

Bridging Hunger and Food Surpluses through Food Bank (Case study: Food Bank Neder-Veluwe, Wageningen)

Gendis Ayu Satiti Irawan^{1†}, Muchammad Gumilang Pramuwidyatama², Lous van Vloten-Doting¹

¹ Food Bank Neder-Veluwe, Industrieweg 22, 6702 DE, Wageningen, The Netherlands

² Business Economics Group, Wageningen University & Research, Hollandseweg 1 6706 KN, Wageningen, The Netherlands
gendis.as@gmail.com

Abstract. Despite the prominent role of food banks throughout the world to bridge hunger and food surpluses, the evaluation of the impacts of food banks is still lacking. This study aims to analyze the impact of a food bank (i) to address food security, (ii) to the economics of household, and (iii) to the preventable food waste and GHG emission. A random sampling of food crates and interview were done to inventories food products in food parcels. Food Bank Neder-Veluwe (FBN) distributes food packages that are estimated to be able to fulfill the dietary needs of 36% (single member household), 39% (two-, three-, and five- member household), and 25% (four-, six-, seven-, and eight-member household) of the total recipients of the FBN for 4, 2, and 1 day(s) respectively. The range of estimated economic value of food packages received is 92-219 euro per month per household, depending on the number of family members in the household. Also, the estimated preventable food waste and GHG emission are approximately 148.27 tons per year and 387.88 tons CO₂-eq per year. Our result shows that the food bank scheme has a potential to bridge hunger and food surpluses at the local level.

Keywords: Food bank, distribution management, food security, food waste

1. Introduction

The dilemmatic hunger and food waste have been a part of the global attention. The issue of hunger and food waste are included as the sustainable development goals (SDGs) 2 and 12.3. Food waste is not only a significant problem for the economy and food security of a nation but also for the environment with regards to the insufficient use of natural resources and generation of the greenhouse gas (GHG) emission [1]. In 2016, the number of hungry people in the world is estimated to have increased to 815 million, almost two times the total population of the European Union [2]. Individuals who have hunger and malnutrition problem are more prone to get sick which leads to being less productive and, consequently, unable to work to improve their livelihood. Meanwhile, one-third of food in the global world is roughly estimated have turned into food waste [3].

A food bank scheme has been developed as a local and direct measure that bridges the food waste and hunger issues, particularly in urban areas. As firstly introduced in 1967 in the US, the main idea of food banks is to deliver food surpluses directly from food manufacturers, retails, households, and individuals to the people in need at the local level [4]. The notion that the food bank scheme offers a

promising solution to prevent certain forms of food waste is also evidenced by their growth in the developed countries as shown in the US, Canada and Europe countries including the Netherlands [5].

In the Netherlands, the number of food banks has grown since the first food bank was established in 2002. During 15 years of its operation, food banks in the Netherlands have grown to 167 local food banks, under the national food bank network, namely *Voedselbanken Nederland*, and have distributed approximately 40 million food products per year for 135,000 receivers in 2016 [6]. The development of food bank not only has impacts on supporting the livelihood of poor households but also on the environment regarding the reduction of food waste by 1.5% of total food waste in the Netherlands [6]. The increasing number of food banks is argued to be caused by the increasing of ‘demand’ of food banks, as the rate of deprived households in the Netherlands steadily increased over past years [5] and, possibly, the robustness of the system in food bank scheme.

Despite the prominent role of food banks throughout the world, the evaluation of the impacts of food bank with regards to food security, economic of household, and the environment is still lacking. Studies are scattered, such as the study of the economic and environmental impact of food loss [7] and the impact of food banks to household food security [8]. Thus, the evaluation with regards to the impacts of food banks is essential. Particularly, the evaluation of food parcels distributed by food banks can provide information with regards to the sufficient provision of food, the economic value of food parcels, and the preventable food waste which later can be converted to prevented GHG emission.

Therefore, this study aims to analyze the impact of a food bank on (i) addressing food security and food surpluses, (ii) the economics of household, and (iii) the preventable food waste and GHG emission. The information of this study can later be used to the development of food banks in the world. For this study, we used a study case of the food bank scheme in Food Bank Neder-Veluwe, Wageningen, the Netherlands.

2. The supply chain of Food Bank Netherlands (Neder-Veluwe)

The FBN is a volunteer-based organization of which all activities in FBN are conducted by volunteers. The primary activities in FBN can be divided into three parts such as food acquisition, food controlling and sorting, and food distribution.

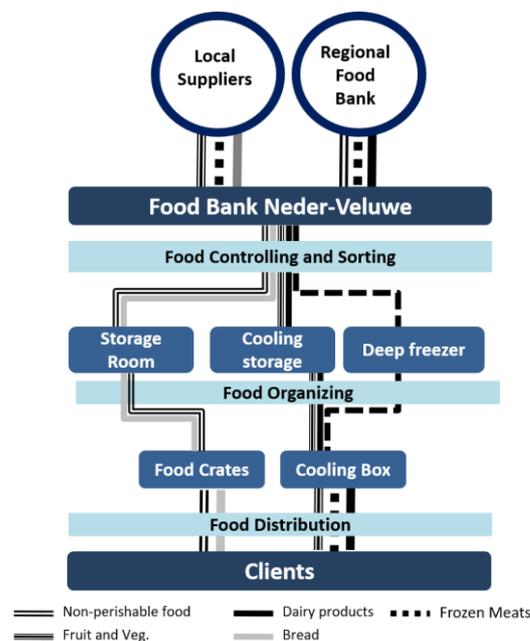


Figure 1. Food flow in Food Bank Neder-Veluwe.

2.1 Food acquisition

The food supply comes from two sources: local suppliers and Regional Food Bank Arnhem. Local suppliers consist of retailers, local food companies, and local farmers, as well as donations from individuals who directly give food surpluses to FBN or through collective ways (e.g., via churches). The local suppliers provide mostly perishable foods such as fruits, vegetables, meats, and dairy products. In addition, the Regional Food Bank Arnhem delivers basic food packages such as meats (including beef, pork, chicken, fish, and 'vegetarian' meats), dairy products, and perishable foods.

2.2 Food controlling and sorting

Food controlling aims to ensure the food that will go to the recipients' hands meet the food safety requirements set by the government. The food controlling is undertaken by identifying the label of the products. Food sorting comprises categorizing and arranging a number of food items which will be distributed to the recipients (clients). Perishable foods are stored in the deep freeze, fridge, or directly packaged into cool boxes while non-perishable food is kept in a storage room or goes directly into the food crates.

2.3 Food distribution

The food parcels are distributed on a weekly basis to approximately 600 people from 200 households in five different regions such as Wageningen, Renkum, Doorwerth, Oosterbeek, and Elst. The eligible people who meet the criteria (i.e. The basic income of the clients is € 130 per month, plus € 85 per person) will get a maximum of three years food assistance.

3. Methodology

3.1 Data collection

We conducted random sampling and inventoried one food crate for each household size four times (i.e., once a week) in February 2018. The food items in the food crate were categorized (i.e., perishable, non-perishable) and listed them by brand name, size, and amount. In addition, interviews with the staffs in charge were done to complete the inventory of food that is not in the food crate but will be given to the clients during the distribution session (e.g., frozen products, perishable products, and bread). The data were calculated using Microsoft Excel 2016.

3.2 Data Analysis

For the first objective on addressing food security issue, we compared the data of the amount of food in the food packages with suggested portion size from the Netherlands Food Center (*Voedingscentrum*) to estimate the contribution of the food package in fulfilling the dietary needs of clients.

For the second objective of economic valuation of food parcels, we used the price of products' brand in the supermarkets. We assumed that the value of the food items is 50% of the selling price. There are different products in each food category with different prices so that we made a range of prices from the cheapest to the highest price in the supermarkets.

For the third objective, we used the Food Emission Calculator by *CleanMetrics*TM [9] to estimate GHG emission. We estimated the preventable food waste and GHG emission by looking into the amount of food surpluses that redistributed to clients. The GHG emission is generated from three sources such as food production, transportation, and waste management when the food turned into waste (the packaging waste management does not account in this calculation). Within the calculation, we assumed that all products are produced in the Netherlands for the sake of simplicity of the calculation.

4. Results and discussion

This section highlights several aspects such as the amount and composition of food parcels, the comparison between food received by the clients and suggested dietary needs, the economic value of food parcels, and potential preventable food waste and GHG emission.

4.1 Food amount and composition

We listed and categorized all food items into eight food categories such as fruit and vegetables, meats, beans, dairy products, potato and grain products, bread topping, snack, and others (Table 1). Each food item might be varied weekly, but the representative from each category is always present.

Table 1. List of food items found during the sampling.

Category	Food items
Fruits	Fresh fruits (e.g., apple, pear, orange), and canned/bottled fruits (e.g., canned pineapple, squeezed orange).
Vegetables	Fresh vegetables (e.g., cabbage, zucchini, paprika, tomato, carrots, cauliflower, broccoli, lettuce) and canned vegetables (e.g. carrots, green beans, and tomato)
Meats	Frozen meats (Pork, beef, chicken, lamb, fish (e.g., Herring, salmon, pangasius, mackerel), 'vegetarian meat,' canned meat (tuna, sausage, beef).
Beans	Mixed nuts (almond, peanuts, and cashew), canned red beans.
Dairy products	Milk, cheese, butter, yogurt, and <i>quark</i> .
Breads	Whole wheat breads, white breads, 'luxury breads' (e.g. <i>croissant</i> , <i>baguette</i> , sweet breads).
Potato and grain products	Potato, rice, rice noodle, couscous, wrap, flour, oats, corn, pasta, granola, cereal, and noodle
Spreads	Chocolate sprinkle, peanut butter, chocolate spread, and apple jam
Snacks and beverages	Chips, salty crackers, sweet biscuits, chocolate bars, candies, cakes, and beverages (e.g., soda, fruit-flavored drinks, coffee drink)
Others	Soup (powder and liquid), pasta sauce (powder and liquid), sauces (Mayonnaise, ketchup), margarine, coffee, and tea.

Note: We separated bread from 'potato and grains products' category because the supply of bread is always present considerably compared to other food items in 'potato and grain products'.

Table 2 shows that each family receives 8-19 kg of food per household depending on the family size. The composition of each food category is relatively similar among the different sizes of the family. Food categories that have the biggest amount are snacks and beverages (20%), dairy products (18%) and meats (13%).

Table 2. Amount of food items per crates.

Food Categories	Food items received for different family size (grams)								(%)
	1	2	3	4	5	6	7	8	
Fruits	430	595	640	465	945	838	843	730	4.7
Vegetables	667	873	1,072	1,346	1,328	1,624	1,841	1,793	9.1
Breads	450	450	900	900	1,350	1,350	1,350	1,350	7.0
Grains product	616	671	1,046	1,406	1,243	1,216	1,410	1,613	8.0
Potato	875	1,125	875	875	875	875	875	500	5.9
Meats	1,000	1,000	1,733	1,646	2,071	2,000	3,040	3,000	13.4
Beans	133	143	133	538	410	400	400	600	2.4
Dairy products	1,608	1,773	2,173	2,105	3,049	3,049	3,527	3,356	17.8
Snacks and beverages	1,618	2,737	3,026	2,716	3,233	2,878	3,355	3,875	20.3
Spreads	977	1,288	1,052	902	977	1,480	1,580	1,110	8.1
Others	395	446	380	537	484	474	474	605	3.3
Total	8,768	11,101	13,029	13,436	15,965	16,184	18,694	18,533	100.0

Figure 2 depicts the amount of food received per person in different size of the family. We assumed that on average the portions used by children, man and women equals the portions indicated for female adults indicated by the *Voedingcentrum*. The clients with small size-family received (almost 3-4 times) higher amount of food than in large size-family (family number 5-8). The single-member family clients received the highest amount of food, 8.7 kg/person/week while the large size-family received 2.3-3.2 kg food/person/week. Our result shows that there is an inequality in the distribution of food, particularly to the single-member family.

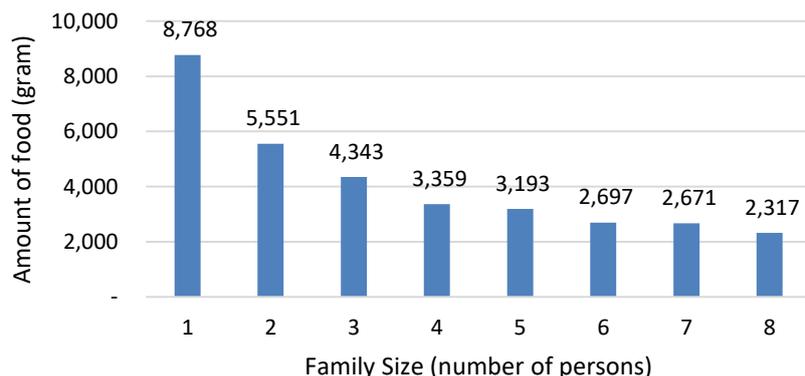


Figure 2. Food received per person for different household sizes.

We compared the food received with the suggested portion from the *Voedingcentrum*. Table 3 shows some days needed to consume the amount given for each food category. The overall food parcels can be last for 1-4 days.

Table 3. Estimation of time needed for consuming all food items from food parcels (days).

Type of food	Number of Days per family size								Median
	1	2	3	4	5	6	7	8	
Fruits	2	1	1	1	1	1	1	0	1
Vegetables	3	2	1	1	1	1	1	1	1
Bread	3	1	2	1	2	1	1	1	1
Potato	2	1	1	1	1	1	1	1	1
Grains product	9	6	3	2	2	1	1	1	2
Meats	10	5	6	4	4	3	4	4	4
Beans	5	3	2	5	3	3	2	3	3
Dairy products	5	3	2	2	2	1	1	1	2
Spread/cooking fats	24	16	9	5	5	6	6	3	6
Median	4	2	2	1	2	1	1	1	

Note: We used suggested portion for adult women because the clients are mostly female.

4.1. The economic value of food parcels

Figure 3 shows the ranges of economic value of weekly food parcels received for different family sizes. We assume that the value of the food item is 50% of the normal price in the supermarket to avoid an over estimation of food parcels' value. Thus, on average, the economic value of a food parcel is at least approximately 23-55 euro. The money that can be saved by clients is approximately 92-219 euro/month. As the basic needs of single clients and family with eight members family are 215 euro and 810 euro per month, respectively, the value of food parcels contributes to 43% and 27% of the basic living cost of single and eight-members family, respectively.

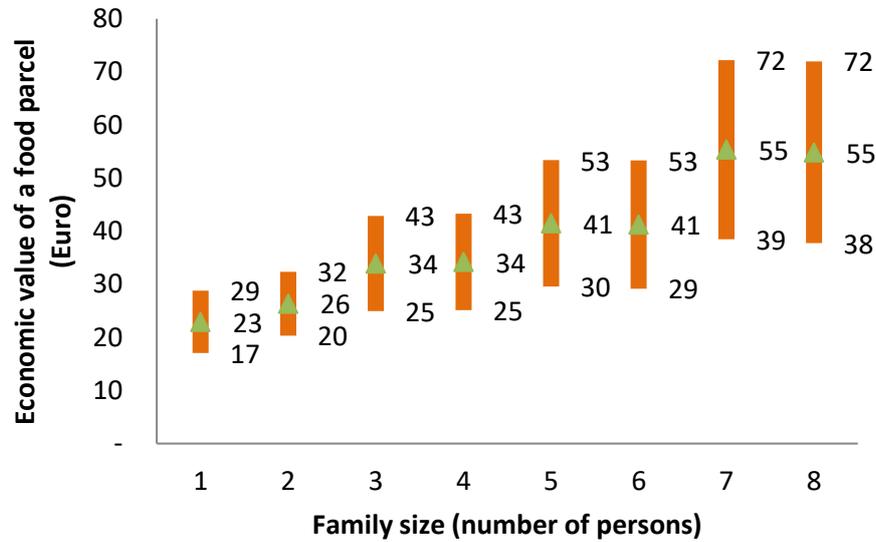


Figure 3. The economic value of food parcels.

4.2. Potential preventable food waste and GHG emission

In total, preventable food waste is approximately 148 tons/year, and potential preventable GHG emission is approximately 387 tons CO₂-eq/year. The amount of preventable GHG emission is roughly estimated since we excluded several aspects, for instance, GHG emission from the transportation to collect food from the supermarkets and send it to the warehouse; the electricity usage for cold storage in the warehouse (e.g., renewable vs. non-renewable sources); assuming that the food is produced locally in the Netherlands. As shown in Figure 4, some types of food give different GHG emission because of the different emission factor, and the amount of prevented food turned into waste. The preventable GHG emission from beef, dairy products, and snacks are higher among other food categories which are 59,200 to 77,700 kg CO₂-eq/year. Beef and dairy products have a higher emission factor compared to other food categories. This is because, at the production stage, beef and dairy products have a high carbon footprint (i.e., required a high amount of resources such as water, energy, and land use).

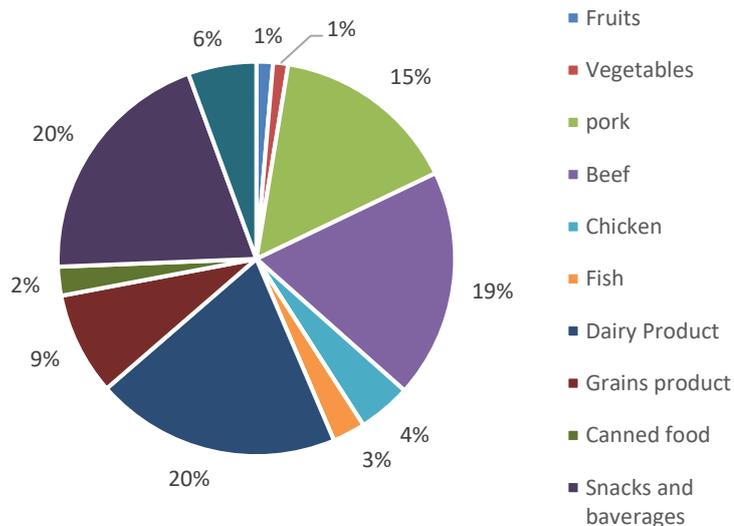


Figure 4. Percentage of preventable GHG emission from different food categories.

4.3. Discussion

This study carried out a food parcels sampling to analyze the impacts of the food bank on the food security of different sizes of households, the economics of households, and preventable food waste and GHG emission. The food bank scheme has a potential to improve the food security among the clients by providing access to food, fulfilling the dietary needs for one to four days, and providing food based on certain preferences of the clients.

The food bank scheme has a potential to improve food security among the clients by providing access to food in two ways, physically and economically. Physically, each food parcel contains various food items matching the daily food items that suggested by *Voedingcentrum* such as, grain products, fruits, vegetables, dairy products, meats, spreads, and cooking fats. Food banks provide food parcels on a weekly basis can help to fulfill the dietary needs of clients for one to four days. Economically, the clients can save money that can be used to fulfill their other basic needs, for instance purchasing additional nutritious food.

Regarding to food preferences, food banks also consider the food preferences of the clients based on their diet choice and religious beliefs. For instance, the vegetarian clients can ask to substitute the meats with a ‘vegetarian meats’ or Muslim clients can request to have fish instead of pork. Nevertheless, the extent to which the food bank scheme is tackling the food insecurity problem among the clients cannot be predetermined. Further assessment such as assessing food insecurity level in the clients before and during receiving the food assistance needs to be undertaken.

Furthermore, the food bank scheme exists as an ‘end of pipe’ strategy for food surpluses management and food waste prevention measures while the producers and retailers are improving their uptakes for a long-term waste minimization strategy. The scheme offers a sustainable solution for food waste prevention by contributing to the reduction of GHG emissions and community development for local people (i.e., volunteers and clients). Food banks in the different country context in which food banks can collect food surpluses from residential and restaurants will surely prevent more food waste and GHG emission.

5. Conclusion

All in all, the food bank scheme has a potential to reduce food insecurity of different household sizes. At the local level, the scheme can prevent a considerable amount of food surpluses to turn into food waste which consequently reduces the GHG emissions from food production and food waste management.

6. References

- [1] Xue L, Liu G, Parfitt J, Liu X, Van Herpen E, Stenmarck Å, ... and Cheng S 2017 Missing food, missing data? A critical review of global food losses and food waste data. *Environmental Science & Technology* **51**(12) pp 6618-6633
- [2] Food and Agriculture Organization of the United Nations 2017 *The State of Food Security and Nutrition in the World 2017: Building Resilience for Peace and Food Security*. FAO.
- [3] Gustavsson J, Cederberg C, Sonesson U, Otterdijk R and van Meybeck A 2011 *Global Food Losses and Food Waste: Extent, Causes and Prevention* (Rome, Italy: FAO)
- [4] FEBA 2018 *Who we are- mission*. [Online]. Available at: <https://www.eurofoodbank.org/en/mission-vision-values> access on 11-01-2018. (access on 18 March 2018)
- [5] van der Horst H, Pascucci S and Bol W 2014 The “dark side” of food banks? Exploring emotional responses of food bank receivers in the Netherlands. *British Food Journal* **116**(9) pp 1506-1520
- [6] Voedselbanken Nederland 2016 *Facts and figures of food bank netherlands*. [Online]. Available at: <https://www.voedselbankennederland.nl/feiten-en-cijfers/> (access on 18 March 2018)
- [7] Venkat K 2011 The climate change and economic impacts of food waste in the United States. *International Journal on Food System Dynamics* **2**(4) pp 431-446
- [8] Bazerghi C, McKay F H and Dunn M 2016 The role of food banks in addressing food insecurity: a systematic review. *Journal of community health* **41**(4) pp 732-740

- [9] CleanMetrics™ 2018 [Online]. Available at <http://www.foodemissions.com/foodemissions/Calculator.aspx> (accessed on 13 June 2018).