the environment

The above list shows 44 percent of the companies ranging from bakery to fast-food chains have agreed to purchase the edible cutleries at a higher price as they recognize environment and conservation of ecosystems to be priceless. However, it should also be noted that, the volume of purchase varies significantly between the industries. For instance, companies such as Café Crème Du La Crème and Gweebarra require plastic cutleries for their take away orders, while companies such as Movenpick and Novo Air need them at a higher volume to cater to their consumers who sit and dine or during flights.

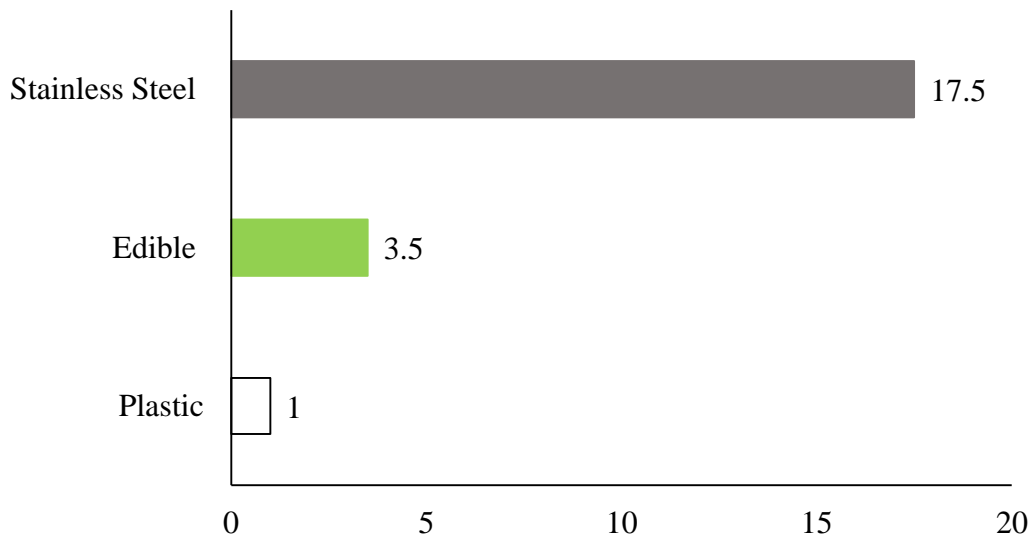
Organisation	Industry-wise Monthly Demand of Plastic Cutleries						
	Bakery Chain	Coffee Chain	Fast-Food Chain	Ice-cream Chain	Restaurant Chain	Airlines	Grand Total
Café Crème Du La Crème	2%						2%
Gweebarra (Coopers)	12%						12%
Movenpick				8%			8%
Nandos					4%		4%
North-End Coffee Roasters		5%					5%
Peyala			5%				5%
Presley the Bakers	2%						2%
Tasty Tibet			23%				23%
Novo Air						39%	39%
Grand Total	16%	5%	28%	8%	4%	39%	100%

**Table 9:** Allocation of demand for single-use cutleries of various industries

As discussed previously, the total monthly demand for these companies accumulates to 128,000 units, of which the lion's share of the demand is with the airlines industry at 39 percent, followed by fast-food and bakery chains respectively.

The reason companies are relying heavily on plastic cutleries is because they are extremely cheap. A basic stainless steel spoon costs BDT 17.5/unit to purchase.

When considering its whole-life costing, it becomes much more expensive with the associated cost of cleaning and maintaining the spoon. As plastic spoons are much cheaper financially, these organizations find it easier to operate using these spoons instead.



**Figure 5:** Cost per unit of various types of spoons

It is approximately 1650 percent cheaper to use a plastic spoon instead of stainless steel and 250 percent cheaper when compared to edible cutlery. Furthermore, we must also analyze the additional financial impact of shifting to edible cutleries for these organizations. This is explained further in the table below.

Organization	Monthly Demand	Purchase Cost of Plastic Cutleries	Purchase Cost of Edible Cutleries	Financial Impact
Café Crème Du La Crème	3000	BDT 3,000	BDT 10,500	BDT 7,500
Gweebarra (Coopers)	15000	BDT 15,000	BDT 52,500	BDT 37,500
Movenpick	10000	BDT 10,000	BDT 35,000	BDT 25,000
Nandos	5000	BDT 5,000	BDT 17,500	BDT 12,500
North-End Coffee Roasters	6000	BDT 6,000	BDT 21,000	BDT 15,000
Novo Air	50000	BDT 50,000	BDT 175,000	BDT 125,000
Peyala	6000	BDT 6,000	BDT 21,000	BDT 15,000
Presley the Bakers	3000	BDT 3,000	BDT 10,500	BDT 7,500
Tasty Tibet	30000	BDT 30,000	BDT 105,000	BDT 75,000

**Table 10:** Cost Analysis of purchasing edible cutleries for various organizations

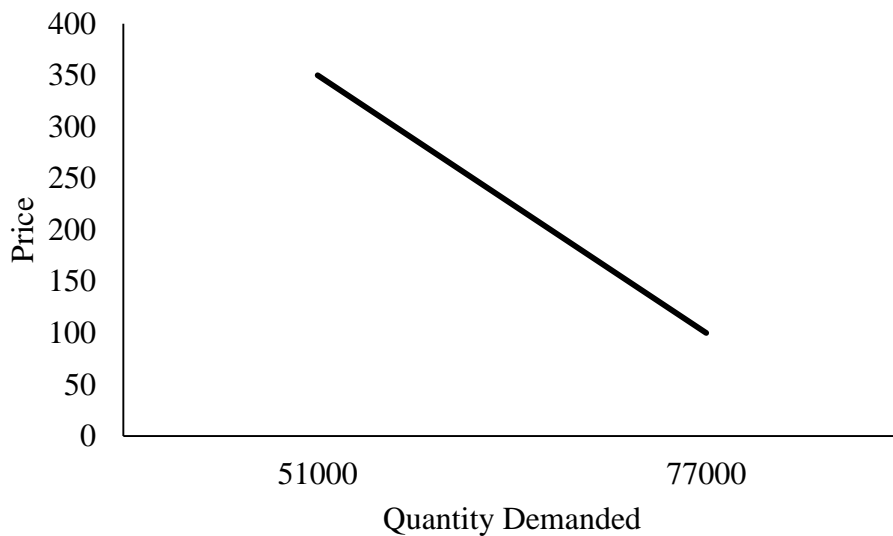
From this table we can also see that shifting to edible cutleries would cause the companies to incur a 250 percent increase in purchasing cost of cutleries.

However, during the survey we had asked the decision makers about the expected price that they wish the edible spoon should be. Although they provided various pricing expectations, in order to simplify and ascertain the demand curve for edible cutleries, we have assumed the demand to vary between two price ranges, BDT 350 and BDT 100, that is, the companies who accepted the higher price range and those who rejected it. Meaning, the companies who accepted the price as BDT 350, their total quantity demanded accumulates to 51000 units, and for those who rejected the higher price have quantity demanded accumulating to 77000 units (including the quantity of the companies who accepted the higher prices).

Price	Demand
BDT 100	77000
BDT 350	51000

**Table 11:** Price and Quantity demanded of edible cutleries for any given month

Based on the above data table we can plot the demand curve below:



**Figure 6:** The Demand Curve of edible cutleries

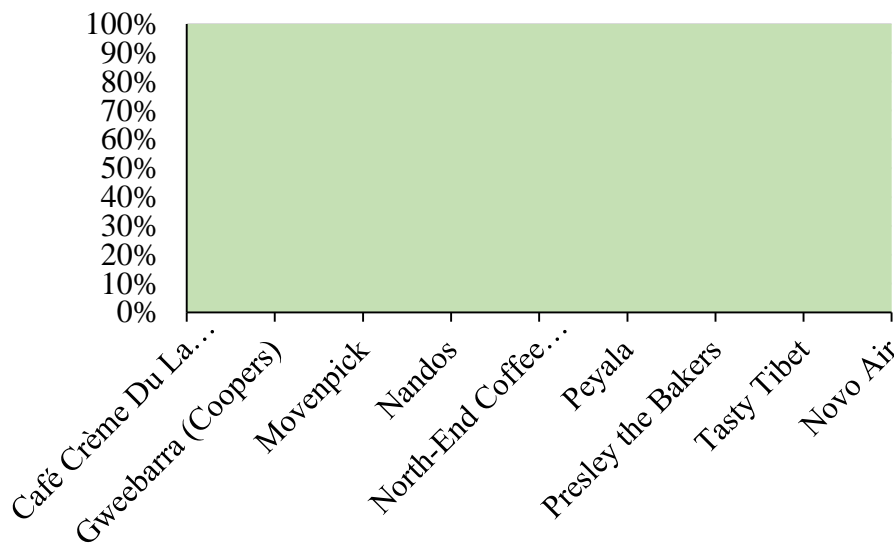
Judging from the demand curve we can also calculate the price elasticity of demand. The change in QD is -33.77 percent while change in price is 250 percent. The resulting PED is -0.14, which is highly inelastic. This makes sense as various companies are willing to shift towards environmentally sustainable alternatives.

### **g) Government Support:**

Studies and research on Bakeys have shown that one of the reasons their product took a long time to gain exposure is because of a lack of acceptance from the market, but also due to lack of government support programs to make the innovative product compete with the highly cheap plastic cutleries.

However, the government of Bangladesh is much more serious about achieving the Sustainable Development Goals, and one of the best examples from recent times is their initiative on ‘Clean and Green Bangladesh’, and revival of the four rivers project worth BDT 850 crore (The Daily Star, 2019). Stronger policies are also being imposed towards the Environmental Conservation Rules, while introducing new policies such as Environment Court Act and the Brick Manufacturing Rules (Kemper & Fan, 2018).

Considering the above scenarios, the respondents were asked whether they would purchase the edible cutleries if government incentives were provided. All of the answers came with a resounding yes, with some providing additional remarks on their decision based on Cost Benefit Analysis summarized in the chart below.



**Figure 7:** List of Organizations agreeing to receive government incentive for purchasing edible cutleries

The green shaded area in the above chart represents the count of votes for acceptance of government incentives. As all the organizations agreed to receive government incentive for the product, the entire area is covered in the shade of green. However, further research need to be made with consideration to government support, on how the government can aid the edible cutlery product to thrive in Bangladesh market.

### **4.3 Findings for B2C:**

The B2C market consists of the end users of the product. They are the white collar working population who has a good educational background and substantial income, for instance, university faculties and corporate job holders. The sample population has few opportunities to bring lunch from home and relies heavily on eating outside in various restaurants within their work peripherals. With the economy growing by an average of 6.41 percent over the past 11 years (The World Bank, 2019) and per capita income growing by an unprecedented 149 percent to US\$ 1,751 at present (The Independent, 2018), more people are having disposable income for leisure and entertainment in Bangladesh.

The corporate job holders nowadays find themselves travelling frequently from Dhaka to other districts or cities and vice-versa, within the country for various business activities. Recent studies have also found that there is a strong upward trend amongst the white collar working population to travel during their holidays, which has increased the number of air travels for both inbound and outbound. According to an article published by Dhaka Tribune, over the last five years the country has seen international air passengers increased by nearly 22.10 percent, while domestic air passengers increased approximately 64.73 percent in Bangladesh (Dhaka Tribune, 2018). Another article published by The Daily Star, indicates that current spending pattern on tourism, by the middle-income and upper middle-income group ranges between BDT 15,000 to 20,000 and 80,000 respectively (Rahman & Chakma, 2018).

#### **a) Population Demographics:**

When taking survey of B2C respondents, we considered age groups ranging 19 to 31 and older, as it is mostly seen that these are the individuals who mostly spend their allowance or income on restaurants and fine dining. While the age bracket of 19-23 may not be considered in the

mainstream working population, given they spend this time completing their undergraduate studies, it is important to note that their response in this research is also very relevant, as they would be in the mainstream working population in the foreseeable future.

<b>Gender</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Male</b>	<b>188</b>	<b>59%</b>
19-23	14	4%
24-27	87	27%
28-30	35	11%
31 and older	52	16%
<b>Female</b>	<b>129</b>	<b>41%</b>
19-23	8	3%
24-27	72	23%
28-30	27	9%
31 and older	22	7%
<b>Grand Total</b>	<b>317</b>	<b>100%</b>

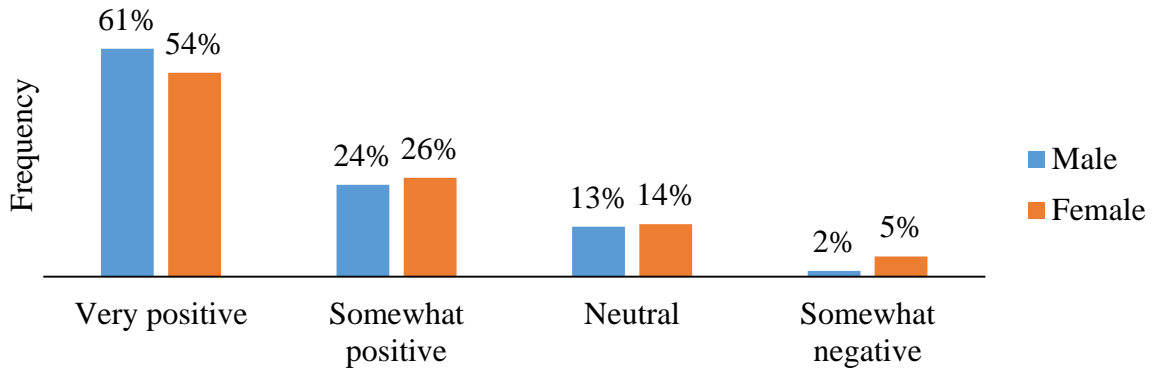
**Table 12:** Population demography of the respondents

The majority of the sample population consisted of men, while 50 percent of the entire population falling in the age group 24-27, and followed by 23 percent being 31 and older.

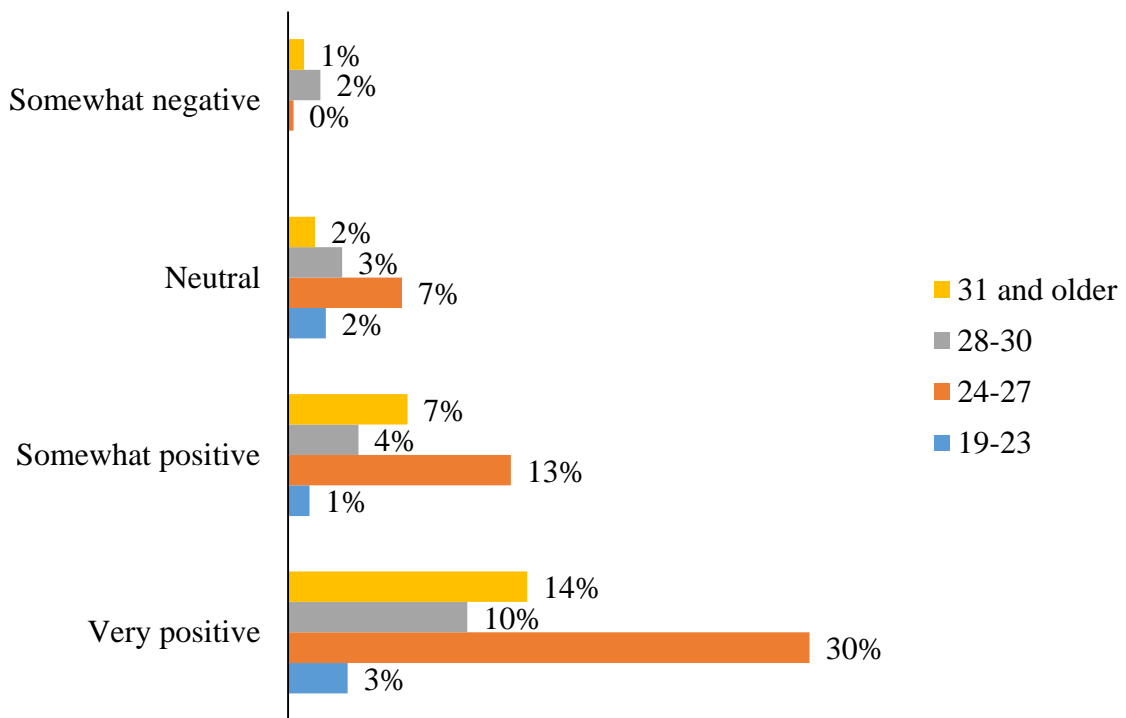
**b) Product Reaction:**

Product reaction has been measured based on the product descriptions, benefits and features summarized in the questionnaire. For ease of viewing, the data labels in the charts are rounded up to the nearest one. For instance, the zero in one of the chart is actually 0.32%, but as this number is negligible, all numbers have been rounded to the nearest one.





**Figure 8:** Reaction of the respondents towards edible cutleries

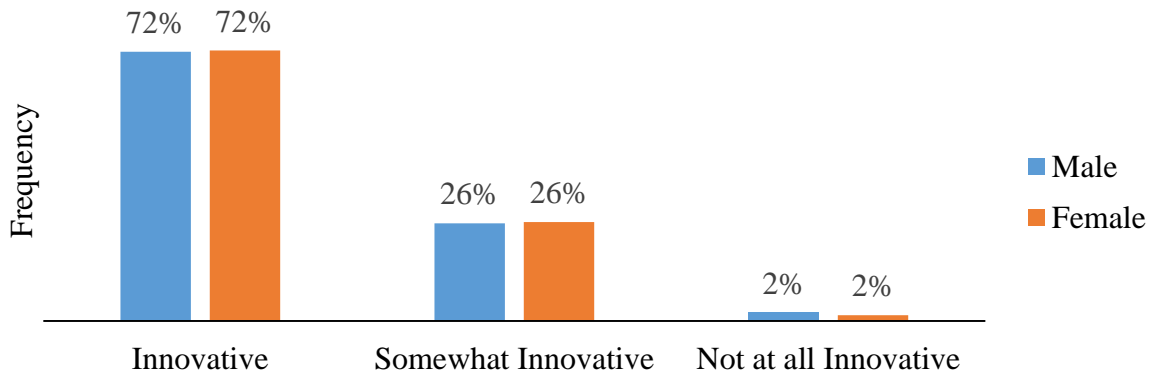


**Figure 9:** Reaction and Age Bracket of the respondents for edible cutleries

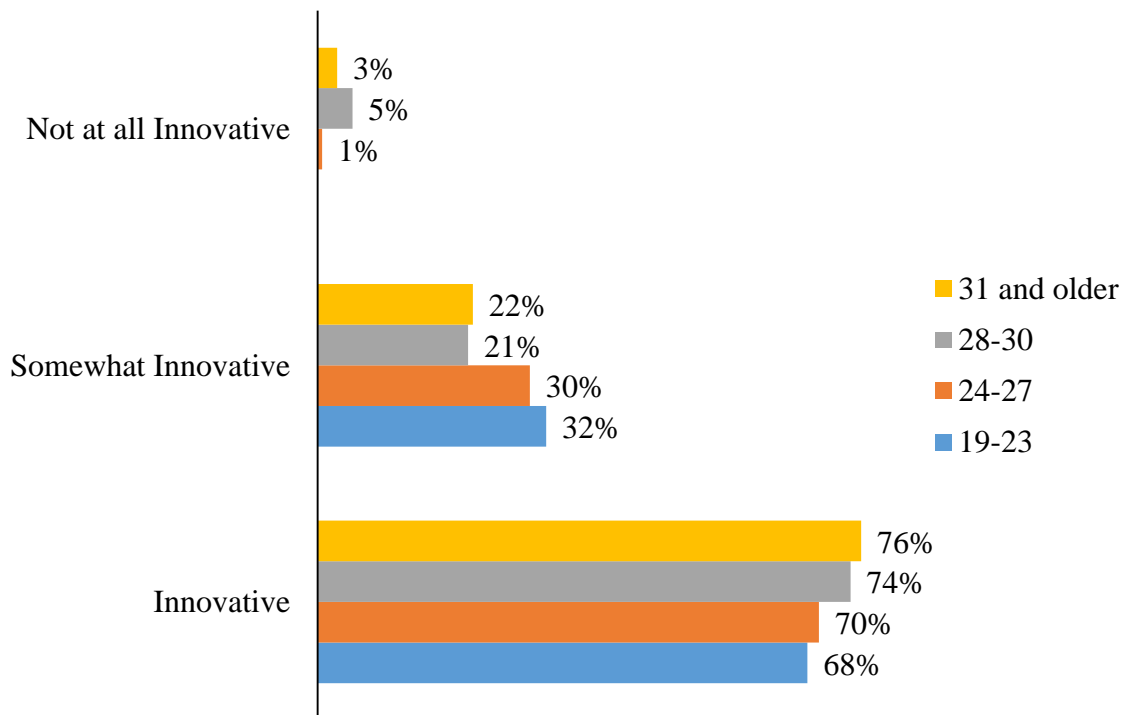
The product has received a strong positive reaction amongst 83 percent of the entire population, with 58 percent voting for 'Very Positive'. Considering the age bracket, a chunk of 30 percent of the positive response has come from the age group 24-27, followed by 14 percent from the age group 31 and older.

**c) Product Innovation:**

Similarly, product innovation has been measured based on the product descriptions, benefits and features summarized in the questionnaire.



**Figure 10:** Count of respondents who found the product to be innovative



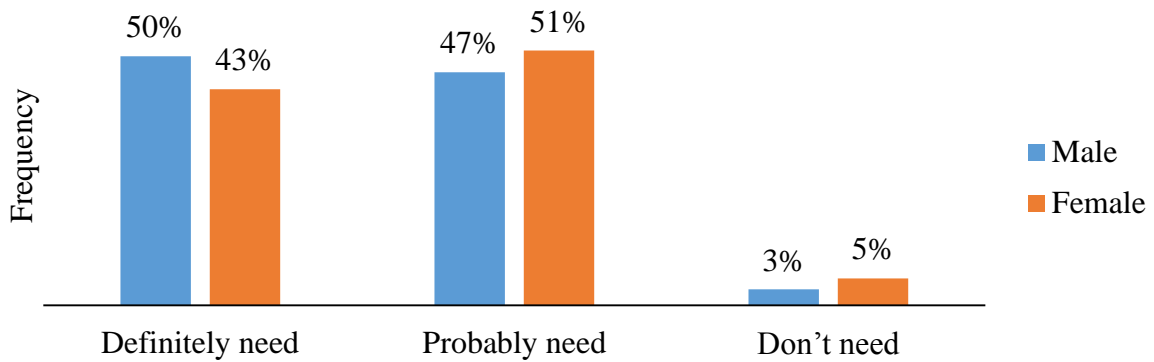
**Figure 11:** Age Bracket of respondents who found the product to be innovative

In terms of product innovativeness, the product has received 72 percent vote on being ‘Innovative’ amongst all the age groups.

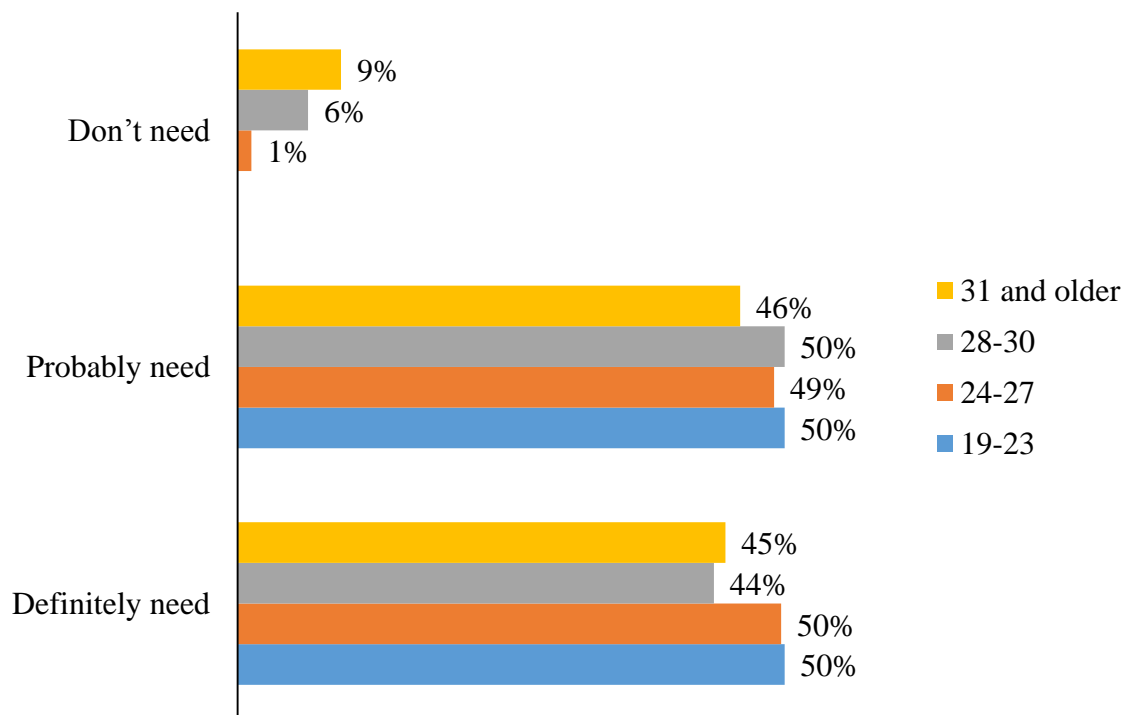
**d) Product Necessity:**

When measuring product necessity, the respondents were asked whether they believe edible cutleries are necessary and should be available in the market as opposed to plastic cutleries.

The below table summarizes their responses.



**Figure 12:** Percentage of respondents who agreed that the edible cutlery should be available in the market

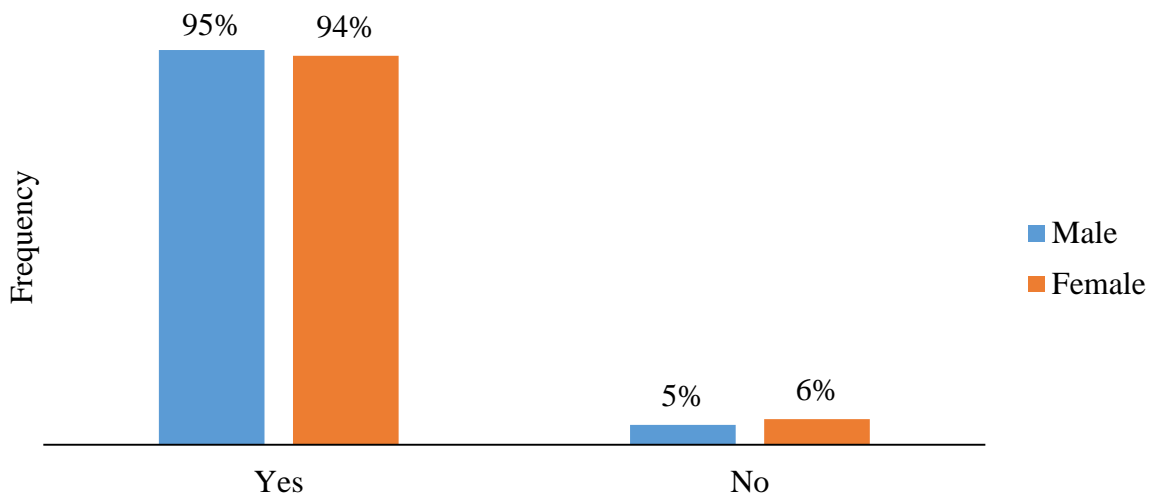


**Figure 13:** Age Bracket of respondents who agreed that the edible cutlery should be available in the market

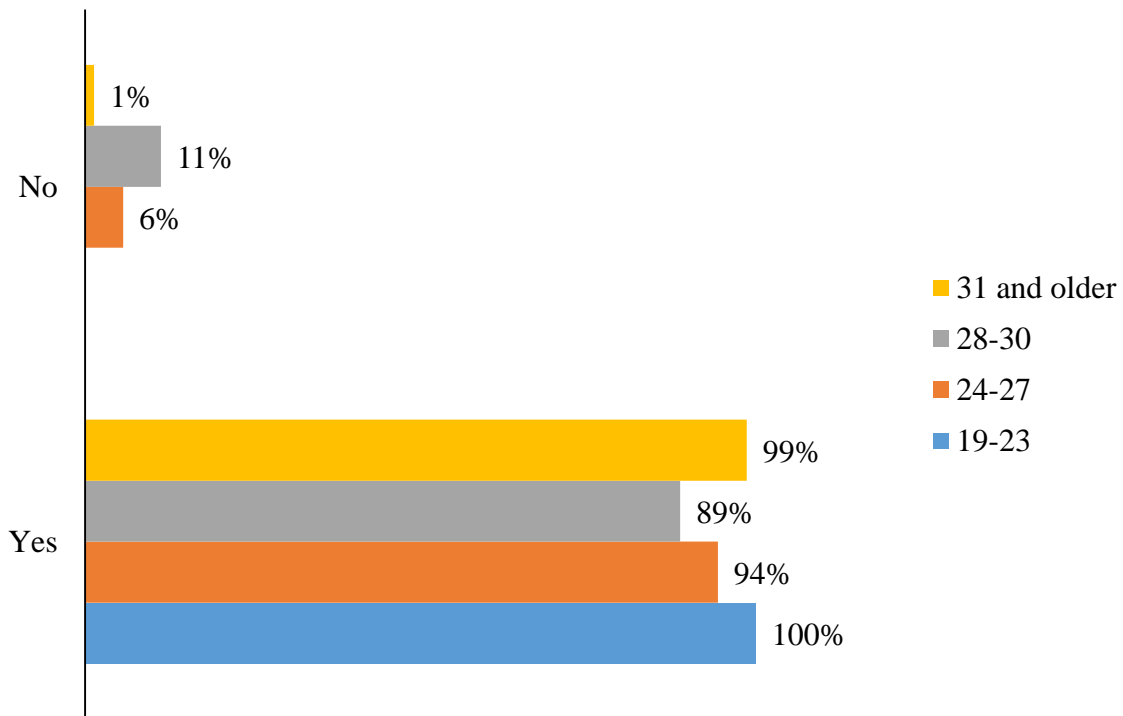
When calculating the end user's perception on the importance of the product's presence in the market, it has been found that 47 percent of the population stated that edible cutleries are definitely needed as an alternative to the plastic spoons, while 49 percent were unsure of the products' importance as a sustainable substitute. It is also seen that amongst all the age groups the product is met with almost even spread between confidence and uncertainty.

**e) Product Recommendation:**

Product recommendation from B2C customers analyzes the end users interest towards word of mouth marketing of the product; edible cutleries.



**Figure 14:** Percentage of respondents who agreed to recommend the product



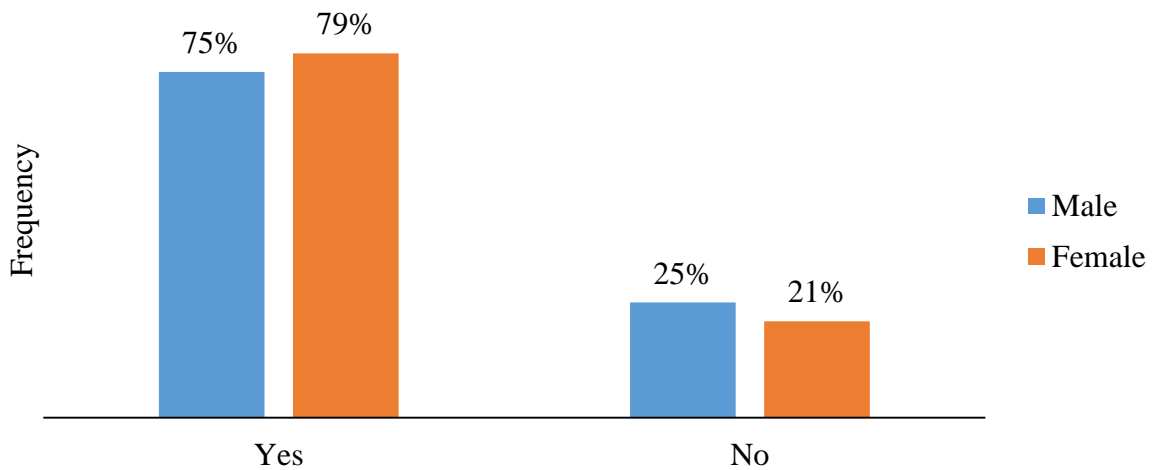
**Figure 15:** Age Bracket of respondents who agreed to recommend the product

Similar to the B2B response, the customers of B2C also showed strong indication towards product recommendation to their friends and families, with 95 percent of the total respondents agreeing, with almost equal acceptability from men and women, and high acceptance rate from all age groups.

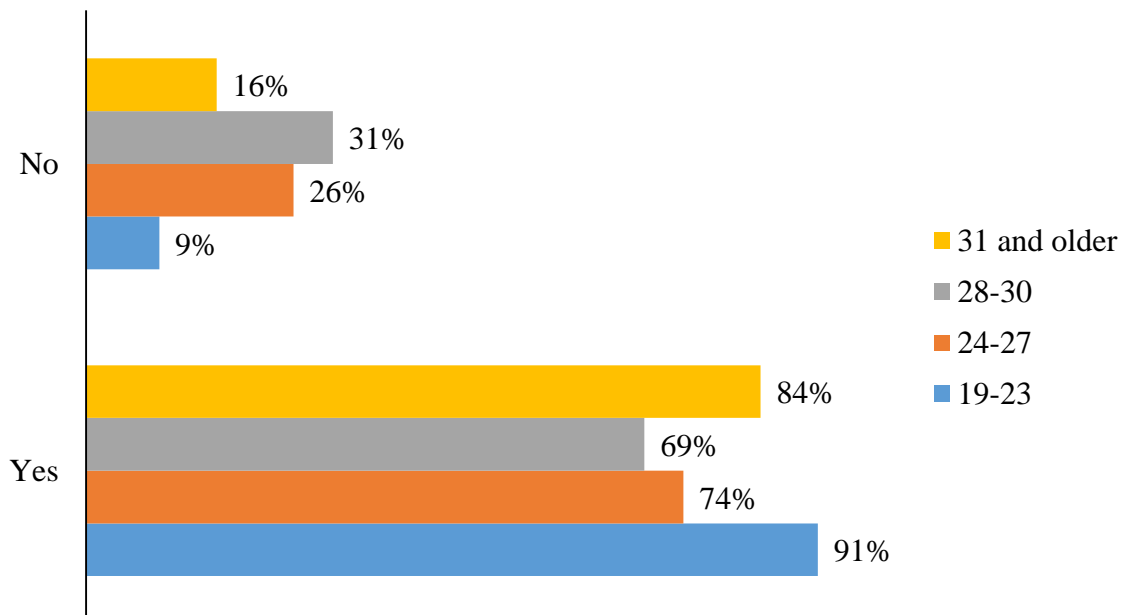
**f) Price Acceptance:**

The measurement of price acceptance from the end user is to determine their willingness to shift to a sustainable and environmentally friendly alternative. The acceptance and readiness to pay a higher price from the end user would indicate to the B2B customers that, purchasing edible cutlery is a feasible and logical choice. As discussed previously, the product’s main target customers would be B2B market segment but the acceptance from the end users would determine their buying decisions, while the higher cost of purchasing edible cutlery would trickle down to their main products.

The respondents of B2C were asked, whether they would purchase the edible cutleries at a higher price, in comparison to the existing plastic cutleries. Although the price of edible cutleries is assumed to be ±BDT 3.5/unit, we declared the estimates to be ±BDT 2.5/unit to this market segment. The responses received regarding price acceptance from the B2C sample population is summarized below.



**Figure 16:** Percentage of respondents who agreed to pay a higher price

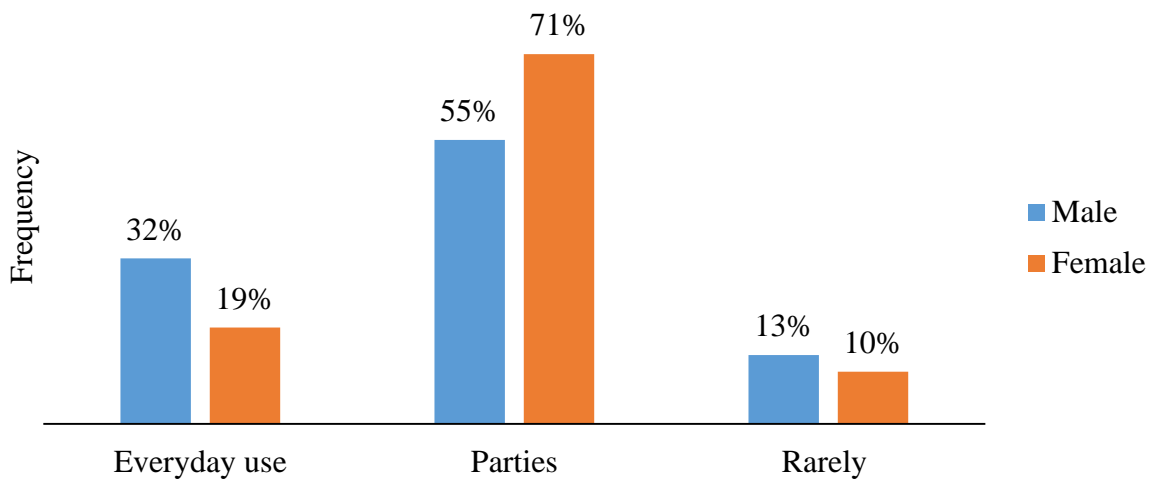


**Figure 17:** Age Bracket of respondents who agreed to pay a higher price

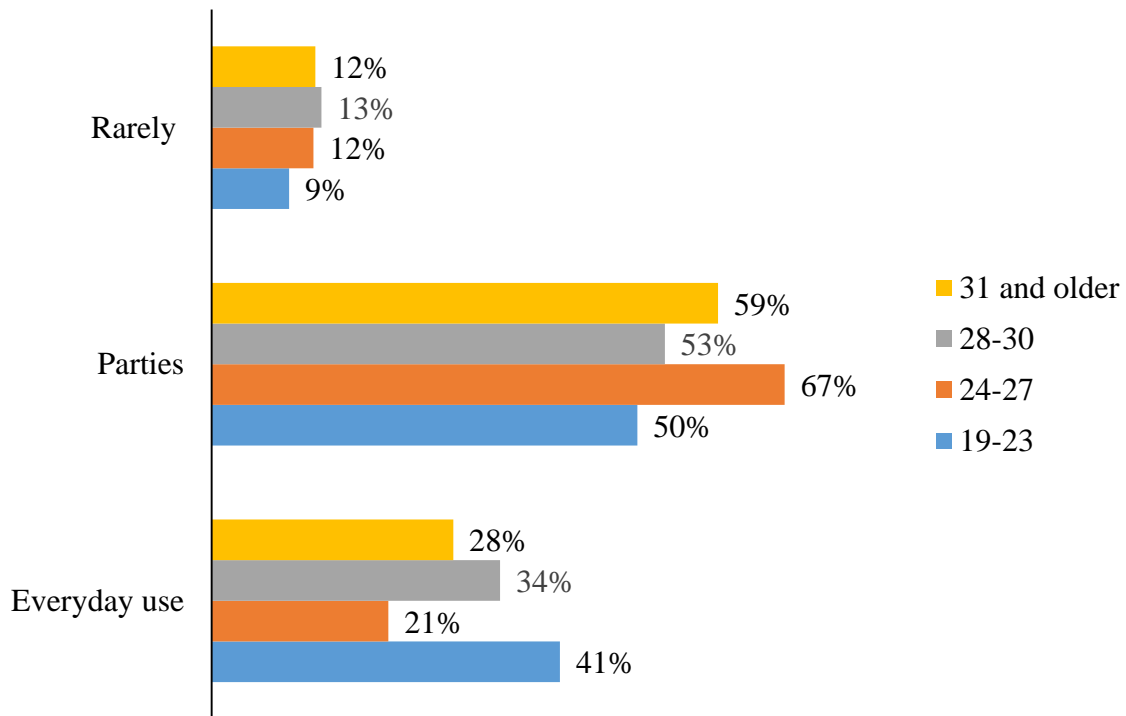
The product's price acceptance received a decisive 77 percent acceptance rate amongst the respondents with a good average acceptance rate from all the age groups. It was also found that, women had a higher tendency towards accepting environmentally sustainable alternatives compared to men, while customers under the age bracket of 31 and older, 84 percent of them chose to accept higher price for safeguarding the environment as they have comparatively higher disposable income.

**g) Purchase Frequency:**

The respondents were asked the question of purchase frequency, and although the product is not aimed to sell as mass market, the target segment of B2C usually does have lunch outside almost every working day, and has a good spend on various special occasions such as on birthdays, anniversaries, Valentine's Day, etc. From a personal experience in working in two renowned corporates, it has been observed that special occasions such as birthdays of employees are celebrated often. The responses have been summarized in the table below.



**Figure 18:** Purchase frequency of respondents



**Figure 19:** Age bracket and purchase frequency of respondents

From the above data it can be established that, the B2C customers are hardly going to be frequent buyers, and mostly purchase for special occasions as stated previously.

#### **4.4 Rejection of Null Hypothesis:**

The research hypothesis stated that the Null Hypothesis, assumes that there is no demand and acceptance for edible cutlery in the market, and the demand needs to be created. While it has been true that customers never thought of environmentally sustainable alternative to be edible, the findings have suggested that if the cutlery is available in the market, then there would be a strong demand for the product for both market segments.

The Alternative Hypothesis stated that, if we introduce an edible cutlery as an alternative to the single-use plastic cutlery, there is a demand and acceptance of at least 70 percent amongst the B2C and B2B markets. It can be argued that pricing is a major issue for both B2B and B2C markets, and price acceptance has been 44 percent and 77 percent respectively, although the



B2B customers did vote for buying the edible cutleries at a higher price if they receive adequate government incentives that would offset the dearer purchase decision. This validates the alternative hypothesis and rejects the null hypothesis.

#### **4.5 Further Research Possibilities:**

There still lies plenty of scope for further research on this topic, as stated in the research limitations. For instance, airlines industry alone has other 3 big players such as Biman, US Bangla and Regent Airways, who cater to both domestic and international flights. There are various other organizations within the six industries such as Pizza Hut, KFC, Domino's Pizza, Mr. Baker, Well Food, Cold Stone Creamery, etc., who should be surveyed for a better understanding of the product's demand position in the market. Not to mention, a wider pool of survey for B2C market in Dhaka and other areas of the country could provide a better understanding for the product to be fit for mass market production. Additionally, the supply-side analysis needs to be assessed further, in order to determine the product's ability to compete against the plastic cutlery industry.

## **Chapter 5: Conclusion**

The main goal of the research has been to establish a suitable, environmentally sustainable alternative, to the plastic cutlery that is damaging the country's biodiversity. It has been evident from all the research references that elimination of plastic is vital to achieving the SDGs and the only way to achieve this, is to implement a commercially sustainable environmentally friendly alternative, which is able to cater to the increasing demand both domestically and globally.

The research has been able to showcase consumer's awareness of the environment and their willingness to accept the necessary change. Although implementation and adoption of edible cutleries require further feasibility studies for Bangladesh market, it has been proven that the sorghum-based edible cutlery is the best option going forward when considering its frugality in water footprint, energy savings and CO<sub>2</sub> emissions.

Edible cutleries are also a viable alternative for Bangladesh towards achieving the various SDGs as it paves a new dimension of thinking out of the box, and implementing practical ways to use natural, renewable, environmentally friendly resources to satisfy consumer demands, while also ensuring sustainable usage of resources for future generations. It can realistically and directly achieve 7 of the goals and it may go on to help achieve the rest 10 for Bangladesh and rest of the world, if implemented successfully.

We believe this research to be the cornerstone for the introduction of sustainable means of consumption, production and disposal in Bangladesh cutlery industry, while also promoting sustainable agriculture, by adopting sorghum cultivation to facilitate the edible cutlery business.

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## Appendix

### 1 Absolute Values for B2B market:

#### a) Product Reaction:

Product Reaction	Gender		Count of Total Population
	Male	Female	
Very positive	6	2	8
Somewhat positive	1		1
Count of Segmented Population	7	2	9

**Table:** Reaction of the respondents towards edible cutleries

Product Reaction	Age Group			Count of Total Population
	24-27	28-30	31 and older	
Very positive	1	3	4	8
Somewhat positive		1		1
Count of Segmented Population	1	4	4	9

**Table:** Reaction and Age Bracket of the respondents for edible cutleries

#### b) Product Innovation:

Product Innovation	Gender		Count of Total Population
	Male	Female	
Innovative	7	2	9

**Table:** Count of respondents who found the product to be innovative

**c) Product Necessity:**

Product Necessity	Gender		Count of Total Population
	Male	Female	
Definitely need	7	2	9

**Table:** Count of respondents who agreed that the edible cutlery should be available in the market

**d) Product Recommendation:**

Organisation	Acceptance
	Yes
Café Crème Du La Crème	1
Gweebarra (Coopers)	1
Movenpick	1
Nandos	1
North-End Coffee Roasters	1
Peyala	1
Presley the Bakers	1
Tasty Tibet	1
Novo Air	1
<b>Grand Total</b>	<b>9</b>

**Table:** List of Organizations who agreed for product recommendation



**e) Government Support:**

<b>Organisation</b>	<b>Accepting Government Incentives</b>
	<b>Yes</b>
Café Crème Du La Crème	1
Gweebarra (Coopers)	1
Movenpick	1
Nandos	1
North-End Coffee Roasters	1
Peyala	1
Presley the Bakers	1
Tasty Tibet	1
Novo Air	1
<b>Grand Total</b>	<b>9</b>

**Table:** List of Organizations agreeing to receive government incentive for purchasing edible cutleries

## 2 Absolute Values for B2C market:

### a) Product Reaction:

Product Reaction	Gender		Count of Total Population
	Male	Female	
Very positive	114	70	184
Somewhat positive	46	34	80
Neutral	25	18	43
Somewhat negative	3	7	10
Count of Segmented Population	188	129	317

**Table:** Reaction of the respondents towards edible cutleries

Product Reaction	Age Group				Count of Total Population
	19-23	24-27	28-30	31 and older	
Very positive	11	96	33	44	184
Somewhat positive	4	41	13	22	80
Neutral	7	21	10	5	43
Somewhat negative		1	6	3	10
Count of Segmented Population	22	159	62	74	317

**Table:** Reaction and Age Bracket of the respondents for edible cutleries

**b) Product Innovation:**

Product Innovation	Gender		Count of Total Population
	Male	Female	
Innovative	135	93	228
Somewhat Innovative	49	34	83
Not at all Innovative	4	2	6
Count of Segmented Population	188	129	317

**Table:** Count of respondents who found the product to be innovative

Product Innovation	Age Group				Count of Total Population
	19-23	24-27	28-30	31 and older	
Innovative	15	111	46	56	228
Somewhat Innovative	7	47	13	16	83
Not at all Innovative		1	3	2	6
Count of Segmented Population	22	159	62	74	317

**Table:** Age Bracket of respondents who found the product to be innovative

**c) Product Necessity:**

Product Necessity	Gender		Count of Total Population
	Male	Female	
Definitely need	94	56	150
Probably need	88	66	154
Don't need	6	7	13
Count of Segmented Population	188	129	317

**Table:** Count of respondents who agreed that the edible cutlery should be available in the market

Product Necessity	Age Group				Count of Total Population
	19-23	24-27	28-30	31 and older	
Definitely need	11	79	27	33	150
Probably need	11	78	31	34	154
Don't need		2	4	7	13
Count of Segmented Population	22	159	62	74	317

**Table:** Age Bracket of respondents who agreed that the edible cutlery should be available in the market

#### d) Product Recommendation:

Product Recommendation	Gender		Count of Total Population
	Male	Female	
Yes	179	121	300
No	9	8	17
Count of Segmented Population	188	129	317

**Table:** Count of respondents who agreed to recommend the product

Product Recommendation	Age Group				Count of Total Population
	19-23	24-27	28-30	31 and older	
Yes	22	150	55	73	300
No		9	7	1	17
Count of Segmented Population	22	159	62	74	317

**Table:** Age Bracket of respondents who agreed to recommend the product

**e) Price Acceptance:**

Price Acceptance	Gender		Count of Total Population
	Male	Female	
Yes	141	102	243
No	47	27	74
Count of Segmented Population	188	129	317

**Table:** Count of respondents who agreed to pay a higher price

Price Acceptance	Age Group				Count of Total Population
	19-23	24-27	28-30	31 and older	
Yes	20	118	43	62	243
No	2	41	19	12	74
Count of Segmented Population	22	159	62	74	317

**Table:** Age Bracket of respondents who agreed to pay a higher price

**f) Purchase Frequency:**

Purchase Frequency	Gender		Count of Total Population
	Male	Female	
Everyday use	60	24	84
Parties	103	92	195
Rarely	25	13	38
Count of Segmented Population	188	129	317

**Table:** Count of purchase frequency of respondents

Purchase Frequency	Age Group				Grand Total
	19-23	24-27	28-30	31 and older	
Everyday use	9	33	21	21	84
Parties	11	107	33	44	195
Rarely	2	19	8	9	38
Grand Total	22	159	62	74	317

**Table:** Age bracket and purchase frequency of respondents

### 3 B2C Survey Form:

Product: Sustainable Cutleries

Features: Environmentally friendly utensils.

Biodegradable and completely opposite to the conventional plastic cutleries.

Organic product, does not contain any artificial chemicals, preservatives, pesticides.

**Special Feature:** Edible-Have it too after you are done eating!

---

1. Gender: a) Male b) Female
2. Age:  
a) 19-23                      b) 24-27                      c) 28-30                      d) 31 and above
3. What is your first reaction to the product?  
a) Very positive                      c) Neutral                      e) Very negative  
b) Somewhat positive                      d) Somewhat negative
4. How innovative is the product?  
a) Innovative                      b) Somewhat innovative                      c) Not at all innovative
5. When you think about the product, do you think of it as something you need or don't need?  
a) Definitely need                      b) Probably need                      c) Don't need
6. Price of plastic spoons are BDT 100/bag of 100 spoons, but the sustainable spoon would cost higher, such as BDT ±250/bag. Would you buy this product instead of the plastic substitute?  
a) Yes                      b) No
7. Please state how often would you like to purchase the product:  
a. Everyday use                      b. Parties (Occasionally)                      c. Rarely
8. Would you recommend about this product to a friend/family:  
a) Yes                      b) No

**Please note the purpose of this survey is strictly for academic publications. Your answers below would not be shared with any third party associations.**

#### 4 B2B Survey Form:

- Product: Sustainable Cutleries
- Benefits: Environmentally friendly utensils.  
Biodegradable and completely opposite to the conventional plastic cutleries.  
Organic product, does not contain any artificial chemicals, preservatives, pesticides.
- **Special Feature:** Edible-Have it too after you are done eating!

- 
1. Name of the Organisation: \_\_\_\_\_
  2. Designation of the Respondent: \_\_\_\_\_
  3. Gender: a) Male    b) Female
  4. Age:  
a) 24-27                                  b) 28-30                                  c) 31 and above
  5. What is your first reaction to the product?  
a) Very positive                                  c) Neutral                                  e) Very negative  
b) Somewhat positive                                  d) Somewhat negative
  6. How innovative is the product?  
a) Innovative                                  b) Somewhat innovative                                  c) Not at all innovative
  7. When you think about the product, do you think of it as something you need or don't need?  
a) Definitely need                                  b) Probably need                                  c) Don't need
  8. Please state your daily demand for plastic cutleries: \_\_\_\_\_
  9. Price of plastic spoons are BDT 100/bag of 100 spoons, but the sustainable spoon would cost higher, such as BDT ±350/bag. Would you buy this product instead of the plastic substitute?  
a) Yes    b) No
  10. If No, please state at what price you would like to buy it: BDT \_\_\_\_\_
  11. Please state how often would you like to purchase the product:  
a) Everyday use  
b) Special Events (e.g. birthdays)  
c) Not Interested
  12. If you do not wish to purchase the product due to high price, would you consider buying the product if government incentives were given to you?  
a) Yes    b) No
  13. Would you recommend this product to your various stakeholders:  
a) Yes    b) No