Re-Food: Digital Platform-based Innovation Solutions for National Food Waste Problems

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Abstract. The problem of food waste in Indonesia is an important issue to overcome. Indonesia is the second-largest producer of food waste in the World. This makes national food waste issues get more attention. This paper aims to identify problems in food waste prevention, to formulate prototype of food waste application, to design digital platform-based business models innovation that complies with consumer preferences, and to map the impact generated by the presence of Re-Food. The method used are the customer discovery method with a qualitative descriptive approach and business model innovation methods. The results of this paper are verified social enterprise business model innovation offering an application that can help in utilizing excess food and help in the social problems of hunger and poverty. The potential impact generated by the Re-Food business model is the opportunity to contribute to social problems by utilizing environmental issues and increasing education on environmental issues, especially in food waste issues.

Keywords: application, customer discovery, food waste, social enterprise

1. Introduction
Global warming is one of the problems that causes an increase in the average temperature of the earth and the high surface of seawater, prolonged drought, and the effect of greenhouse gases. Global warming is caused by many things, one of the causes of global warming is garbage. Trash also causes increased greenhouse gases and decreased air quality. The composition of garbage in the world is dominated by food waste or food waste with composition as much as 46%. Food waste is a food that is discarded where food products or alternative food products are still safe and nutritious for consumption [1].

The FAO Data shows that the consumer's food waste per capita is between 95-115 kg per year in Europe and North America, while consumers in sub-Saharan Africa, south and southeast Asia, each only dumping 6-11 kg per year [2]. The Data shows that the developed countries have higher per-capita than developing countries in food waste issues. The FAO Study Report [2] states that the amount of food wasted enough to feed to 800 million is poor in the world.

According to [3] Indonesia is the second largest producer of food waste in the world by producing a per capita of 300 kg of food waste each year. Indonesia produces a food waste annually of 13 million tonnes in its defence, the waste can be consumed by 28 million people and valued at Rp 27 trillion or amounting to approximately US $2 billion [2].

The development of information technology advances can be one way to support and impact the food waste problem. Internet users in Indonesia in 2019 reached 107.5 million and increased by 13 percent compared to the year 2018 [4]. It is expected to continue to grow in 2023 with 150 million people. The magnitude of Internet users causes the impact and knowledge of food waste.

Re-Food is a digital platform using the food sharing scheme with the merger of opportunities and food waste problems that produce the form of business model and prototype. Re-Food aims to connect Re-Food users to purchase excess food from Re-Food partners and to provide excess food on pre-consumer waste to the intended party in order to reduce the food waste produced and help reduce hunger. This paper aims to identify problems in food waste prevention, to formulate prototype of food waste application, to design digital platform-based business models innovation that complies with consumer preferences, and to map the impact generated by the presence of Re-Food.
2. Materials and Methods

2.1 Data
The technique of data retrieval in this study uses non-probability sampling with the purposive sampling technique in-depth interviews with middle-income community criteria, NGOS for co-creator elements and middle to lower income communities for beneficiary. The number of respondents on the problem test was 50 in accordance with the recommendations on the books [5]. In the test phase of the solution, the number of respondents was 34 potential people who were the result at the test stage.

2.2 Customer Development
The Customer Development is a four-step framework to find and validate that you have identified the market for your products, built the right product features to solve customer needs, test the right methods to acquire and convert customers, and use the right resources to scale up the business. This framework was introduced by [5] in his book The Four Steps to The Epiphany.

2.3 Social Enterprise Business Model Canvas
The difference between the Social Enterprise Business Model Canvas and the conventional Business Model Canvas [6] is that the determination of the product and consumer segments begins with the company's mission so that on the Social Enterprise Business Model Canvas plus the mission element that contains the objectives that you want to achieve and will be the basis for decision making. Avoiding the ambiguity and describing the relationship between the customer segment and value proposition elements, is done adaptation of the addition of dashed lines on this element. This dashed line will separate the value proposition and customer segment based on co-creator (the party that created the value) and beneficiary (beneficiary Party) [7].

![Social Enterprise Business Model Canvas](image)

**Figure 1.** Social Enterprise Business Model Canvas

3. Results
The Re-Food application was created from the many food waste produced by the people in Indonesia to occupy the second largest in the world in 2017 [3]. On the other hand, there are still many people in Indonesia who are still in the poverty line that can not be adequate daily eating. This phenomenon is A's dilemma because Indonesia ranks to two for the capita in food waste but there are still many who experience hunger. Re-Food is present to help food sovereignty in Indonesia with better redistribution of food access and creating a more equitable food access for poor people and poor nutrition in children.

One of the NGO that raises the issue of food waste utilization by providing food access in Indonesia is Foodbanks of Indonesia located in DKI Jakarta province. Foodbanks of Indonesia or commonly called FOI that was established since the year 2015 has an activity that is to channel the food gained from the industry of the Boga Service company which is then channeled to the local volunteer or foodbank to be channeled to the right. FOI-owned programs include shining Sun, mother wings, and food posts.

Re-Food An application that can help as a means of redistribution of food access in a massive and equitable way to help NGO activities. Re-Food distributes excess food for free to people who are right like middle-to-lower
society. The birth of Re-Food is expected to reduce the number of bad nutrition, poverty, and the main thing is food waste.

The hypothesis of this business model was conducted with the collection of literature studies and pre-research interviews to Foodbanks of Indonesia. The hypothesis serves as a framework for researchers to make it easier to provide the working direction and preparation of this research can be seen in Appendix 1.

3.1 Problem Test

The problem test was done by spreading a mixed questionnaire with an in-depth interview method to gain insight and problems from potential customers. This research has received respondents as many as 50 people. This research through the test phase of the problem twice because it uses data that can be from two types of potential customers, namely co-creator and beneficiary with respondents respectively as much as 25 people.

Here are the problems faced by potential users and solutions provided by Re-Food based on the order of problems most encountered by potential users can be seen in Table 1.

| Customers Problems | The Solutions Offered |
|--------------------|-----------------------|
| 1. Food quality is not assured | 1. Providing food eligibility information in the form of creation date |
| 2. Difficulty in meeting the needs of eating | 2. Provide free food provided by Re-Food through the application |
| 3. An elusive application | 3. Re-Food through the application |
| 4. An elusive application | 4. Provide free food provided by Re-Food through the application |
| 5. Not practical if bring your own place | 5. Add the delivery feature |
| 6. Limited Payment features | 6. The catering service company will provide a place by adding certain fees |
| 7. Limited Payment features | 7. Add the Payment gateway feature |
| 8. Worry about the service provided | 8. To add payment and security options |
| 9. There is no legal in Indonesia that governs the management of food waste | 9. Submitting Disclosure reports on donation information |
| 10. Minimum excess food education | 10. A hotline is available to help in case of any unwanted waste |
| 11. Lack of infrastructure to perform equitable distribution of excess food deficiency in terms of income because it depends only on donations | 11. Conduct education and food waste prevention training |
| 12. Add ad columns on the digital Re-Food platform | 12. Conduct education and food waste prevention training |

3.2 Making Prototype Product

The creation of prototype products is necessary when conducting a test solution to show the prototype to potential users to understand more about Re-Food. Prototype This application is made through the app maker's website marvelapp.com. Marvelapp.com is a website that can assist in the creation of mock-ups of an application and has an easy thing that is to change the page you want to go without coding. The display of this prototype can be seen in Figure 2.
3.3 Solutions Test
Test solution is the third stage in the customer discovery stage. Test solution is done to know the suitability between business model canvas and prototype that has been made to solve problems in potential respondents. The purpose of testing solutions to get other elements in the business model developed on the Social Enterprise Business Model Canvas 2.

Re-Food has some of the main features consisting of food around me, food hero, my order, and my reward. These features are supported with other supporting features including delivery, payment gateway, product creation information. In this test solution all the main features and supporting features are tried to know the interest and satisfaction in using Re-Food.

The food around Me feature is presented in the prototype of an interesting and easy Re-Food application as much as 100% of respondents in making it easier to find excess food. The supporting feature of food making information on food around me has an interest of 97% Respondents in informative food making information, but there is a 3% Respondents saying that food making information is less informative and interesting to see. The delivery and payment gateway features that are intended for co-creator group respondents have a 100% interest in the delivery and payment gateway features to provide convenience and practicality in using Re-Food. The use of Payment gateway feature of Re-Food in conducting transactions is quite easy, it is said as much as 100% of respondents co-creator group said that the transaction on Re-Food is easy and safe.

The Food Hero feature has an interest of 100% of respondents co-creator group in channeling donations through Re-Food and the transparency of donations made as much as 67% of respondents agreed if the report on donations in social media publications and as many as 33% of respondents said that it would be more agree if donation reports are sent by email each user. In the feature my reward has a total of 92% of respondents in increasing the loyalty and frequency of using Re-Food applications.

3.4 Verification SE BMC
Verifying the business model aims to determine the suitability of the business model already made based on action results. The verification phase will see if the products and features offered meet the product market fit will be verified. According to Blank and Dorf (2012) There are three ways to verify the business model is the analysis of product suitability with the market, large consumer segments and business channels, as well as the business ability to generate profits.

3.4.1 Analysis of Product Suitability with The Market
The first component is the level of interest in consumers. Through testing the problem resulted in problems that the respondent felt urged. This can be the respondent's answer to the problem test that resulted in some problems. The second component is the products and features that can address consumer problems. Based on the results of the data obtained from the solution test showed that the respondent agrees that the solution given by Re-Food can solve the problems experienced by the respondent by saying that the solution has answered problems experienced by users and as much as 97% of respondents feel interest in using Re-Food applications.

The third component is the number of markets to give the business a profit. The amount of market or size of this market is from potential users who will use and transact in Re-Food. With the analysis of TAM's SAM TM obtained by 6.64 million people is a prospective user from Re-Food so it concluded that there is enough market for Re-Food to be a business opportunity.

3.4.2 Large Consumer Segments and Business Channels
The consumer segment of Re-Food is divided into 2 sub-segments, namely co-creator and beneficiary. On the co-creator of the consumer segment consists of upper middle class and donor community. How to reach these consumers by using online and offline channels such as social media, Re-Food applications, public dialogue. In beneficiary that consist of middle class community can reach by way of partnership with existing NGO and social
media. The use of social media in both sub-segments because the results showed that 98% percent of respondents used social media and connected to the Internet.

3.4.3 The Business Ability To Generate Profits

In social enterprise, revenue is a very important thing. Revenues will greatly affect sustainable business activities. Therefore, Re-Food must have the financial income and profit so that the business can run and continue. Re-Food Application revenue consists of transaction administration fees, donations, and advertisements. In solution test as much as 100% of respondents agreed with the cost of administration of transactions in the Re-Food application. A total of 61% of respondents agreed with a fee of Rp. 2,000 and 39% of respondents agreed to the cost of Rp. 1,000. Advertising becomes one of the revenue streams in the Re-Food app. A total of 88% of respondents said it agreed if there were ads on the Re-Food app. The last revenue channel is donation. Donations derived from food hero features are expected to be a source of income on Re-Food applications.

3.5 Verified of Social Enterprise Business Model Canvas

The business model update is done to get the changes that correspond to the solution desired by the Re-Food user. Re-Food also added some features to support and evaluation of user incompatibility in using Re-Food. SE BMC Re-Food that is verified can be seen in Appendix 2.

5. Discussion

The strategy in reducing food waste has been launched by the [1] entitled Reducing Food Wastage Footprint which illustrates the food waste reduction strategy in the inverted pyramid that the order of priority starts reduce, reuse, recycle & recover. Reduction of food loss and leftovers greatly affects the increase in availability availability.

It is found that Osterwalder’s Business Model Canvas cannot completely capture the business model of a social enterprise. From literature review and analysis on social enterprise and social entrepreneurship, business model and Business Model Canvas, additional building blocks are necessary to understand how social enterprise creates, delivers and captures value. They are Mission and Impact & Measurements blocks.

In Mission block, it is stated the purpose of the social enterprise, its reason of existing. It does not only state the problem but also the customer, the method and the impact in one clear sentence. It acts as the guidance for the enterprise. The Impact and Measurements block describes the benefits for the customers of the social enterprise as the indicators of the success and progress of the social enterprise. The additional blocks also change the sequence of the building blocks starting from Mission, (2) Customer Segments, (3) Value Propositions, (4) Channels, (5) Customer Relationships, (6) Revenue Streams, (7) Key Resources, (8) Key Activities, Key Partnerships, (10) Cost Structure, and (11) Impact & Measurements [7].

Ribiero, et al [9] conducted a research titled A Sustainable Business Model to Fight Food Waste. This research uses quantitative methods using triple layer business model canvas and social return on investment. The purpose of this research is to analyse the sustainability of a new business model aimed at functioning as a practical and emulable solution to food waste problems and to change paradigms in society regarding the consumption of fruit and vegetables following aesthetic rules. Food waste research is seen on all environmental, social and economic indicators analyzed according to the methods set differently from LCC and LCA to S-LCA and SROI. Positive results proved the success of this model and have been tested in Lisbon for more than two years.

Xiao and Siu [10] conducted a study titled Challenges in Food Waste recycling in high-rise buildings and public design for sustainability: A case in Hong Kong. Research uses qualitative methods with triangulation data. The purpose of this research is to analyse the level of effectiveness on the Food waste Recycling Program (FWR) on high buildings. Data collection is done with a semi-structured interview with respondents as many as 30 people. The results of this study show that effective management and high quality on public design for collaboration are an effective way to facilitate behavioral change. Approaches that include sorting, collecting, and gardening, can be described as active strategies or ‘ from passive to active ‘. This is a potential approach to increasing the motivation of residents to the FWR program in tall buildings.

This research is a qualitative research so that primary data is obtained by in-depth interview methods with mixed question types. The instrument in the study was an interview script then the data from the interview was reduced to get the results experienced by the respondent. For secondary data are obtained from theses, journals, and data from related agencies.

In testing the problem, data analysis began with the transcription of the interviews into writing. The transcription results are then analyzed using reduction techniques and categorisation. Data reduction techniques are the process of selection, attention-centered and simplification, abstracting and transformation of abusive data arising from written records in the field. Categorisation is done after data reduction. This technique is used to classify answers to statements from respondents to separate the category of problems encountered and potential customer segments.
A potential customer segment is determined if it meets five parameters predefined by the researcher. Data analysis on solution testing is done similarly to testing issues in which the interview results will be transcribed, then reduced, categorized and then verified or matched with the business model. The categorization technique at this stage is performed to classify respondents’ responses to product solutions, features, product views, and sales channels.

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Acknowledgment
We would like to thank Foodbanks of Indonesia for providing and helping us to make this research accomplish and to School of Business IPB University for publication funding.
APPENDIX

Appendix 1. Hypothesis of Social Enterprise Business Model Canvas (BMC)

**Mission**
- Assisting food sovereignty in Indonesia with better redistribution of food access
- To make a real impact on social problems (poverty and hunger) by utilizing environmental problems (FOOD WASTE)
- Supports government programs related to waste management (provincial regulations of DKI Jakarta No. 4 year 2019)

| Key Partnership | Key Activities | Value Proposition | Customer Relationship |
|-----------------|----------------|-------------------|-----------------------|
| Food Company    | Survey and collection of donor and partner data | [Co-creator] Get food prices below the market price | [Beneficiary] Reward points |
|                 | Digital development Platform | Alternatives to donate | |
|                 | Partnership development | Food around Me features | |
|                 | **Key Resources** | Help campaigning for food waste issues | |
|                 | UI dan UX digital platform | Food Hero features (donation) | |
|                 | Financial | Beneficiary | |
|                 | Human Resources | Get excess food for free to help reduce hunger | |
|                 | Intellectual Resources | Food Around Me Features | |

| Cost Structure | Revenue Streams |
|----------------|-----------------|
| Payment of free food | Donation |
| Maintenance digital platform | Sales Food Commission |
| Operational Cost | |
| Marketing Cost | |

**Impact and Measurement**

**Impact**
- Opportunities contribute to social impact (hunger and poverty) by utilizing environmental issues (food waste)
- Increased education on environmental issues, especially in food waste issues

**Measurement**
- Decrease in food waste rates on bps data and other literary study data
- Declining poverty rate and hunger for BPS data and other literary studies
Appendix 2. Verified Social Enterprise Business Model Canvas (BMC)

| Mission |  |
|---------|  |
| • Assisting food sovereignty in Indonesia with better redistribution of food access | |
| • To make a real impact on social problems (poverty and hunger) by utilizing environmental problems (FOOD WASTE) | |
| • Supports government programs related to waste management (provincial regulations of DKI Jakarta No. 4 year 2019) | |

| Key Partnership | Food Company | OVO, Gopay, Dana | Gojek, Grab |
|-----------------|-------------|-----------------|-------------|
| Key Activities  | Survey and collection of donor and partner data | Digital development Platform | Partnership development |
|                  | Education of food waste |  |  |

| Value Proposition Co-creator |  |
|-----------------------------|  |
| • Get food prices below the market price | |
| • Alternatives to donate | |
| • Food around Me features | |
| • Help campaigning for food waste issues | |
| • Food Hero features (donation) | |
| • Product eligibility information | |
| • Delivery features | |
| • Payment gateway features | |

| Customer Relationship |  |
|----------------------|  |
| • Reward points | |
| • Open reports on donations | |
| • Training and knowledge of health and the environment | |
| • Consumer complaints Hotline | |
| • Online consumer complaints chatbot | |
| • Flash Sale Features | |

| Channels |  |
|----------|  |
| • Digital platform | |
| • Partnership with NGO | |
| • Social media | |
| • Public dialogue on food waste and poverty | |

| Key Resources | UI dan UX digital platform | Financesial | Human Resources | Intellectual Resources |
|---------------|---------------------------|------------|----------------|----------------------|

| Cost Structure |  |
|----------------|  |
| • Payment of free food |  |
| • Maintenance digital platform |  |
| • Operational Cost |  |
| • Marketing Cost |  |
| • Education & training cost |  |

| Revenue Streams |  |
|-----------------|  |
| • Donation |  |
| • Sales Food Commission |  |
| • Advertisement |  |

| Impact and Measurement |  |
|------------------------|  |
| Impact |  |
| • Opportunities contribute to social impact (hunger and poverty) by utilizing environmental issues (food waste) | |
| • Increased education on environmental issues, especially in food waste issues | |
| • Making rules governing excess food utilization | |

| Measurement |  |
|-------------|  |
| • Decrease in food waste rates on bps data and other literary study data | |
| • Declining poverty rate and hunger for BPS data and other literary studies | |