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Date	2023
Type	Article de revue / Article
Version	Version officielle de l'éditeur / Published version
URL de PolyPublie PolyPublie URL	https://publications.polymtl.ca/54368/
Évaluation par les pairs Peer reviewed	Révisé par les pairs / Refereed
Conditions d'utilisation Terms of use	Creative Commons Attribution 4.0 International (CC BY)
Référence Citation	Patreau, V., Bernard, S., Leroux, J., Bellemare, M., & Morissette, J. (2023). Consumer interest and willingness to pay for in-bulk products with reusable packaging options. Frontiers in Sustainability, 4, 1228917. https://doi.org/10.3389/frsus.2023.1228917

Publication officielle
Official publication

Titre de la revue Journal title	Frontiers in Sustainability (vol. 4)
Maison d'édition Publisher	Frontiers Media S.A.
URL officielle Official URL	https://doi.org/10.3389/frsus.2023.1228917
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frontiers | Frontiers in Sustainability

TYPE Original Research
PUBLISHED 27 July 2023
DOI 10.3389/frsus.2023.1228917

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RECEIVED 25 May 2023
ACCEPTED 11 July 2023
PUBLISHED 27 July 2023

CITATION
Patreau V, Bernard S, Leroux J, Bellemare M and Morissette J (2023) Consumer interest and willingness to pay for in-bulk products with reusable packaging options.
Front. Sustain. 4:1228917.
doi: 10.3389/frsus.2023.1228917

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Consumer interest and willingness to pay for in-bulk products with reusable packaging options

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Consumers are looking for solutions to reduce waste at source, especially plastic waste from single-use packaging. Simply recycling packaging will not be enough and reduction at the source must be emphasized as part of a sustainable circular economy. Selling products in bulk using reusable containers is one of the emerging paths of the zero waste movement. To achieve this, it is necessary to change consumption patterns and behaviors. Our goal is to better understand how source reduction of plastic packaging can be an asset in a zero waste objective. Using a contingent valuation method, we conducted a large pan-Canadian survey on the purchasing preferences of 2002 Canadian households to analyze the willingness to pay (WTP) for different food and household products. Results indicate that most consumers do not appear to be willing to pay more for bulk products with reusable packaging even if they are interested in buying more bulk products. Different socio-demographic and attitudinal parameters, such as age, gender, sense of convenience, and pro-environmental behaviors, influence willingness to buy and pay. The originality of this work is to provide an economic perspective on the reduction of single-use containers and changes in consumption practices in the context of the zero waste movement and the circular economy.

KEYWORDS

willingness to pay (WTP), contingent valuation, zero waste, plastic, reusable packaging, bulk, source reduction, eco-modulation

1. Introduction

For more than 50 years, plastic has become one of the most important materials in our society. It is a light, strong, easy-to-handle and inexpensive material. It is used more and more, especially to produce disposable products and packaging, causing pollution and end-of-life management issues. The trend of increasing production continues to grow across the globe, over 8 billion tons of plastic have been produced since the 1950s and are still present on planet Earth (Geyer et al., 2017). If nothing is done, plastic production is expected to reach 34 billion tons by 2050. Plastic waste accumulates in natural environments, including oceans (Jambeck et al., 2015) and is considered a global problem (Hartmann et al., 2019). In addition, the Organization for Economic Co-operation and Development (OECD) estimates that plastic production is currently responsible for 3.4% of annual global greenhouse gas (GHG) emissions (OCDE, 2022).

The lifespan of plastic products varies. The majority of packaging reaches its end-of-life after less than 1 year (Geyer et al., 2017). By industry sector, the packaging field accounts for a large share of waste generation (Geyer et al., 2017). Plastic items from the food and take-out sector dominate global plastic waste, ahead of waste from fishing-related activities (Morales-Caselles et al., 2021). Single-use products such as shopping bags, bottles, food containers, and packaging are the four most prevalent macro-litter (Morales-Caselles et al., 2021). In Canada, only 9% of plastic is recycled and 47% of plastic waste is packaging (Deloitte, 2019).

The fight against plastic pollution has led many to view recycling as a key solution. By creating a circular system, recycling can make the packaging sector potentially more sustainable (Hahladakis and Iacovidou, 2019). There are various plastic recycling techniques available, including mechanical and chemical processes (Dewulf et al., 2021; Larrain et al., 2021; Sakthipriya, 2022). In addition, "green" innovations such as bioplastics have emerged as a promising alternative (Karan et al., 2019; Liliani and Cao, 2020; Beltran et al., 2021). Bioplastics and biodegradable plastics aim to simplify end-of-life management, but they can pose challenges in terms of degradation. They are less and less considered as short-term solutions to avoid plastic pollution especially when analyzing these products using life cycle assessment approach to evaluate environmental impacts (CIRAIG, 2017; EEQ, 2021). Moreover, recycling and bioplastic options are more expensive than virgin plastic options, especially when crude oil prices are low (Milios et al., 2018).

Only improving waste management will not be enough; reducing waste at source is required (González-Fernández et al., 2021). Changes in consumption patterns and behaviors must take place (Heidbreder et al., 2019). Reduction is at the highest priority and the circular economy has a huge potential if correctly implemented (Klemeš et al., 2020).

For many, the circular economy is seen as a way out of these plastic pollution issues (Walker and Xanthos, 2018). A movement has been building in the past years. The Ellen MacArthur Foundation is one of the important players in this sector and encourages reuse in the packaging sector (EMF, 2019). It also collaborates with the industry to improve the end-of-life and recycling of materials (Hawkins, 2021). However, while the circular economy seems for some to be the way forward, for others the approach should be more nuanced. It is important to ensure that the implementation of circular solutions is actually more sustainable (Lonca et al., 2018). Life cycle assessment (LCA) is a scientific tool that can be very useful to evaluate sustainability of different options to improve the plastic packaging industry (Civancik-Uslu et al., 2019; Lonca et al., 2020).

Zero waste strategies are also in line with circular economy concepts and propose a hierarchy of actions that prioritize "rethink and redesign, reduce, reuse" before the other actions recycle/compost, material recovery, residuals management and judge as unacceptable incineration and waste to energy. The zero waste International Alliance defines zero waste as: "The conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health" (ZWIA, 2018).

Consumers are aware of the environmental issues of their consumption and of the waste they generate (Storm, 2020). In terms of consumer priorities, when implementing a zero waste program in a UK municipality, 18% of respondents wanted measures to enable them to act on product packaging levels and 12% wanted to increase their knowledge and information about recycling (Cole et al., 2014). Consumers are increasingly aware of the problems associated with plastic, but question the options available to change their consumption (Rhein and Schmid, 2020). To date, governments invite consumers to act mainly on the end-of-life of packaging by sorting materials within their households or using a deposit system. Very few source reduction options are available to get away from single-use packages (Phelan et al., 2022). However, consumers are seeking for more alternatives to plastic packaging and are willing to pay more for some of them (Herrmann et al., 2022). More and more companies are offering bulk products, allowing consumers to shop with less packaging waste (Beechener et al., 2020). However, packaging free shops are often niche businesses (ZWE, 2020). Worldwide, some supermarkets have launched pilot projects, especially prior to the COVID-19 pandemic, but still very few propose a diversified and large bulk offer [e.g.: Carrefour in France, Metro in Canada (before the pandemic)]. How to make this offer mainstream? Are consumers ready to embrace this consumption format? Are they willing to pay a premium for zero waste consumption as they are for eco-friendly packaging or organic products?

We aim to shed some economic light on this trend of package-free consumption from a consumer perspective. Using a contingent valuation method, we conducted an analysis of the willingness to pay (WTP) of consumers for different food and household products. We conducted a large pan-Canadian survey and collected data on the purchasing preferences of 2002 Canadian households. An econometric analysis of this data allows us to highlight the socio-demographic characteristics and latent traits that influence bulk consumption using refillable containers. These containers can be owned by the consumer or in deposit format.

The following sections present a review of the literature on the willingness to pay for environmentally friendly food and packaging options, the methodology used, an analysis of the data collected through a pan-Canadian survey, a discussion of these results and finally, a conclusion.

2. Literature review

2.1. Consumption using reusable packaging

From our literature review, a primary finding is that consumer interest in eco-friendly packaging options is particularly strong when discussing plastic packaging issues (Charlebois et al., 2019; Ketelsen et al., 2020; Otto et al., 2021; Walker et al., 2021). Another finding is that even if the zero waste movement is growing and consumer interest in zero waste consumption is increasing (Louis et al., 2021), no economic studies specifically on consumer willingness to pay on bulk consumption have yet been published. Economic studies on refillable containers exist in the restaurant sector, on Business-to-Business (B2B)

product delivery systems (e.g., secondary, and tertiary packaging) (Coelho et al., 2020). Regarding returnable container formats in Business-to-Consumer (B2C) format, deposit systems in the beer sector are the most known to consumers (CREATE, 2015). However, in recent years, these deposit systems have had a tendency to decline in favor of non-refillable containers (e.g., aluminum cans for beer rather than returnable multi-use bottles) (Coelho et al., 2020). So far, the zero waste movement and the development of packaging-free shopping is mainly the subject of niche studies, by public or activist organizations (Planète and ADEME, 2012; ADEME et al., 2018; Beechener et al., 2020; Valiante, 2022). More studies can be found in the environmental, behavioral, or retail scientific literature than in the economics one.

2.1.1. Reusable packaging and environmental impact

At the environmental level, several studies on reusable packaging and packaging-free grocery stores emphasize the importance of evaluating the environmental impacts of purchasing scenarios. To avoid false good ideas, it is important to be able to confirm which options are really the most sustainable (Beitzen-Heineke et al., 2017; Nguyen et al., 2020; Otto et al., 2021).

Several scenarios using reusable containers vs. disposable options in the take-out sector have been evaluated using LCA (Greenwood et al., 2021). All scenarios investigated using reusable containers were found to be less environmentally impactful than scenarios using disposable options (Greenwood et al., 2021). These results are in line with ones obtained by studies on disposable vs. reusable tableware in a cafeteria setting (CIRAIG, 2017) as well as in a restaurant setting for reusable coffee cups (CIRAIG, 2014). With respect to bulk stores, a comparative analysis of six bulk purchase scenarios using LCA has been conducted (Scharpenberg et al., 2021). The results were slightly more nuanced than for the food service sector and showed that four out of six bulk scenarios perform better with respect to climate change. In fact, since one of the products was gummy bears, the cleaning required for the dispensing machine has a negative impact on the results. As for the glass packaging for the purchase of tofu, it has a significant impact on GHG emissions, mainly during glass production and transport phase. Moreover, for five of the six products, the impact on water depletion is larger for the unpackaged products due to cleaning. Scenarios that consider the entire supply chain are important. Customer behavior, cleaning processes, choice of packaging material, and means of transportation have a significant impact on LCA results (Scharpenberg et al., 2021). In addition, while bulk retail scenarios using reusable packaging have interesting environmental outcomes, the issue of food waste should be kept in mind. Indeed, several studies indicate that for many products, the use of packaging prevents food waste (Verghese et al., 2013). In addition, consumers often perceive packaging waste as more important than food waste (Lindh et al., 2015). With such observations, a holistic approach and consumer awareness must be considered to achieve environmental success.

TABLE 1 Main barriers and levers for a consumer to buy in bulk using a reusable container from the literature.

Barriers	Levers
• Change in lifestyle and in the grocery shopping practice • Efforts required to plan purchases, transport, and clean containers • Doubts about food safety and cross-contamination issues • Lack of knowledge of unpackaged food offerings and lack of product information • Limited range of products available • Proximity of unpackaged food stores • Culinary skills required and desire to cook • Complexity of returnable container systems	• More transparency and sustainability on products and how they are made • Facilitate healthy, low-impact consumption behavior • Price advantage due to avoided production and packaging disposal costs • Price advantage due to reduced food waste and the ability to purchase only the quantity desired • Reduced costs and price incentives such as discounts for reusing containers • Trusted relationship with the retail industry • Increased product variety and customization • A reduction in the amount of household waste • Commitment to pro-environmental behavior

2.1.2. Bulk retail using reusable containers—barriers and levers

To be able to buy unpackaged food products, consumers need first to have access to such products. So far, this offer is mainly found in specialized zero waste stores, but more and more traditional grocery chains develop an offer of bulk products (Otto et al., 2021). For the share of bulk purchases to increase within household purchases, it is necessary to rethink the shopping practice, even reinvent it (Rapp et al., 2017; Fuentes et al., 2019; Louis et al., 2021).

Several studies have analyzed the barriers and levers of bulk retail purchases with reusable containers. Our study focuses mainly on the consumer side. The main barriers and levers to buying in bulk with reusable containers for a consumer, as identified in the scientific literature (Fernqvist et al., 2015; Beitzen-Heineke et al., 2017; Coelho et al., 2020; Marken and Hörisch, 2020; Louis et al., 2021; Long et al., 2022), are summarized in Table 1.

The analysis of key barriers and levers to buying food in bulk indicates that consumers must make efforts to shift their purchasing habits from packaged to unpackaged products. However, this analysis also indicates that food prices and financial incentives can be important levers for bulk purchasing. Not only is consumer acceptance a key factor in shifting to packaging reduction practices (Long et al., 2022), but willingness to purchase and pay for packaging alternatives is also a key aspect (Herrmann et al., 2022).

The following sections focus specifically on the literature review of methods for assessing consumer WTP and WTP for different food products and packaging options.

2.2. Willingness to pay for different food and packaging options

2.2.1. Contingent valuation and WTP

Non-market impacts, such as environmental impacts, can generally be estimated through different valuation methods. There

are two main methods for assessing agents' preferences: revealed preference methods and stated preference methods. Revealed preference methods rely on market information or observed behavior to estimate the value of a related non-market impact (e.g., hedonic pricing methods, travel cost methods, prevention behavior and protection expenditures, etc.).

For stated preferences, the methods commonly used are the so-called contingent valuation methods and choice modeling methods (Whitehead and Haab, 2013). The contingent valuation method relies on results from surveys, in which respondents state their preferences for hypothetical scenarios that are presented to them. This method is used in a variety of scenarios related to the environment and natural resources, as well as recreational spaces, or waste issues such as plastic waste (Dahal et al., 2018; Tyllianakis and Ferrini, 2021). The choice modeling approach is increasingly used for policies incorporating environmental aspects as it allows for studies in complex and multidimensional contexts.

Economists generally favor revealed preference methods since they rely on existing data that are independent of the agents, as opposed to stated preference methods that present a hypothetical context in which agents are asked to state their preferences (Pearce et al., 2007).

In this study, the contingent valuation method was used because it better met the constraints of the questionnaire developed. Indeed, the questionnaire dealt with broader topics on zero waste consumption and a limited time to answer all the questions had been determined. The questions had to be simple and direct, to take the least amount of time for the respondent to answer.

In 1993, the National Oceanic and Atmospheric Administration (NOAA) extensively documented this method (including good practices), as contingent valuation was used to assess the "environmental losses" of various stakeholders following the Exxon Valdez environmental disaster in Alaska (Arrow et al., 1993). Since 1993, the research community has also commented on this method, some criticizing it and others improving certain aspects (Carson et al., 2001; Pearce et al., 2007; Whitehead and Haab, 2013; Johnston et al., 2017). The points that many emphasize are the quality of the questionnaire to be developed, the flexibility that this method provides for testing different scenarios, or when analyzing the results on their validity and reliability.

To express the preferences of individuals in monetary terms, it is necessary to estimate the maximum amount that the respondent is willing to pay for the realization or the avoidance of an activity or change. The maximum amount a person is willing to pay is called the WTP (Willingness to Pay) and the minimum amount a person is willing to receive is called the WTA (Willingness to Accept). NOAA suggests using the WTP, which is a priori the more conservative value of the two.

2.2.2. WTP in the food and packaging sectors

In the food and household/personal care sector, consumer willingness to pay is one of the tools used in many studies to measure consumer interest in purchasing different types of products. For example, there are studies on different food products such as organic products (Batte et al., 2007), healthy products (Dolgopolova and Teuber, 2017), local products (Printezis et al., 2019), products produced using eco-responsible processes (e.g., using less water to grow fruits and vegetables) (Krovetz et al., 2017), products using eco-responsible certifications (Moser, 2016). Several studies also analyze combinations of these different characteristics [e.g., WTP for organic and local products (Onken et al., 2011; Connolly and Klaiber, 2012)]. Most of these studies show that consumers are willing to pay an additional amount (premium) for these different "beneficial" product characteristics or for their "more sustainable" environmental impact.

Furthermore, in the context of addressing plastic pollution, there is a growing interest in the scientific literature to study consumers' WTP for alternative packaging to conventional plastic (Ajayi and Reiner, 2020; Zwicker et al., 2020, 2021; Fischbach et al., 2022) or so-called "green" packaging (Hao et al., 2019). In Canada, a national survey was conducted on the willingness of 1,014 people to reduce their consumption of single-use products and their WTP for more environmentally friendly packaging (Walker et al., 2021). Results showed that 41.9% of respondents were willing to pay more for biodegradable packaging and that young people (24–38 years old) were willing to pay more than other segments of the population. These results echo several other recent findings (Zwicker et al., 2021). A systematic review of the literature on "environmentally friendly food packaging" reports that in most of the studies analyzed, consumers were willing to pay more for such packaging (Ketelsen et al., 2020). On the other hand, a logo warning of the plastic pollution caused by packaging can reduce consumers' WTP (Van Asselt et al., 2022). However, another Canadian study obtains that the WTP for cereal bars in cardboard packaging with environmental certification does not make consumers want to pay more (Ertz et al., 2017).

Most methods used to assess consumer willingness to pay in these packaging studies are discrete choice analyze, contingent valuation surveys, or other methods (Ketelsen et al., 2020). Some studies are conducted using quantitative surveys and others using qualitative surveys via focus groups. Of the 46 studies analyzed, 9 focused on selling without or with less packaging and 12 of them used images as stimuli for respondents in questionnaires (Ketelsen et al., 2020). The results of this study also show that the main factors influencing the purchase of products in environmentally friendly packaging are environmental concerns and beliefs, preference for organic food, age, gender, and education level.

Using an approach based on a discrete choice experiment and qualitative free text analysis, a study analyzes different packaging materials, including the "unpackaged" option for purchasing 500 grams of grapes (Herrmann et al., 2022). Results indicate that consumers are willing to pay more for products with packaging perceived as sustainable. Consumers were asked about their perception of the sustainability of the packaging options offered (recycled plastic, paper, bioplastic, plastic and unpackaged) as well as their WTP for the different options. The unpackaged option stands out as the one for which consumers would be willing to pay more. The results also show that for more than 75% of respondents, there is a positive relationship between WTP and their assessment of the sustainability of the options. However, these results must be put into context: although the survey was conducted in Germany, the sample of respondents is not representative of the

German population and is significantly younger and more educated than average.

It is apparent from the literature review that while many studies examine alternatives to plastic packaging and consumers' WTP for these alternatives, few studies analyze packaging-free bulk product options. Table 2 lists studies that examine consumers' WTP and purchase intent for products without packaging or using returnable containers.

Results regarding consumer WTP vary across studies. One study looks at the sale of potatoes in durable packaging and shows that consumers expect to pay less for bulk potatoes without packaging (Fernqvist et al., 2015). Another study indicates that consumers are willing to pay more for grapes without packaging or for grapes with alternative packaging to conventional plastic (Herrmann et al., 2022). Consumers expect to pay less for tap water than for bottled water (Bass et al., 2021). However, offering milk in a returnable glass container is a reason to pay more (Neill and Williams, 2016). In addition, consumer interest in organic produce may encourage the purchase of fruit and vegetables without packaging (van Herpen et al., 2016). Finally, the fact that consumers must pay more for eco-responsible packaging (including bulk products) encourages them to prefer the sustainable packaging option to bulk products, when they have the choice (De Canio, 2023).

2.3. Latent parameters

While consumers' WTP is an important parameter for establishing their preferences, their behavior and environmental perceptions and beliefs are latent parameters that influence the purchase of packaging-free products (Neill and Williams, 2016; Marken and Hörisch, 2020; Herrmann et al., 2022). Selling bulk products can be a strategic tool for a company to strengthen its relationship with its customers. Loyalty and proximity to businesses that offer bulk products can be a lever for retailers (Louis et al., 2021). In addition to pro-environmental behaviors and personal norms, it is interesting to analyze the perception of barriers in the context of purchasing food without packaging (Marken and Hörisch, 2020). This study directly analyzed consumer behavior in a supermarket and interviewed them using a questionnaire. The researchers also measured purchasing habits and intentions. Lack of product information and limited availability of bulk products were found to be barriers to purchase for customers interviewed in situ.

Other latent metrics also emerge from the literature related to agents' WTP and willingness to buy for plastic pollution reduction. In particular, guilt is a factor that increases willingness to pay according to (Zwicker et al., 2020) and packaging-free purchases offer a balance with consumers' ecological values (Gordon-Wilson et al., 2022).

With respect to environmental beliefs, measures derived from the New Ecological Paradigm Scale (NEPS) (Dunlap et al., 2000) are widely used to measure environmental beliefs (Tyllianakis and Ferrini, 2021). Since the present study was conducted in both French and English, it is important to ensure that questionnaires are appropriate. This Environmental Belief Measurement Scale was translated into French (Schleyer-Lindenmann et al., 2016). This scale measures environmental beliefs by grouping them under five paradigms: the existence of ecological limits to growth, the importance of preserving natural balances, rejection of anthropocentrism, rejection of human exceptionalism, and belief in a severe ecological crisis. It is now the most used scale for measuring environmental beliefs (Cruz and Manata, 2020).

2.4. Research gap

Bulk purchases without packaging have been the subject of some recent studies, but often in the context of scenario comparisons with different types of packaging presented as more sustainable. Consumer willingness to pay is one of the parameters analyzed by some of these studies, in addition to other latent parameters. However, none of these studies on package-free purchasing have been conducted in a Canadian context (several studies have been conducted in Germany), for different types of food and household products typically sold in plastic containers. The possibility of purchasing products in bulk using a personal or returnable container at a traditional grocery store has also not been studied in the scientific literature.

To our knowledge, this is the only study that examines consumers' willingness to buy and pay for food and household products in bulk, in a traditional supermarket, using reusable packaging (instead of single-use plastic packaging), including their own containers and returnable containers. The following sections present the data and methods used to conduct this study.

3. Data and methods

3.1. Survey design

This article uses data collected as part of a large exploratory project on zero waste consumption in Canada (Équiterre, 2023). The development of the survey questions was carried out by the authors of the article in collaboration with a non-governmental organization (Équiterre) and its advisory committee (a committee composed of experts in zero waste consumption, retail, packaging as well as scientific experts in research methodology). A broad review of scientific and gray literature on zero waste consumption identified a lack of information on zero waste consumption, particularly in Canada, and served as the basis for the development of the survey. The purpose of this survey was to provide an initial quantitative portrait of zero waste consumption across the country and more specifically on zero waste practices, consumers' knowledge of the environment and the zero waste concept, levers and barriers to zero waste, public policies in place and the impact of the COVID-19 on zero waste.

The socio-demographic profile was characterized by age, gender, education level, income categories, main occupation, and household composition.

TABLE 2 In bulk and unpackaged products and reusable containers willingness to pay (WTP) and purchase intention from the scientific literature.

Author(s)	Product	WTP—purchase intention	Other latent traits	Methods
(Fernqvist et al., 2015)	1 kg of bulk potatoes	Bulk potatoes seen as a less costly option than the packaged products	N/A	Qualitative method—focus groups
(Neill and Williams, 2016)	Milk in a returnable glass bottle	On average, consumers are willing to pay a premium	Perception of the eco-friendliness of the container, personal responsibility, local product	Survey—contingent valuation—dichotomous choice
(van Herpen et al., 2016)	Unpacked and packed organics and non-organics fruits and vegetables	Potential increase in sales of unpacked organics products (compare to packed organics products)	N/A	Immersive 3D virtual technology
(Bass et al., 2021)	Tap water (vs. bottled water)	WTP for bottled water higher than WTP for tap water	Perception of water quality (healthier, tastier, more sustainable)	Survey—contingent valuation—willingness to pay and to accept comparison
(Herrmann et al., 2022)	500 g of grape unpackaged	WTP higher for unpackaged option than for the other packaged options (bioplastic, recycled plastic, paper)	Perception of sustainable packaging	Survey, discrete choice experiment Qualitative free text analysis
(De Canio, 2023)	Sustainable packaging products and in-bulk products	Sustainable packaging preferred compared to in-bulk product when higher price paid	Familiarity with the concept of eco-sustainability, environmental concern, health concern, label influence	Online survey through social network sites

The definition of consumption in bulk using reusable containers was stated in the survey for respondents. Two categories of zero waste products were defined:

- *Bulk products, allowing consumers to bring their own containers and choose the product quantity they wish to buy*
- *Products in returnable containers that can be reused at the store via a deposit system (the store charges the consumer a fee that is then partially or fully refunded upon return of the container post-consumption)*

Zero waste grocery products include unpackaged fruits and vegetables, bulk dry products such as cereal, pulses and nuts, and fresh products like yogurt, cheese, milk and juice for which consumers can bring their own containers. Note: dry products sold in "prepackaged" format (single-use plastic bags or containers) are not considered to be bulk.

The survey was composed of the following sections:

- Food shopping habits
- Bulk buying habits
- Commitment to buy unpackaged food in bulk
- Purchase criteria and consumption scenarios
- Willingness to pay
- Perceptions of environmental responsibilities and policies
- Commitment and beliefs on the environment
- Socio-demographic data
- Comments (open-ended question)

3.2. Design of the willingness to pay questions

Questions on consumers' WTP for different types of products sold in bulk were developed to focus on everyday products, mainly sold in single-use plastic packaging in traditional grocery stores. The three products offered to respondents were condiments, almonds, and laundry detergent in liquid format. Nuts and dried fruits have been identified in several studies, as well as laundry detergent, as products regularly offered in bulk sections or in environmentally responsible packaging (Moser, 2016) (Champion and Remond, 2021). As for condiments, the choice was made to purchase condiments commonly used by Canadian households and within fast food outlets or cafeterias. Thus, many Canadians regularly consume ketchup, mustard, or mayonnaise in "bulk" format outside the home but less often during meals at home. In addition, the "semi-liquid" nature of these condiments requires a certain amount of effort in handling these products with reusable containers. Moreover, the laundry detergent product allowed us to move away from the food aspect and the potential safety issues raised by some people. For each product, two scenarios were presented to the respondents:

a) buying the product in bulk with their own container
b) buying the product in bulk with a deposit returnable container proposed by the grocery store.

To facilitate the understanding of the respondents, images of the different products and scenarios were used, inspired by (Bass et al., 2021). An example for the almonds scenarios is presented in Figure 1. Guidelines for contingent valuation methods suggest

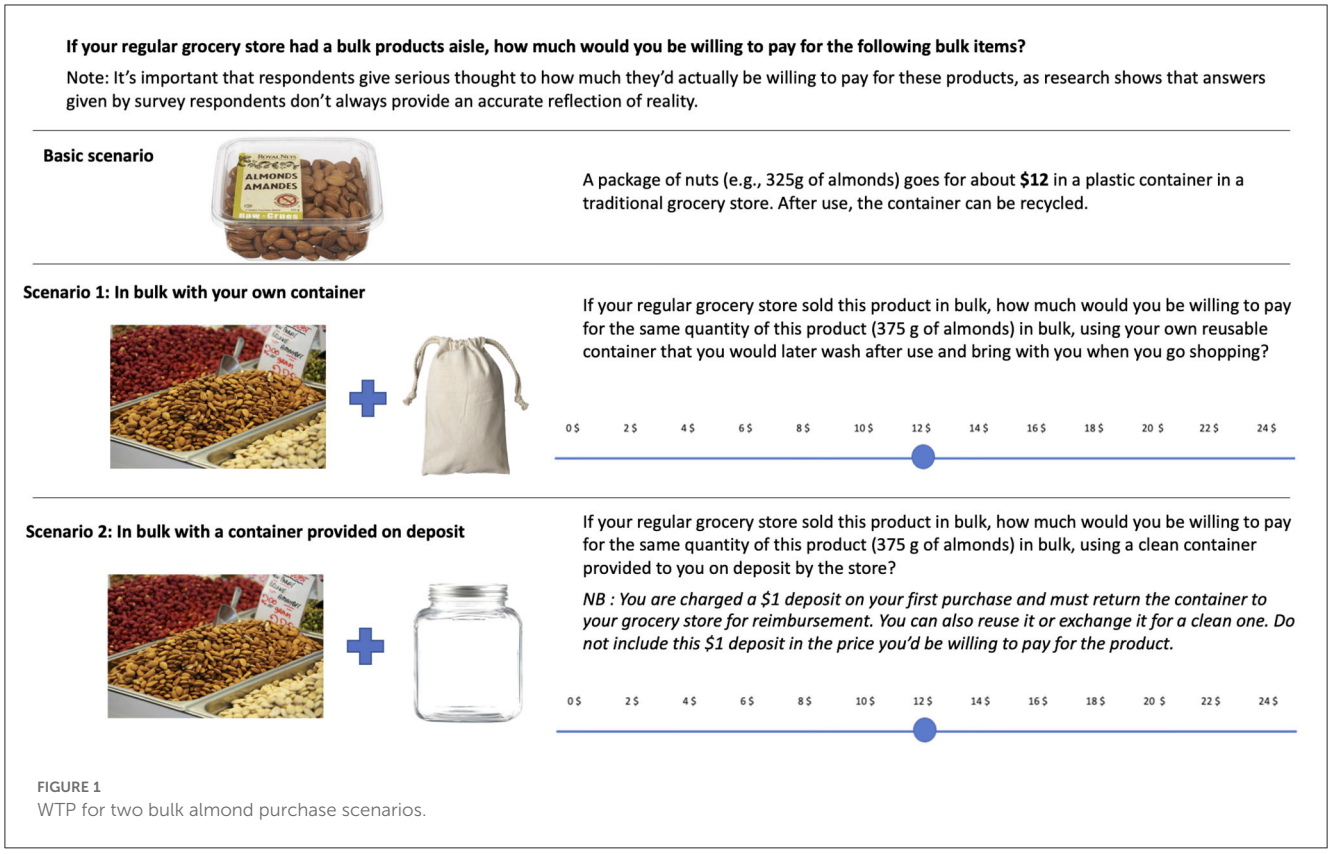


FIGURE 1
WTP for two bulk almond purchase scenarios.

using photos and visual aids can be an effective way of presenting scenarios (Whitehead and Haab, 2013).

For each scenario, respondents were asked to position a slider on a price scale to identify the amount they were willing to pay for the bulk product in the proposed container. The initial position of the slider corresponded to the price of the same product sold in a single-use plastic container in a major Canadian supermarket (Metro, Sobeys, Loblaws) at the time of the questionnaire's development (fall 2021). The scale proposed for each product ranged from 0 to twice the initial price. Respondents also had the option of not answering the question.

3.3. Econometric model

The objective of the econometric model is to determine the socio-demographic and personal factors that may influence consumers' WTP. WTP is the dependent variable that we seek to explain with independent variables (explanatory variables). This method allows us to consider the effect of several variables simultaneously and to isolate the effect of a specific variable "all other things being equal".

Thus, the WTP of consumers of each product is estimated in $CAN according to the following equation

$$WTP_i = \sum \beta_i X_i + \varepsilon \quad (1)$$

with the factor β_i representing the factor we want to estimate for each explanatory variable X_i. These explanatory variables are made up of socio-demographic variables, such as age, gender, income, level of education, place of residence of consumers, etc., and latent variables. The latent variables retained are grocery habits, the willingness to buy in bulk, the feeling of ease to buy certain products in bulk, the environmental beliefs of individuals, the awareness of the waste generated. The parameter ε represents the error term to account for unexplained variation in the WTP estimate.

We used multiple simultaneous regression because the study is exploratory and there is no predetermined hierarchy in the literature regarding the importance of explanatory variables or the variable to be explained. We conducted regressions using the least squares method to study the willingness to buy and pay for bulk goods.

3.4. Data collection

A custom survey is the instrument used for data collection. This survey includes questions with nominal, ordinal, and interval scales, twenty-six (26) questions were related to zero waste, thirteen (13) to sociodemographic profile, and one (1) open-ended question for comments or suggestions. Less than fifteen (15) min were estimated to complete this survey.

The survey was conducted by the market research company Léger between February 8 and 20, 2022 among 2002 Canadian respondents. The respondents are part of a Leger panel of over 420,000 randomly selected individuals. The survey was

conducted online using a CAWI (Computer-Assisted Web Interface) approach. Prior to launching the survey, a pre-test was conducted on 57 respondents, with a minor adjustment of one question regarding the age of respondents to exclude each other. Data collection then continued over a 12-day period between February 8 and 20, 2022. Leger panel members were invited by email to participate in the survey and a reminder was sent on February 14 to re-invite participants. The response rate was 16%. The emails sent contained a unique link that could only be used once, thus preventing an individual from participating multiple times.

To be representative of the Canadian population, the data were weighted based on Statistics Canada's 2016 national census data by age, gender, region, education, language, and presence of children in the household. This weighting primarily readjusted the weights of some provinces and slight imbalances in age groups. The demographic characteristics of the survey respondents are presented in Table 3 in a weighted version.

Leger indicates that because respondents were recruited through its "Leo" panel database, the sampling cannot be considered probabilistic, however, a similar sample of 2002 respondents would have a margin of error of ± 2.19%, 19 times out of 20 (Léger, 2022).

TABLE 3 Descriptive respondents' profile.

$N = 2{,}002$	Weighted data	%
Gender		
Male	972	49%
Female*	1,030	51%
Age		
18–24 years old	218	11%
25–39 years old	478	24%
40–54 years old	519	26%
55–64 years old	364	18%
65 years and over	423	21%
Province		
British Columbia	272	14%
Alberta	225	11%
Saskatchewan	60	3%
Manitoba	70	3%
Ontario	768	38%
Quebec	470	23%
New Brunswick	44	2%
Nova-Scotia	54	3%
Prince Edward Island	8	0%
Newfoundland	31	2%
Households with at least one child under 18 years old		
Yes	554	28%
No	1,448	72%
Native language		
French	416	21%
English	1,396	70%
Other	190	9%
Highest educational level		
Elementary/college	1,448	72%
University	554	28%

*Female category includes 5 non-binary and 1 "do not want to answer" respondents.

4. Descriptive statistics

The data collected was first "cleaned" to identify missing responses and to assign certain response categories to a specific group. For example, very few people identified themselves as non-binary, so they were classified as female. Several questions in the questionnaire had ordinal responses. These were reworked to provide binary response categories (e.g., yes-no or 1–0), which simplified the analysis of the responses obtained. For other categories of questions, some responses were grouped together to create broad trends. Inferential and descriptive statistical analyses were performed using STATA® 16 software. Some of those descriptive results are presented in a recently released report (Équiterre, 2023).

4.1. Descriptive analysis

First, a descriptive analysis of variables was performed. These variables correspond to the dependent and independent parameters used in the statistical analysis presented below. For each variable, the minimum, maximum, median, mean, and standard deviation were analyzed. Supplementary Tables A1–A3 presents the main descriptive results.

The mean age of respondents is 48 years, and the median age is 47 years. In terms of participants' income, excluding those who did not wish to answer this question (218 people), the mean income is C$78,289 and the median income is C$64,599. In our sample, 62.8% of respondents own their own home, 68.1% live in a single-family home, 67.8% live in an urban area and 82.8% were born in Canada.

Regarding consumption habits, a large majority (86.7%) of respondents use their own car to do their grocery and 23.3% also walk or bike to do it. 40.5% of respondents say they sometimes buy products sold in bulk, and more often fruits and vegetables than other products.

In terms of political orientation, the sample can be described as somewhat centrist, with 59.1% of respondents. Respondents also agree (4.03 on a Likert scale of 5) that they care about the amount of waste they produce as consumers.

In a second step, a check of the presupposed conditions of the regressions was performed: normality, sample size, linearity of the relationships between the independent variables and the dependent variable. Normality is analyzed from the values of skewness and kurtosis variable. Two parameters have a high kurtosis value (WTP for almonds and liquid detergent in a personal container). They

were not normalized (a logarithmic function worsens kurtosis). This aspect can be considered limitation of the present study.

A Pearson correlation analysis was used to test the independence of the independent variables and the variance inflation factor[1] (VIF) to test the existence of multicollinearity between the variables used. Some multicollinearity has been noted between some of the explicative variables. The strongest one[2] regards the Age and the Active status of the respondents. As both variables have been evaluated as important for the explanation of the regressions, separate regressions are performed. Other relatively strong correlations between parameters have been noticed. Explanatory variables were removed from the analysis because they were considered redundant. Analysis of error homoscedasticity was not performed because the present study has an exploratory purpose.

Descriptive analysis of consumers' WTP as a function of age suggests a quadratic effect (U-Shaped impact), with an increase in WTP for the younger and 64+ age groups. This effect is therefore considered in the regressions to assess its statistical significance.

Regarding the validity and reliability of the data, these were determined using the literature. The reliability of the measurement scale is given by Cronbach's alphas and by grouping the variables sharing the same covariance through principal component analysis (PCA). The following sections present the PCAs performed and included in the regressions.

4.2. Environmental beliefs

Environmental beliefs are defined according to the New Ecological Paradigm (NEP) scale (Dunlap et al., 2000). To keep the questionnaire simple, only 3 of the 5 beliefs were measured: limits to growth (belief in the existence of environmental limits to the growth of human activity), balance of nature (belief in the importance of respecting natural balances) and ecological crisis (belief that humanity is heading toward serious disruptions in the functioning of its natural environment).

To measure these three (3) beliefs, five (5) questions were asked. The answers to these five questions were given on a five-point Likert scale (How much do you agree with the following statements? Completely disagree—Disagree—Neutral—Agree—Completely agree):

- (a1) The so-called environmental crisis threatening the human race has been wildly exaggerated
- (a2) The Earth has infinite resources if only we knew how to take better advantage of them
- (a3) If things continue on their present path, we will soon experience a major ecological catastrophe
- (a4) The balance inherent in nature is strong enough to tolerate the effects of modern industrial nations
- (a5) Humans are seriously damaging the environment

Responses to questions (a1) and (a4) were reversed (a1_rev, a4_rev) because they represented opposite trends to the others in their wording. To identify trends from the questions on respondents' environmental beliefs, the variables were grouped together using a PCA. Following this factorization, 2 factors are highlighted, one of which is mono-factorial with only the variable (a2). The other factor groups the variables a1_rev, a3, a4_rev, a5 with a Kaiser-Moser-Olkin (KMO) criterion measure of 0.7471, indicating a sampling fit with the model that can be described as moderate. According to the literature (Schleyer-Lindenmann et al., 2016), variables should be grouped according to their facet in the NEP framework.

Three facets are represented for environmental beliefs: ecological crisis (Ecolo_crisis), growth limits (Growth_limits), and balance of nature (Nature_balance). The facets "growth limits" and "nature balance" are explained by (a2) and (a4_inv) respectively. The facet "ecological crisis" is formed by the answers (a1_inv), (a3) and (a5) supported by a Cronbach's Alpha of 0.7672, indicating an acceptable internal consistency. These three variables follow normal distributions, which confirms the first hypothesis necessary for future regressions in the analysis. The analysis of the correlation matrix revealed a strong positive correlation between the variables Ecolo_crisis and Nature_balance. Two regressions are necessary to include these parameters.

The inversion of some scales allows us to conclude that a score close to 5 indicates that the respondent has strong environmental beliefs. The means and medians are presented in Supplementary Table A1. The three categories reveal that the average respondent believes in the ecological crisis (3.852/5), believes that there is a limit to economic growth (3.020/5), and that the balance of nature is not strong enough to survive the effects of modern industrial nations (3.626/5).

4.3. Ease of bulk purchase by product type

To assess the perceived ease of purchasing products in bulk, one of the survey questions specifically addressed this aspect. Respondents were asked to indicate, using a 5-point Likert scale, whether they found it easy or not to buy each of the following types of products in bulk: Fruits and vegetables, Dry foods (pasta, beans, nuts, etc.), Fresh products like meat and fish, Cheese, Juice and drinks, Household products (detergent, household cleaners, etc.), Personal hygiene products (soap, liquid body gel, shampoo, etc.).

Figure 2 presents the descriptive results of this question. For all respondents, fruits and vegetables and dry foods are the easiest to buy in bulk. This is followed by household products and personal care products. Fresh products, as well as cheese, juices and beverages are perceived as the least easy to buy in bulk.

For statistical analysis, to group items and facilitate analysis, responses to questions regarding the perceived ease of purchasing certain types of bulk products were grouped using a PCA. A Bartlett's test to validate the fact that the variables are not inter-correlated and a measure of the KMO criterion of 0.778 were performed. The KMO obtained indicates that the sampling is adequate for the model and can be qualified as good for a factorization. After factoring, varimax rotation and analysis, three

1 Strong multicollinearity was considered when VIF $\geq$ 3.

2 A strong correlation was considered when the correlation factor belongs to the interval (-0.5; 0.5).

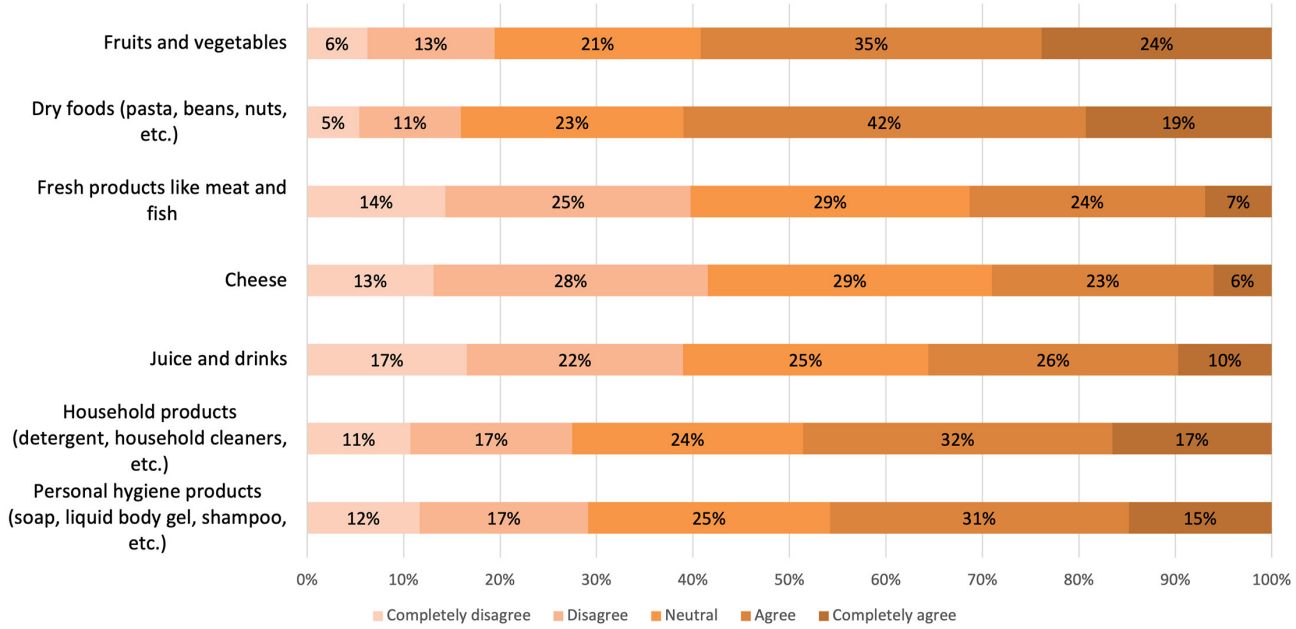


FIGURE 2
Ease of bulk purchase by product type.

(3) categories of variables were generated: fruits and vegetables (Ease_fruits_veg), fresh foods (Ease_fresh_products) and non-perishable foods (Ease_non_perishable). The Cronbach's alpha coefficients for the Ease_fresh_products and Ease_non_perishable parameters are 0.7615 and 0.8483, respectively, indicating acceptable and good internal consistencies.

5. Results

5.1. Willingness to buy in bulk

On average, 54.4% of respondents indicate that they would be willing to do some of their grocery shopping in bulk if it were offered to them in their regular grocery store. 51.3% of these respondents indicate that they would be willing to do so with their own container and 47.4% with returnable containers offered by their grocery store. Consumers indicated that they are willing to buy in bulk mainly for environmental and economic reasons, but also because it is possible to adjust the desired quantity or for health reasons. Respondents who were unwilling to purchase bulk products mainly indicated that it was for health reasons, effort, lack of interest in this type of product, availability of bulk products, unattractive price, lack of information, or lack of knowledge of the purchasing process. More details regarding those descriptive results of willingness to buy in bulk were presented in a recently released report (Équiterre, 2023).

All linear regressions performed for the analysis of willingness to buy in bulk are presented in the Supplementary Table B. The independent variables that explain the intention to buy in bulk are grouped into the following categories: socio-demographic characteristics, political positioning, grocery habits, feeling easy to buy products in bulk, and environmental beliefs and awareness.

All regressions are tested for statistical significance using a Fisher test, which indicates that for each regression, at least one of the explanatory variables is non-zero and statistically significant in explaining the intention to buy in bulk. These same results are observed for the intention to buy in bulk using one's own container or using a returnable container. A Student *t*-test is used to determine the statistical significance of each regression coefficient. This significance is indicated using asterisks "*" in the results table. In terms of practical significance of the regression, the adjusted coefficients of determination (R^2_a) range from 0.13 to 0.25. The explanatory power of the model is therefore relatively low but considered acceptable given the exploratory nature of this study. The R^2_a is higher for the model presenting the intention to buy with one's own containers and is lower for the intention to buy with returnable containers.

5.1.1. Intention to buy in bulk

The intention to buy in bulk if this option is available in the regular grocery store is explained by several socio-demographic characteristics. The most significant characteristics that have a positive influence are being female, having at least one college degree, having at least one child under the age of 18, and being a homeowner. As for age, it has a significant negative effect: as age increases, purchase intention decreases. However, there is a quadratic effect (U-shaped effect) that shows that older people (64 years and older) positively influence bulk purchase. Respondents stated political positioning also influences the intention to buy in bulk. According to the sample, those on the right of the political spectrum positively influence the intention to buy in bulk, compared to those in the center. In terms of current grocery habits, it is essentially the fact that they sometimes buy products in bulk

that predicts the intention to do so if this option becomes available in the regular grocery store. Regarding the feeling of ease to buy certain types of products in bulk, the fact of finding it easy to buy fruits and vegetables and non-perishable products in bulk positively influences the intention to buy in bulk. Finally, regarding the environmental positioning of the respondents, being aware of the amount of waste generated by their consumption is a very significant factor that positively influences the intention to buy in bulk as well as thinking that humanity is facing an ecological crisis and thinking that it is important to respect the balance of nature.

5.1.2. Intention to buy in bulk with its personal container or a returnable container

Regression analysis of the intention to buy in bulk specifying the type of container, with own containers or with returnable containers, indicates that several of the explanatory variables influence bulk buying in the same way as for intention to buy in bulk (without specifying the container). However, several variables differ significantly. The most important differences are between living in a city and being born in Canada. Both are highly significant and have a negative influence, i.e., those living outside a city and not born in Canada are more likely to want to buy products in bulk with their container or returnable containers than others.

Income, as well as having a college degree, being employed, being on the left side of the political spectrum, and being comfortable buying fresh produce in bulk were slightly more statistically significant and positively influenced these two categories of regressions. Regarding the intention to buy with personal containers, having children is less significant, while going to specialized stores is more statistically significant. For intention to buy with returnable containers, walking or biking to the grocery store appears to be significant, as does province of residence. Intention to buy with returnable containers has a significant influence for residents of British Columbia and Quebec, and a somewhat weaker influence for residents of the Prairie provinces (Saskatchewan and Manitoba).

5.2. Willingness to pay for products in bulk with different container types

The descriptive results of the WTP survey for the different products offered[3] are presented in Table 4. For each product, a portion of the respondents identified the proposed limit values as their WTP value; these results correspond to the minimum and maximum values presented in the Table 4. All responses were retained, even those that indicated a WTP of zero or the maximum value allowed. In addition, respondents were given the option of not answering the question.

For all products offered to respondents, regardless of the type of reusable container, the average WTP value for bulk products is lower than the price of the same product packaged in a single-use plastic container. The statistical significance of these results was validated using Student t-tests[4].

In addition, there is a difference in the average WTP value by type of reusable container. This difference is in favor of a returnable container but not statistically significant for all products. The statistical significance of these results was validated using Student t-tests. Mean WTP values are slightly higher for the returnable container purchase of condiments and liquid detergent (the deposit amount is not included in the product price), but not for almonds. These results may suggest that for a product that requires some container management effort (e.g.: containers cleaning and management), such as condiments and liquid detergent, the use of returnable containers may be perceived as positive by consumers.

Analysis of willingness to pay by percentile shows that for each bulk product, regardless of the reusable container used, the highest 10–25 percentiles of the respondents (p75 and p90) would be willing to pay an amount equal to or greater than the amount of product sold in single use plastic packaging. For all 6 scenarios, the median value of each WTP is between 75 and 80% and the mean value between 74 and 79% of the value of the product sold in single-use plastic packaging.

The WTP questions asked about the amount consumers would be willing to pay, not the "maximum" amount they would be willing to pay, as is typical in contingent valuation. This aspect of our survey may suggest that the WTP values reported by respondents in our sample are lower than if the maximum amount had been asked. On the other hand, this does not preclude us from analyzing the factors that influence WTP. To understand those factors, simultaneous linear regressions were run for each WTP parameter. These regressions are presented in Supplementary Tables C1–C3.

As seen previously for the willingness to buy in bulk, all regressions are tested for statistical significance using Fisher test. A Student t-test is used to determine the statistical significance of each regression coefficient. In terms of practical significance of the regression, the adjusted coefficients of determination (R^2_a) range from 0.07 to 0.14. The explanatory power of the model is therefore low but, once again, considered acceptable given the exploratory nature of this work. The R^2_a is higher for the model presenting the WTP for condiments (around 0.13–0.14) than for the WTP for almonds and detergent (R^2_a is around 0.07–0.09).

Analysis of the set of regressions reveals a few significant parameters for all scenarios, while several of the explanatory parameters are significant only for some scenarios.

5.2.1. Main influencing parameters

Thus, for all the scenarios analyzed, the fact of being an active person and certain aspects related to pro-environmental behaviors (the intention of wanting to do bulk, the awareness of the quantity of waste generated by one's consumption and, to a lesser extent, the use of a car-sharing vehicle) positively and significantly influence the consumers' WTP for bulk products. On the other hand, according to our sample, residing in Alberta, relative to residing in Ontario (the reference parameter of the province of residence variable for the regressions), has a significant negative

3 All amounts are in Canadian dollars ($CAN) and do not reflect inflation since February 2022 (data collection period).

4 The Student t-tests were performed on the unweighted data.

TABLE 4 WTP in bulk for different products ($CAN).

WTP ($CAN)	Condiments (4 $CAN in a single-use package)		Almonds (12 $CAN in a single-use package)		Liquid detergent (8 $CAN in a single-use package)	
	Personal reusable container	Container provided on deposit	Personal reusable container	Container provided on deposit	Personal reusable container	Container provided on deposit
Mean	2.98	3.13	9.15	9.21	6.24	6.33
p10	1.50	1.20	5.00	4.50	3.70	3.30
p50	3.00	3.00	9.50	9.60	6.00	6.40
p75	4.00	4.00	11.00	11.50	7.60	8.00
p90	4.40	4.80	12.00	12.50	8.30	9.00
Min	0.00	0.00	0.00	0.00	0.00	0.00
Max	8.00	8.00	24.00	24.00	16.00	16.00
sd	(1.402)	(1.446)	(3.600)	(3.768)	(2.506)	(2.611)
se (mean)	(0.034)	(0.036)	(0.085)	(0.091)	(0.059)	(0.063)
Observations (*N*)	1,695	1,631	1,787	1,726	1,787	1,733

influence on this WTP. Other explanatory variables also influence consumer WTP according to the regressions performed. Being female emerged as a significant positive influence on WTP for a large portion of the scenarios studied, as did income, having a university degree, and reporting making bulk purchases. The influence of income is however very weak since the regression coefficients are very close to zero and can be positive or negative.

5.2.2. Influence of age

Consumer age also appears as a significant negative effect, with a quadratic aspect, as for bulk purchase intention. In other words, as age increases, consumers are less willing to pay, but we find that younger and older consumers positively influence WTP (U-shaped impact). The effect of age is particularly significant for the scenarios of purchasing bulk products with a personal container and for the scenario of purchasing bulk condiments with a returnable container.

5.2.3. Influence of housing type

The housing type inhabited has some influence on the WTP of several scenarios. Living in a building with 9 or more units and, to a lesser extent, in a condominium, appears to have a significant negative influence on consumers' WTP. These results may suggest problems with container storage in smaller dwellings than in a single-family home.

5.2.4. Influence of other socio-demographic parameters

Other socio-demographic parameters significantly influence consumers' WTP across scenarios. Having at least one child under the age of 18 positively influences WTP significantly in the detergent purchase scenario for both personal and returnable containers. Under these parameters, such as owning a home or not, the participants' place of residence or even birth have both positive and negative influences on WTP. When the effects are significant, all three parameters exert a negative influence. Finally, the influence of province of residence is negative for Alberta, as mentioned above, and to a lesser extent for the Prairies and Quebec.

5.2.5. Influence of political positioning

In terms of political positioning, relative to those who identify as being in the center of the political spectrum (most of our sample), being positioned on the right significantly influences positively WTP in several of the scenarios (almond and detergent). On the other hand, being left-wing as well as those who do not wish to declare their political position have a rather negative influence on the WTP, and this is slightly significant for some scenarios. These results may seem relatively surprising, as the parties positioned on the right of the political spectrum often insist less, in their program, on responsible consumption than the parties positioned on the left. Nevertheless, this is consistent with right-wing political ideologies that prioritize private efforts over public interventions, which are generally supported by left-wing views.

5.2.6. Influence of shopping habits

In terms of shopping habits, in addition to the positive influence of buying in bulk and using a car-share vehicle to get to the grocery store rather than a personal vehicle, using public transportation to shop has a positive influence on WTP, and significantly so in the case of buying condiments in bulk. However, having groceries delivered has a significant negative influence on WTP for condiments in bulk. In terms of the types of stores frequented for shopping, frequenting specialty stores has a positive and marginally significant influence on WTP for almonds in bulk using a personal container. Local store patronage positively and quite significantly influences WTP for bulk condiments in a returnable container.

5.2.7. Influence of the sense of ease

While the sense of ease of purchasing different types of products in bulk emerged as a significant positive influence on purchase intention, results regarding its influence on WTP are more mixed. Finding it easy to buy fruits and vegetables in bulk has a negative influence on WTP, and this result is significant for the scenarios of buying condiments and detergents in a returnable container (some may think that since it is easy, why should the price be higher and others may think that since container management is already complex, the price should not be higher). Finding it easy to buy non-perishables in bulk influences some scenarios positively (especially buying condiments in bulk, significantly) and others negatively (but not statistically significant). Finally, finding it easy to buy fresh produce in bulk (which, for some people, may correspond to extra effort) positively influences WTP, and significantly so for the condiment and detergent purchase scenarios (scenarios that a priori require more effort to buy in bulk than the almond purchase scenario).

5.2.8. Influence of environmental beliefs

Regarding the influence of environmental beliefs on WTP, the results are nuanced. Indeed, while thinking that we are currently experiencing an ecological crisis has a significant positive influence on the WTP of several of the scenarios, thinking that there is a limit to growth only appears to be significant in the condiment-buying scenario (a scenario that can be considered as requiring more effort than the others). Our results also show that the influence is negative for the balance of nature explanatory variable for several of the scenarios and is not significant for the detergent purchase scenarios. This result may seem counterintuitive, as high environmental beliefs do not always positively influence consumers' WTP, whereas they more clearly influence their intention to buy in bulk. Some people do not advocate price adjustment as a solution.

5.2.9. Comparison of the container type (personal or provided on deposit)

When comparing purchase scenarios based on the use of a personal container or a returnable container provided on deposit, some parameters stand out and are significant for WTP: age, gender, income, education level, currently doing bulk, and being politically right wing. For returnable containers, being female has a significant positive influence on WTP while this aspect is not significant for the intention to buy with a returnable container (being female is significant for the intention to buy in bulk with a personal container). Thus, women are more likely to intend to buy in bulk with personal containers and are more willing to pay for the purchase of products using a returnable container.

5.2.10. Comparison of the product type

The comparison of WTP by product type (condiments, almonds and detergent) highlights the difference in influence of the feeling of ease of purchasing these different products in bulk. This explanatory parameter is particularly significant for the purchase of condiments in bulk and to a lesser extent for detergent. This parameter is not significant for WTP for bulk almonds, which is a product that seems easier to buy in bulk than the other two. Thus, it can be said that the sense of ease (and its counterpart, the sense of effort required) is an important parameter to consider in explaining WTP for different types of bulk products.

6. Discussion

6.1. Discussion of the results

The present study is an exploratory study whose objectives were to better understand the parameters influencing the willingness to buy and pay for different products sold in bulk, with a personal container or with a deposit. The data used was taken from a pan-Canadian study on zero waste consumption (Équiterre, 2023). Key findings indicate that an average of 54.4% of respondents would be willing to buy in bulk if this option was available to them in their traditional grocery store. In terms of WTP, on average, respondents are willing to pay between 74 and 79% of the amount of the same product sold in a single use container. Respondents are also willing to pay a little more (around 2.5–5%) for a bulk product if a returnable container system is made available, specifically for products requiring effort (e.g., condiments and liquid detergents). In addition, between 75 and 90 percentiles of those surveyed are willing to pay the same or a higher amount (a premium) to purchase products in bulk.

These results are to be put in perspective with other descriptive results obtained[5], notably the fact that 88% of the respondents would like the bulk offer to be developed within supermarkets, 66% of them on a voluntary basis and 22% on a mandatory basis. Regarding the supply of returnable containers, 72% of respondents were in favor of the implementation of returnable container systems, with 46% mainly in large grocery chains and 26% wanting to see this offer in all types of grocery stores. Finally, when it comes to responsibility for implementing a greater supply of bulk products, most respondents believe that industry has a large role to play. 38% of respondents believe that producers (manufacturers) have a responsibility to offer their products in bulk, followed by retailers (29%). This is followed by governments (17%) and the public (16%). In summary, most consumers are willing to purchase some products in bulk, have expanded offerings within their traditional grocery store, have access to deposit systems, and pay less than if the products were offered in single-use packaging.

Several links to the literature can also be made. The first finding from the results is that, in contrast to the WTP for products considered to have a positive impact on the environment or other socio-economic aspects (e.g., organic or local products), consumers on average are not willing to pay more for bulk products. Our results are therefore consistent with those obtained for the purchase of potatoes offered in different packaging formats (Fernqvist et al., 2015) and for the purchase of shampoo using "refill pack" (Yamaguchi and Takeuchi, 2011). On the other hand, they go against the results of a study on alternatives to traditional plastic packaging (Herrmann et al., 2022). However, they are willing to pay a little more if a returnable format is offered. This aspect of the

5 These results were also presented in the report published (Équiterre, 2023).

deposit is consistent with the study conducted for milk delivered in a returnable glass bottle (Neill and Williams, 2016) as with home-delivered meals, consumers are willing to pay a premium for reusable food containers (Schuermann and Woo, 2022).

Active people are one of the main characteristics of people who shop at bulk stores in Europe (Beechener et al., 2020), which is consistent with our results. For households with at least one child under the age of 18, this is an important factor influencing bulk purchase intention and WTP in our results, which is partly consistent with the findings of (Batte et al., 2007). This result may seem somewhat counterintuitive, but analyses of household recycling point in the same direction. Larger families and those with children are more likely to recycle, and children seem to participate in the process by sorting waste (Roca i Puigvert et al., 2020). Residing in a city is a significant negative factor for intention to buy in bulk and, to a lesser extent, for WTP. This may also seem counterintuitive, given that in general, bulk stores seem to be concentrated in large urban centers (Beechener et al., 2020). The fact that the younger population has a significant influence on bulk purchase intentions and willingness to pay is a factor that has emerged from other studies in the bulk and zero waste sector (Louis et al., 2021; Walker et al., 2021). Those aged 40–55 are the least likely to commit to doing some of their shopping in bulk. More surprising, however, is the fact that older people (64+) are also more interested.

Regarding the influence of gender on our results, being a woman is significant and generally positive for purchase intention and WTP. Women are more likely to make a mass commitment (43 vs. 32% for men). These results are consistent with those expected, there is a significant difference between men and women and are consistent with many studies identified in the literature for different types of food products (Batte et al., 2007; Gracia et al., 2012; Bryła, 2021). United Nations Environment Programme (UNEP) emphasizes the importance of considering gender equity in analyses related to single-use product reduction (UNEP, 2021). Within our sample, women do grocery shopping more than men (72 vs. 58%), with 20% of women reporting that it is equally shared within the couple, compared to 30% of men. Our results also show that women are more likely to use their own containers (41 vs. 30% for men) and returnable containers (35 vs. 30% for men). In addition, the effort required is a greater barrier for men than for women (65 vs. 48%), but health-related barriers are more important for women (67 vs. 51%), as is lack of information (25 vs. 11%) (Équiterre, 2023). All this information leads us to recall the importance of gender analysis in the implementation of solutions and public policies to ensure equity.

With respect to pro-environmental behaviors and beliefs, our nuanced results are consistent with the literature. For example, many users of carpooling systems seek to reduce their transportation-related environmental footprint (Ramos et al., 2020). We can make a parallel with the results obtained in our study for which, the fact of seeking to reduce its environmental footprint is an important motivation for zero waste consumption and particularly for bulk consumption. That being said, the perception of barriers to bulk purchasing is the same whether one is pro-environmental or not (Marken and Hörisch, 2020). These are therefore real "material" barriers that need to be addressed. In this context, information about the ease of purchasing certain categories of bulk products is important information to remember for grocery stores that want to develop a bulk product offering. It would be advisable to start the offer in the fruits and vegetables department as well as in dry food (products considered easier). A European study on bulk sales supports this idea (Beechener et al., 2020). The products most offered by these stores are household products and cosmetics, followed by food products (eggs, dry goods, tea and coffee, dairy products, seeds, oils and vinegars, fruits and vegetables). Meat and fish do not stand out among products sold in bulk in the results of this study (Beechener et al., 2020). The Agency for Ecological Transition in France (ADEME) has made the same observation regarding the diversity of the bulk product offer. It found that most of the bulk supply consisted of salty dry goods (pulses, pasta, rice, seeds, cereals, etc.) and sweet goods (dried fruit, sugars, confectionery, etc.). Liquid products (oil, vinegar and wine) were less frequently offered in bulk. It also noted that the development of the household products, perfumery and hygiene categories seemed to be underway (ADEME, 2021).

Being born in Canada has a significant negative influence on consumers' WTP and intention to buy in bulk. This result may appear relatively surprising. Analysis of the foreign-born [18.6% of our sample, while Statistics Canada estimated it at 20.6% in 2011 (Statistics Canada, 2011)] reveals, on the contrary, that it is composed of more men (52.15%), a population with fewer university degrees (35% iso 43%) and a lower income than the average income of the Canadian-born population (C$81,014 iso C$84,270). All these factors tend to reduce WTP rather than increase it. This result was not expected, and further analysis of this aspect could be an interesting avenue to improve our understanding of the determinants of bulk purchasing (e.g.: cultural effects).

Province of residence emerged as a significant factor positively influencing intention to purchase with a returnable container (highly significant for British Columbia and Quebec, marginally significant for Alberta and the Prairie provinces). Some provinces may differ from others in the deposit systems already in place. Currently, all Canadian provinces have a deposit system for beverage containers. The characteristics of these systems and their acceptability by populations could be avenues of research to better understand the factors influencing the use of deposit systems. However, the deposit systems currently in place in Canadian provinces are not intended to support the supply of unpackaged products, but to improve the quality of recycling. It is important to note that the development of zero waste grocery stores has seen the development of deposit systems directly implemented and managed by the zero waste grocery stores themselves (e.g.: Nada store in British Columbia, Épicerie Loco[6] in Quebec, Zerocery[7] grocery store in Ontario) or via third-party companies that manage the containers and ensure their reuse (e.g.: La Tasse[8] and Retournzy[9] project in Quebec, Freiburg Cup[10] project in Germany).

6 Loco: https://www.epicerieloco.ca/.

7 Zerocery: https://www.zerocery.ca/.

8 La Tasse: https://www.la-vague.ca/la-tasse.

9 Retournzy: https://retournzy.ca/.

10 Freiburg Cup: https://freiburgcup.de/.

Some producers can offer their products in returnable, multi-purpose containers (e.g.: La Pinte[11] in Quebec). These different initiatives demonstrate that new business models are possible in a zero waste consumption and circular economy perspective. Their acceptability by customers remains an aspect to be further explored. This could lead to solutions to reduce barriers to bulk consumption.

6.2. Implications for the operationalization of bulk purchasing

Now that we know that most consumers are interested in buying products sold in bulk, a reverse logistics exercise with the entire supply chain can be considered. Retailer initiatives are emerging in specialty stores, but rarely in traditional grocery stores. The COVID-19 pandemic had an impact on this level (Kitz et al., 2020; Équiterre, 2023). However, several governments are taking steps to stop waste at source, including the fight against single-use plastics. Several public policies can be put in place, including specific measures for plastics (Abbott and Sumaila, 2019).

Our study provides information for the implementation of these policies. The lower WTP of consumers (around 75% of the amount for the same product sold in single-use packaging) establishes that eco-modulation measures could be considered to support behavioral changes among consumers and offer them financial incentives. For example, in a grocery store, bulk offerings could be encouraged by charging a higher price on products sold in single-use containers. The extra money collected for the packaged product could then be used to offer the product in bulk at an incentive price. In addition, to implement the system, retailers could be encouraged, even forced, to expand their bulk offerings with products considered easier to buy in bulk (fruits and vegetables, nuts, dried vegetables,...). This type of public measure is currently being developed in certain regions of the world (e.g. France, Canada) (Équiterre, 2023). In addition, a supply of returnable containers would be an asset.

Another possibility is to encourage retailers to strengthen their commitment to the environment. Indeed, a strong commitment on the part of retailers is one way of influencing consumer purchasing intentions (De Canio et al., 2021). And as our results show, the intention to buy products in bulk has a positive influence on WTP.

The role of awareness is not to be overlooked. Knowing that for consumers, the amount of waste generated by their consumption is an important parameter, that the lack of information on the supply of bulk products is a barrier (Équiterre, 2023), that the perception of the sustainability of packaging exerts an influence on consumers' WTP (Herrmann et al., 2022), as well as information on the sustainability of products (Hilger et al., 2018), it would be important to improve information on bulk products and their environmental benefits, with an LCA approach.

7. Conclusion and future perspectives

The objectives of our study were to take an economic perspective at bulk consumption in a Canadian context. Specifically, we sought to assess willingness to buy and pay for different food and household products sold in bulk rather than in single-use plastic containers. We sought to understand the factors that influence the purchase of products using reusable, personal or returnable containers. Key findings from the study indicate that most consumers are willing to purchase some products in bulk but want to pay less than if the products were offered in single-use packaging. Consumers would also like their traditional grocery store to offer more bulk products and have access to deposit systems.

Several factors influence consumers' willingness to buy and pay, including socio-demographic characteristics such as age, education, gender, occupation, province of residence and type of housing. Latent factors also help explain consumer choices. These include consumption habits, a sense of ease in buying in bulk, as well as pro-environmental beliefs and awareness of the waste generated by household consumption.

The results provide important information for policymakers in developing new public policies to encourage bulk purchasing and ensure that this format does not remain a niche market. Economic incentives may be considered depending on the results obtained, to implement eco-modulation measures or to regulate the supply of bulk products, starting with the products that appear to be the most accessible in bulk to consumers. The results can also be used as a basis for studies by retailers and producers to rethink the packaging of their products and innovate in their marketing.

However, several aspects remain to be explored. The specificities according to the place of residence (province, type of community, type of dwellings of the households for example) are important aspects to better understand the nuances to be brought in the implementation of systems of returnable containers or the localization of the offer of products in bulk. Cultural characteristics that promote bulk buying are also potential avenues of research, as our results revealed that being born abroad is a significant influencing factor.

In terms of limitations, it should be kept in mind that the Canadian consumer survey was conducted, in February 2022, in the context of the Covid-19 pandemic, which highlighted some decline in zero waste practices in Canada. Another aspect to keep in mind is the importance of studying bulk buying scenarios with a multi-criteria approach. Indeed, while fruits and vegetables, for example, appear to many consumers as easy products to buy in bulk, studies have shown that food waste, due to poor preservation of food without proper packaging, can have significant environmental impacts. It is therefore strongly recommended that a life cycle approach be taken to determine whether bulk purchasing scenarios actually reduce the environmental impacts of household consumption.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

11 Compagnie La Pinte: http://lapinte.ca.

Ethics statement

The studies involving human participants were reviewed and approved by Guillaume Paré, Polytechnique Montréal. The patients/participants provided their written informed consent to participate in this study.

Author contributions

Conceptualization: VP, SB, and JL. Data curation and investigation: VP, MB, and JM. Formal analysis and writing—original draft: VP. Methodology, writing—review, and editing: VP, SB, JL, MB, and JM. All authors contributed to the article and approved the submitted version.

Funding

The present study has been financially supported by Mitacs, Équiterre, and RRECQ (Réseau de Recherche en Économie Circulaire du Québec).

Acknowledgments

The authors would like to thank Virginie Francoeur for her expertise in pro-environmental behaviors and beliefs; and Carl St-Pierre for his valuable advice in statistical analysis.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/frsus.2023.1228917/full#supplementary-material

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