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Circular cities: analyzing bottom-up initiatives for making Amsterdam more circular

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ABSTRACT

Circular economy is becoming ever more widespread sustainable concept for promoting efficient resource usage; Amsterdam is one of the first cities to implement this approach to solve waste management problems. While the circular transition is mostly examined from a top-down perspective, the role of bottom-up initiatives is often left unstudied. This article determines the contribution of bottom-up initiatives to Amsterdam's circular transition by assessing their environmental, economic, social impact together with their commitment to circularity. The study utilizes the survey method followed by a statistical analysis to investigate the influence of such initiatives on public awareness, involvement, and behavioral change. The content analysis of initiatives' official documentation and news articles allows revealing the environmental and economic impact and analyzing initiatives' commitment to circularity. The results communicate that bottom-up initiatives mostly create an economic value and positively affect citizens' involvement. However, the environmental impact, the influence on public awareness and partly on behavioral change is insignificant due to their small local scale and inconsistency between the declared and actual priorities. Such initiatives might still serve as trendsetters thereby indirectly tackling waste problem and facilitating Amsterdam's circular transition.

1. Introduction

Nowadays mankind faces numerous challenges, among which overpopulation is one of the acutest (see Chiarelli, 1998; Cafaro & Crist, 2012). Only in Europe, the level of urbanization is expected to reach 83.7% in 2050 (European Commission, n.d.). With a growing urban population, cities' environmental footprint also increases because of meeting citizens' wants and needs. This negative environmental impact is expressed in numerous ways, inter alia in urban waste mismanagement.

In scientific literature, researchers often rank improper waste management among the most serious challenges for cities to deal with (see, f.ex. Mavropoulos, 2010; Zaman & Lehmann, 2011). As an environmental issue, waste mismanagement contributes to climate change, air and soil pollution, degradation of ecosystems, etc. Moreover, waste constitutes an economic loss and burden to society, since all the inputs used during product lifecycle are lost when waste is discarded (European Environment Agency, 2014). The described resource use is characterized as linear, i.e., raw materials are used to produce goods that are disposed of soon. This traditional "linear" perception of resources has proven to be ineffective and needs changing (Michelini, Moraes, Cunha, Costa, & Ometto, 2017).

A solution may lie in the circular economy (CE). As opposed to the linear economy, the CE concept promotes reduced consumption, renewable energy, restoration and circularity of product components (ibid.). Moreover, the CE is aligned with sustainable development (SD) "that meets the needs of the present without compromising the ability of future generations to meet their own need" (WCED, 1987). Currently, there are already several cities moving towards circularity, among which Amsterdam is considered one of the frontrunners (Cramer, 2015). Already in 2015, Amsterdam declared its intention to turn fully circular by 2050 thereby becoming the first city in the world to state such an ambition explicitly (C40, 2018). In five years, the Municipality of Amsterdam adopted four guiding documents anchoring Amsterdam's precise ambitions concerning its circular transition (Municipality of Amsterdam, 2020).

The transition towards circularity cannot take place without the contribution of businesses, institutions, and residents. The question arises to what extent particular actors facilitate Amsterdam's circular transformation. The contribution of both the public sector (see Cramer, 2015; Ghosh, 2020) and the commercial sector (see Bauwens et al., 2019; van Buren, Demmers, van der Heijden, & Witlox, 2016) to a CE transition is subject to frequent investigations by consultancies and academics. However, not enough attention is dedicated to the role of bottom-up initiatives in the CE transition, although they possess a potential for accelerating this process (Hargreaves, Haxeltine, Longhurst, & Seyfang, 2011; Kirchherr, Reike, & Hekkert, 2017). More specifically, bottom-up or community-based initiatives (BUIs or CBIs) are civic action groups "including end users as [...] consumers, [...] co-decision makers, co-creators, and/or co-managers" (Mavropoulos, 2014). They tend to fulfill the functions of the public sector when the latter fails to address a problem. The detailed study of

bottom-up initiatives' role is considered especially crucial since many studies neglect the social dimensions while examining and applying the CE concept (Kirchherr et al., 2017). As a result, the exclusion of the social aspect from the CE approach prevents it from being sustainable as defined by the WCED.

To help fill this research gap, this article examines the activity of local bottom-up initiatives tackling excessive waste generation, in particular food and plastic waste, and its consequences in Amsterdam. These waste categories represent two types of cycles recognized by the CE. Food waste is regarded as a part of the bio-cycle, in which biomass after being used returns into the environment. Plastic waste in its turn should remain in closed loops since it belongs to the techno-cycle containing inorganic materials. Only when these products are kept in closed loops, it is possible to ensure a circular use of such materials and prevent further pollution (Ellen MacArthur Foundation, 2012). As a result, dealing with food and plastic waste problems is an integral part of the circular transition.

Understanding the degree of local initiatives' contribution to urban circularity is especially important both for policymakers and initiatives themselves. On the one hand, policymakers can make use of this knowledge to overcome the barriers, such as lack of information and public awareness, arising during the implementation of their CE activities (Ehnert et al., 2018). On the other hand, communication of success and advantages among such initiatives is essential for enabling the transition towards circularity and for the development of the initiatives themselves (van Buren et al., 2016). For these reasons, it is critical to understand the extent to which local bottom-up initiatives facilitate the circular transition at the city scale.

1.1 Theoretical Framework

In this study, theoretical evaluation framework developed by Martínez (2016) is utilized since it focuses precisely on local initiatives in the context of circular cities. The four perspectives of the framework are aligned with the CE concept and formulated as follows: closing loops, resource cooperation, community, and awareness and behavioral change which are defined by a strategy and shape a mission (ibid.). The interrelation of these perspectives, initiative's strategy and mission is presented in Figure 1.

"Closing loops" refers to the usage of waste as an input for other processes thereby retaining its highest possible utility and value to the maximum possible extent (Bourguignon, 2016). In Figure 1, "Closing loops" is placed the closest to the mission since this perspective being the part of a strategy strongly influences the ultimate mission of an initiative (Martínez, 2016).

Figure 1: Framework for measuring the performance of circular BUIs (Martínez, 2016)

"Resource cooperation" means an exchange of any necessities from financial resources to information and experience. Martínez (2016) identifies four main ways of resource cooperation that enable the existence and operation of an initiative: input, i.e., waste, finance, education, and media. In this study, the emphasis is put only on waste and education aspects.

"Awareness and behavioral change" represents another crucial element for a successful performance of BUIs. Citizens must be aware not only of the initiatives themselves but also of the underlying environmental problems.

The "community" perspective plays a special role in particular for neighborhood initiatives since they operate only at the local level and depend on the "neighbors" support. In total, Martínez (2016) identifies three aspects to be ensured: bringing people together and engaging them, creating inclusiveness of projects, giving something back to the community. In this research, the community involvement is studied in detail.

2. Research questions and methodology

Having identified the existing research gap in the sphere of circular transition and discussed the theoretical framework underlying the stated problem, I formulate the following research question: *How do bottom-up initiatives in Amsterdam contribute to city's transition towards circularity?*

To provide a detailed answer to the main research question, I identify four research sub-questions each looking into a specific aspect of the problem:

- *What environmental impact do bottom-up initiatives have?*
- *What economic impact do bottom-up initiatives have?*

To address these two sub-questions, the content analysis is used. In organization studies, content analysis "is commonly used to assess organizations' social and environmental disclosures" (Milne & Adler, 1999, p. 237). For the purposes of this research, I make use of content analysis to identify the environmental and economic impacts rather than social disclosures. So, content analysis of the annual impact reports, official websites of the BUIs and their partners, and online news articles on BUIs' activities allows deriving the necessary information. As the basis year for the assessment, the year 2018 was chosen.

- *What local social impact do bottom-up initiatives have?*

To answer this sub-question, one needs discover whether bottom-up initiatives have positive impact on three indicators: public awareness, behavioral change, and involvement. For this purpose, survey method is considered an effective research tool since it allows obtaining information on attitudes, behaviors, lifestyles (Gideon, 2012).

The target population are residents of Amsterdam and the people who regularly come to Amsterdam. More specifically, I examine two groups of respondents: the study group, which includes those involved in the activity or aware of these BUIs, and the control group, which consists of citizens not actively engaged in or unaware of such initiatives. Finally, to establish whether there is a correlation between the actions of the examined initiatives and positive effect on the social dimension, I used the IBM SPSS Statistics 26.

The final sub-question regards BUIs' commitment to circularity, namely:

- *How is bottom-up initiatives' commitment to circularity expressed in their mission statements?*

Content analysis is used to track BUIs' commitment to the circular transition through the examination of their mission statements. Marquez (2016) and Zahan and Sultana (2019) claim that organizations can communicate their commitments and goals to external stakeholder using their mission statements. After all, this method allows for the objective and systematic description of the manifest and latent communication content (Vourvachis & Woodward, 2015).

To enable the assessment of mission statements and the environmental, economic, and other impacts, I operationalize the variables. The variables operationalization also serves as a codebook for the content analysis of the environmental and economic impacts. Although the social impact is not assessed by content analysis, I still describe it to show which perspectives correspond to this impact.

Finally, four food and plastic waste BUIs servings as case studies are selected according to the purposive sampling. The description of the selected initiatives is presented in Table 1.

3. Results

In this section, I measure the environmental, economic, and social impacts of BUIs' activity as well as their commitment to circularity to reveal the contribution of the initiatives to Amsterdam's transition towards circularity.

The environmental impact of the food waste initiatives in the form of "Closing loops" and "Resource cooperation" perspectives is estimated in kilograms of food annually prevented from being wasted and avoided CO_2-equivalent (CO_2-e). Then, the environmental impact from the activity of plastic waste initiatives is calculated in kilograms and PET-bottles collected yearly. The outcome is compared with the negative environmental impact in Amsterdam expressed in an annual amount of food wasted in the municipality, the amount of CO_2-e emissions resulted from such waste, the amount of plastic wasted in wild or incinerated, and the amount of PET-bottles not recycled.

The economic impact from the activity of the BUIs in the form of the "Closing loops" and "Resource cooperation: input" perspectives is estimated in monetary value of goods in euros (€) created and/or provided by such initiatives.

The social impact representing the "Awareness and Behavioral change" and "Community" perspectives is measured through the survey and the subsequent statistical analysis.

Finally, BUIs' commitments to the circular transition are assessed by the content analysis of the initiatives' mission statements.

3.1 Environmental Impact: Closing loops and Resource cooperation (input)

3.1.1 Food waste

According to the Wageningen University and Research Centre, the total amount of food waste in the Netherlands throughout the whole food chain constituted from 1 814 to 2 509 kilotons in 2017 (The Netherlands Nutrition Centre Foundatio, 2019). This quantity equals 106-147 kg per person with an average of 126.5 kg. Applying this estimation to the population of the Municipality of Amsterdam amounting to 862 965 citizens (CBS, 2020), it is found that on average around 109.2 kilotons of food is wasted

	Name	Short Description
Food Waste BUI	Taste Before You Waste (TBYW)	TBYW was founded in Amsterdam in 2012 striving "to reduce consumer food waste by providing citizens with inspiration, knowledge and opportunity for responsible and waste-free consumption" (TBYW, 2019, p.8). This initiative engages with the community holds food-related events and provides with still edible products for free or using "pay-as-you-feel" principle (Martínez, 2016). This financial policy allows targeting a larger share of the population including the most vulnerable citizens while educating them (TBYW, 2019).
	InStock Restaurant	InStock Restaurant was founded in 2014 by four Amsterdam citizens concerned about food waste resulted from unsold products. InStock Restaurant aims to "reduce food waste [...] by using products that would otherwise remain unsold [...] and make people value food more" (InStock, n.d. - a). The initiative uses what is considered waste by supermarkets as a valuable input for its activity to cook and sell meals. By doing this and by providing catering services, publishing related news and articles online, and holding events, InStock Restaurant aims to raise citizens' awareness about food waste problem and the possibilities of such waste prevention.
Plastic Waste BUI	Plastic Whale	Plastic Whale is a social enterprise established in 2011 in Amsterdam to combat plastic pollution in local canals (Plastic Whale, 2018). Having started locally, they aim to "make the world's waters plastic-free [...] by creating economic value from plastic waste [...] involving as many citizens as possible" (Plastic Whale, n.d.). Plastic Whale claims to embrace all components of SD exerting an environmental impact while plastic fishing in Amsterdam canals, an economic impact by creating value out of collected plastic waste, and a social impact by educating people through plastic fishing activities, educational programs, and online brochures and videos.
	WASTEDlab	WASTEDlab was launched in 2015 aiming to "integrate local community members and actors in giving new value to plastic waste" (CITIES Foundation, 2015, p.1). The following main types of activities include value creation from the collected plastic waste, a community-driven recycling and reward system to stimulate the locals to recycle waste and participate in WASTEDlab's activities, educational events, and programs for the local schools to transfer the knowledge to the younger generation, and summer schools for raising people's awareness (ibid).

Table 1: The description of case studies

each year in this city. This amount causes approximately 207.48 kilotons CO_2-e emissions annually (RMIT University, 2020). Since TBYW and InStock Restaurant gather the products either from supermarkets or from regular markets and stores, this number needs to be recalculated for the retail and distribution sector only. Mirabella, Castellani, and Sala (2014) claim that only 5% of food waste occurs at this stage, while 42% is produced by households, 39% by the food industry, and 14% by the catering services. Hence, in retail and distribution, around 5.46 kilotons of food waste occur in Amsterdam annually causing 10.37 kilotons CO_2-e.

TBYW: According to 2018 annual report (TBYW, 2019), TBYW collected 9 800 kg of food to be wasted from 138 activities it held or took part in in 2018. In 2017, the amount of rescued still edible food accounted for 8 378 kg collected from 116 events which shows an increase in 17% of saved food and in 19% of activities (TBYW, 2018). However, the positive environmental impact from this initiative's activities was higher in 2016 when 11 280 kg of food was rescued at 211 events.

Based on the latest available result from the initiative's activity, in 2018, TBYW rescued 0.009% of still edible food out of the total amount thrown away in Amsterdam and 0.179% out of the food wasted in retail and distribution.

CO_2-e avoided by rescuing such amount of food is calculated for vegetarian and vegan products. As a result, the amount of CO_2-e avoided by this initiative is lower than if it included meat and fish products. Using the estimations provided by Clune, Crossin, and Verghese (2017), 1 kg of non-meat and non-fish products causes around 1.2 kg CO_2-e. As a result, in 2018, TBYW avoided 11 760 kg CO_2-e or 0.113% out of all GHGs emitted at this stage.

The end-of-year reports are available from 2016 when TBYW registered as an official foundation after 3.5 years of operating unofficially (TBYW, 2017). With only three annual reports available, it is not possible to conclude about an increasing positive environmental impact from TBYW's activity due to the decreased effectiveness in 2017.

InStock Restaurant: It does not publish annual reports of its activity which prevents the comparison of the results throughout different years. By the end of April 2020, all four InStock Restaurants collected 926 171 kg of food supposed to be discarded, while in January 2020, this amount equaled 853 914 kg (InStock Restaurant, n.d.-a). At the current rate, all InStock Restaurants gather around 24 000 kg of food per month and 288 000 kg per year. InStock Restaurant Amsterdam alone saves approximately 96 000 kg per year avoiding thereby 182 400 kg CO_2-e. Each year, InStock Restaurants collect more still edible products that during the previous year, which can be explained by an increasing number of InStock Restaurants in the Netherlands and by the growing popularity with the local population.

Taking this number as the basis for calculation, it is found that the products rescued by InStock Restaurant Amsterdam account for 1.758% of all food waste generated in retail and distribution in Amsterdam. The share of CO_2-e prevented is also 1.758% since InStock Restaurant is not restricted with vegetarian and vegan dishes only.

3.1.2 Plastic waste

As previously stated, each Dutch citizen generates 29.89 kg of plastic packaging waste within one year (Statista, 2020), which results in the total of 25.79 kilotons of plastics wasted by households in the city of Amsterdam annually. By 2015, the plastic packaging recycling rate in Amsterdam increased up to 7.5% (Gemeente Amsterdam, 2015). So, with such a recycling rate, 1.9 kilotons of plastic are recycled, and 23.85 kilotons are incinerated, landfilled, or end up in the environment.

Moreover, the consumption of single-use plastic bottles is also high in the Netherlands. In 2017, 650 million big and 750 million small PET-bottles were consumed by Dutch residents (The North Sea Foundation, 2017) which gives approximately 81 PET-bottles per person. So, in Amsterdam alone, around 69.9 million bottles are consumed annually[1]. Fortunately, not all these bottles end up in nature and Amsterdam's canals. According to The North Sea Foundation (2017), 95% of PET-bottles are returned under the deposit return system in the Netherlands. Provided this rate applies to the city of Amsterdam as well, it is found that around 3.5 million PET-bottles end up as waste in incinerators or in the environment annually.

Plastic Whale: This BUI does not publish annual reports regularly, so it is not possible to compare its environmental impact over the years. Nevertheless, having collected "tons of other waste in Amsterdam's canals" (B Lab., 2020), Plastic Whale keeps records of PET-bottles exclusively since only this type of waste can be used for a further value creation as part of its activity. According to the Plastic Whale Foundation Impact Report (2018), 11 236 engaged people and 2 022 pupils helped Plastic Whale gather 46 225 PET-bottles in 2018. Such an impact constitutes 1.32% of all improperly treated PET-bottles in 2018 solely.

WASTEDlab: This initiative does not publish annual reports of its activity, either, providing with no possibility to compare the results throughout different years. According to CITIES Foundation (2015), during the first operation year, WASTEDlab gathered 2 233 kg of plastic waste. By May 2020, the total amount increased up to 14 081 kg (WASTEDlab, n.d.) which gives approximately 2 962 kg per year. This amount of plastic collected accounts for 0.012% of all plastic waste that is not recycled. As a result, the positive environmental impact from the initiative's activity is steadily growing, although it does not significantly contribute to the circular transition at the city scale.

As a result, none of the initiatives subject to research have a significant positive environmental impact and, hence, do not contribute directly to the circular transition in Amsterdam in this way. The environmental impact of all the initiatives is summarized in Table 2.

3.2 Economic impact: closing loops and Resource cooperation (input)

TBYW: Since this initiative provides products and dinners for free or using "pay-as-you-feel" principle (Martínez, 2016), there is no fixed price for upcycled food which would represent the value created. Still, the participants of TBYW's events express how they value food received in the form of donations. According to TBYW (2019), the average donation per person received at its Wasteless

[1]This calculation is based exclusively on the number of Amsterdam residents and does not include the negative impact from the visitors of the city.

	Food in retail (kg; percentage of the total amount)	CO2-e (kg; percentage of the total amount)	Plastic (kg; percentage of the total amount)	PET-bottles (number of bottles; percentage of the total number)	Impact assessment
Wasted in Amsterdam	5 460 000	10 370 000	23 850 000	3 500 000	
TBYW	9 800 (0.179%)	11 760 (0.113%)			Low
InStock Restaurant	96 000 (1.758%)	182 400 (1.758%)			Low
Plastic Whale				46 225 (1.32%)	Low
WASTEDlab			2 962 (0.012%)		Low

Table 2: Summary of the environmental impact assessment

Wednesday Dinners and Wasteless Culture Mondays in 2018 equals €5.6 which represents an increase by €1.1 since 2016. In total, TBYW received €25 656 as donations (ibid.), hence around 4 581 dishes served attained monetary value instead of being thrown away in 2018. Meanwhile, each kilogram of food provided by TBYW at all events received the value of €2.94 at least. According to Stenmarck et al. (2016), the value per kilogram of edible food waste thrown away by the wholesale and retail sector is €2.77. So, the current value of food rescued by TBYW is higher than the value the researchers found. Still, it is necessary to consider that not patrons give a donation, which means that the real price for one kilogram of food and for one dish provided by TBYW is even higher.

InStock Restaurant: This initiative offers meals mostly cooked out of supermarket product surplus, using as input what used to be considered waste (Martínez, 2016). The price of a single InStock Amsterdam dish varies from €3.75 to €11 (InStock Restaurant, n.d.-b) with an average of €7.11. At the same time, the price of a dish in a multiple-course menu varies from €7.2 to €8.6 which gives an average of €7.76. Moreover, the initiative produces its own beer, namely Pieper Bier and Bammetjes Bier, thereby helping to tackle the problem of potato and bread waste accordingly and creating the value for otherwise to be wasted products; these beers cost €4.2 for a 330-ml bottle. Finally, InStock Restaurant offers InStock Granola, a product made of brewers' grains which often go to waste (InStock Restaurant, n.d.-b); this BUI sells this product at the price €3.75 for a 350-gram bag.

As a result, InStock Restaurant Amsterdam manages not only to create value for still edible food but also to make such a value a few times exceed the cost of food waste in retailing calculated by Stenmarck et al. (2016). Unlike TBYW, InStock Restaurant sets a fixed price for its dishes which allows the initiative to control the amount of value meals receive and provides relative independence from the customers' willingness to pay.

Plastic Whale: Initially, this initiative was founded with a goal to build a fishing boat out of plastic waste collected in Amsterdam's canals (Plastic Whale, 2018). By 2020, Plastic Whale has already created high value for plastic waste "fished" from the canals by building a fleet that consists of 11 boats in total; each boat was built using around 8 500 PET-bottles (Plastic Whale, n.d.). In 2018, the initiative produced three boats while it had taken Plastic Whale three years to construct the first boat in the beginning (ibid.). Although the price of a single boat is not officially published, the minimum cost of it can be found by using the monetary value of one PET-bottle as a basis for calculations. So, in the Netherlands, there is a PET-bottle deposit return system that foresees a €0.25 refund for a PET-bottle which size equals or exceeds 0.75 liters (Verpakkingen, n.d.). Hence, the Plastic Whale boat made of recycled plastic should cost at least €2 125 for value maximization to take place. Having studied the local boat market (Boats, 2020), it is found that the price of freshwater fishing boats starts from €5 000. So, provided the cost of Plastic Whale boats equals even the lowest price on the current boat market, Plastic Whale succeeds in creating the value out of canal plastic waste.

Furthermore, in 2018, Plastic Whale produced 15 Circular Furniture sets each including the Whale table, eight Whale tail chairs, the Barnacle lamp, and the Whale panel (Plastic Whale, 2019). This Furniture is created not only out of Amsterdam's canal plastic but also out of other waste such as steel or residual fabrics (ibid.). This fact means that the price given to such a set includes both the value of PET-bottles and other waste streams. In particular, 1004 PET-bottles are used during the production of one boardroom table, 67 PET-bottles for a circular chair, up to 100 plastic bottles for a set of barnacle lamps, and 197 bottles for a single acoustic wall panel (ibid.). The total price for a Circular Furniture Table and Chair set amounts to €19 800 which is acknowledged to be too high for an average household (Yates, 2018). Such a cost makes the products of Plastic Whale unaffordable for a regular customer, although it also represents a high value created out of plastics and other types of materials otherwise to be wasted.

WASTEDlab: The process of the value creation by WASTEDlab differs from the ones that are described above and is embodied in Recycling and Reward System. The participants of this program receive WASTED Coins for

each bag of waste they bring to a WASTED collection point; these Coins can be exchanged for a discount at local businesses partnering with WASTEDlab (n.d.). As a result, the value created by this BUI takes the form of a discount that may represent a differing but still monetary value. So, it depends on each discount whether the value created surpasses the cost of plastic waste. According to WASTEDlab (n.d.), each bag brought by a participant contains approximately 0.8-1.2 kg of plastics. Hence, the discount exchanged for a Coin should exceed the cost of one kilogram of plastic waste, i.e., €0.60 (Verpakkingen, n.d.).

In conclusion, Plastic Whale has succeeded to create high value out of PET-bottles through the production of the Circular Furniture unsuitable and unaffordable for regular customers, so its economic impact can be assessed as high. InStock Restaurant serves dishes which price a few times exceeds the value of one kilogram of food waste. Still, its economic impact cannot be considered as significant as Plastic Whale's one, even though it multiplies the value of food waste. So, InStock Restaurant's impact is assessed as medium. TBYW creates a food value that exceeds the price given to thrown away food by academia by €0.17. So, there is a particular economic impact, however, it is not significant enough to have any effect, that is way TBYW's impact is assessed as low. Finally, WASTEDlab does not have a fixed value created since it depends on the quantity of discount received by WASTED Reward System participant. As a result, WASTEDlab's economic impact is assessed as "uncertain". These conclusions are shown in Table 3.

3.3 Social impact (Awareness and behavioral change; Community)

The total number of survey respondents was 149; after filtering the valid responses, the total number of respondents reached 125 people. 53 respondents were part of the study group consisting of those involved in the activity or aware of these BUIs. 72 participants belonged to the control group which did not possess much information about the BUIs researched.

Most of the respondents were women (72,8%) and around one fourth of all participants were men. Almost all respondents were either in the 18-24 age category (50,4%) or in the 25-44 age group (48,0%). Respondent ages are aligned with the targeted population of the BUIs researched and with the demography most representative and active on Facebook where most responses were collected.

Consequently, the monthly net income received by most of the participants was lower than the average in the Netherlands: most of the respondents either earned less than €500 or received from €500 to €1000 per month (Table 4). Moreover, a little share of the participants earned more than €3000 per month.

For the awareness section, one out of four awareness questions was found statistically significant at the 1% level, meaning the answer to this question is statistically different between the study and control groups. This question is highlighted in bold in Table 5. The other responses are not statistically different between two groups in questions. However, the share of respondents who answered all questions correctly is 2,5 times higher in the study group than in the control group accounting for 18.8% and 6.9% accordingly.

Moreover, the follow-up question *"What did you rely on while answering the previous questions?"* shows the study group mostly relied on the combination of their knowledge and intuition or on their knowledge solely while the control group respondents primarily used their intuition, the combination of their knowledge and intuition or answered randomly in a few cases (Table 6).

Regarding the behavioral change section, the responses to two out of eight behavioral questions were statistically different between the study and the control groups (Table 7). The study group respondents chose food with no or little packaging more often than the control group which is statistically significant at 1% level. Moreover, the study group appeared to find another usage for the plastics left after the products more frequently which is statistically significant at 5% level. The corresponding statements are highlighted in bold in Table 7.

The last question in this section concerned not behavioral patterns but the perception of waste as a problem in Amsterdam. The results of the study and the control groups do not differ statistically significantly which means that this problem is acknowledged among most people of various interests and concerns.

Another set of the behavioral change questions asked to the study group members showed that 54.7% of such respondents started participating in different environmental events more often since they had learned about one or

	Value of food waste	Value of plastic waste	Value of PET-bottles	Impact assessment
Academia	1 kg = €2.77	1 kg = €0.60	1 bottle = €0.25	
TBYW	1 kg equals at least €2.94			Low
InStock Restaurant	Average price of one dish is €7.76			Medium
Plastic Whale			Price of Circular Furniture Set is €19 800	High
WASTEDlab		Depends on the discount received		Uncertain

Table 3: Summary of the economic impact assessment

	Frequency	Percent
Under 500 €	37	29,6%
500 € – 1000 €	40	32,0%
1000 € – 3000 €	25	20,0%
3000 € – 6000 €	5	4,0%
6000 € – 10000 €	1	0,8%
Prefer not to say	17	13,6%
Total	125	100,0%

Table 4: Income of the respondents

	STUDY (n=53)	CONTROL (n=72)	p-value
Food waste can occur at different stages of the supply chain. At what stage do you think the most food waste occurs?	**45.30%**	**13.90%**	**0.01**
What food gets thrown away the most?	77.40%	79.10%	0.805
What is the most efficient way to tackle plastic waste?	69.80%	58.30%	0.177
Where does most of the plastic waste end up?	52.80%	63.90%	0.228
Answered all questions correctly	18.90%	6.90%	-

Table 5: Percentage of correct answers per group

	STUDY (n=53)	CONTROL (n=72)
Purely Knowledge	34%	20.80%
Purely Intuition	22.60%	37.50%
Knowledge & Intuition	43.40%	37.50%
Knowledge & Random	0%	1.40%
Knowledge & Intuition & Random	0%	2.80%

Table 6: What respondents relied on while answering the questions

more of the BUIs. Meanwhile, 41.6% of the study groups respondents indicated no effect on their participation in environmental events and 3.8% did not know whether these initiatives affected their participation in any way.

Answering the question *"In principle, have you started paying more attention to your environmental footprint since you became aware of the initiative(s)?"*, 66% of the study group respondents acknowledged the positive impact of the BUIs on their concern about their environmental footprint. Then, 28.3% of the participants reported no observable effect on their paying any more attention to the environmental footprint. The rest did not know the answer to this question or preferred not to respond at all.

The last question from the behavioral change section concerned the adoption of new environmentally friendly habits after finding out about these BUIs. 47.2% of the study group confirmed acquiring new habits such as being more careful about buying and throwing away food, buying zero waste, sorting out the litter and recycling it, etc. Meanwhile, 43.4% of the study group participants did not adopt any new habits and 9.4% responded they did not know.

Lastly, all respondents were asked whether they would like to make any or more voluntary donations to support the initiative(s) in their activity, in other words, to provide the BUIs with financial support. For this section, multiple answers could be chosen. In total, 70.4% of the respondents expressed their willingness to donate unconditionally or under certain circumstances. 39.2% of the participants agreed to contribute financially if they had more money which corresponds to the perception of the financial situation of the population surveyed. Then, 13.7% expressed the readiness to donate if they received more information why it is important, which indicates the lack of awareness and understanding of the food and plastic waste problem and of the way the BUIs function.

As a result, the BUIs in question succeed to exert a positive influence on the public involvement. However, the awareness of those involved in the activities of these BUIs is not statistically different from the awareness of those who do not take part in such events. The findings concerning behavioral change are ambiguous since most respondents from the study group acknowledged the positive impact of the BUIs on their behavior, however, the statistical analysis did not confirm the difference in behavioral patterns between two groups.

	STUDY (n=53)				CONTROL (n=72)				p-value
	Agree / somewhat agree	Undecided	Somewhat disagree / Disagree	Not sure / Do not know	Agree / somewhat agree	Undecided	Somewhat disagree / Disagree	Not sure / Do not know	-
I buy food in small quantities to avoid its spoiling in my fridge.	92%	3.80%	3.80%	0%	81.90%	9.70%	8.30%	0%	0.237
I throw away the products that seem to have gone bad without tasting and smelling them.	22.60%	5.70%	71.70%	0%	26.40%	11.10%	62.50%	0%	0.451
I repurpose or recycle my food waste when it occurs.	20.80%	15.10%	64.20%	0%	26.50%	12.50%	59.70%	1.40%	0.708
I tend to buy some food spontaneously.	45.50%	22.60%	30.20%	1.90%	50%	31.90%	18.10%	0%	0.223
I choose food with little or no plastic packaging.	**66%**	**17%**	**17%**	**0%**	**33.30%**	**36.10%**	**29.20%**	**1.40%**	**0.004**
I sort out the waste from my household including plastic.	79.20%	7.40%	13.20%	0%	76.40%	4.20%	18.10%	1.40%	0.606
I purchase bottled water.	15.10%	3.80%	81.10%	0%	16.70%	12.50%	69.40%	1.40%	0.263
I find another usage for the plastic left after the products.	**30.20%**	**34%**	**35.80%**	**0%**	**23.60%**	**15.50%**	**61.10%**	**0%**	**0.011**
I believe that waste is an issue in Amsterdam.	92.50%	3.80%	3.80%	0%	80.60%	13.90%	2.80%	2.80%	0.149

Table 7: Percentage scores of statistically different behavior questions

3.4 The commitment to circularity

The content analysis of BUIs' mission statements was to reveal the commitment of the initiatives to Amsterdam's circular transition. These mission statements had to contain all three components of the SD that correspond to "closing loops" and "resource cooperation: input", "awareness and behavioral change", and "community" perspectives. This requirement is explained by the main goal of CE which is to achieve SD in forms of economic prosperity, environmental quality, and social equity (Kirchherr et al., 2017; WCED, 1987).

In their mission statements, none of the initiatives explicitly name the achievement of circularity as their goal. Nevertheless, all missions are still aligned with and contribute to a circular transition in Amsterdam to a certain degree since these mission statements include all SD components.

The social dimension is crucial for community-driven organizations and all BUIs differently refer to it. The most vivid focus on the societal involvement and awareness is found in TBYW's statement which mentions the social impact codes significantly more often than the other aspects. Similarly, InStock Restaurant seems to prioritize the social impact higher than the other dimensions mostly concentrating on the activities raising public awareness. WASTEDlab also pays more attention to the societal dimension prioritizing public involvement over the other perspectives. Finally, Plastic Whale does not highlight the social impact as its main priority and evenly distributes different perspectives' codes across the mission statement. This finding implies that Plastic Whale treats all dimensions as equally important.

Interestingly, unlike the other initiatives, Plastic Whale and WASTEDlab include the "Resource cooperation: knowledge" perspective in their mission statements. By "involving as many [...] businesses as possible" (Plastic Whale, n.d.) and "integrating local [...] actors" (CITIES Foundation, 2015), these initiatives are supposed to stimulate the knowledge transfer between them and other actors.

Finally, there is a differential peculiarity found in the mission statement of TBYW and Plastic Whale, namely the strive for exerting a bigger than local impact. Being a neighborhood initiative, TBYW aims to "revolutionize the food system" and thereby influence the entire regime of food waste problem (TBYW, 2019, p. 8). Similarly, Plastic Whale pursues a similar goal in the plastic waste regime by achieving "plastic-free waters worldwide" (Plastic Whale, n.d.).

As a result, all BUIs pursue circularity in Amsterdam and pay attention to the social dimension. Most of the initiatives indicate the goals going beyond the environmental, economic, and social impacts on the city scale. Some of them aim to involve other actors thereby allowing for knowledge transfer while others are willing to exert a more global influence.

4. Discussion

This section looks at the results of this study against other existing scientific findings and reveals questions for further research and particular study limitations.

All BUIs in question do not significantly contribute to the "closing loops" perspective although it can be considered the most important one from the circular point of view (Martínez, 2016). However, this fact does not mean that the initiatives fail to exert any influence. Selma Seddik, the co-founder of InStock Restaurant, believes that the solution of the food waste problem lies not in the collection of as much food waste as possible but in the inspiration of other people both in the Netherlands and around the world (ibid.). Prilleltensky and Prilleltensky (2006) come to a similar conclusion pointing out the importance of delivering the right idea to other communities. Trendsetting is claimed to be a necessary and desirable aspect of initiatives' activity since such a neighborhood organization operates at a too small scale to reach the population needed for a problem solution. In their study, Prilleltensky and Prilleltensky (2006) draw an example of New Zealand's indigenous group aiming to educate the population about the rights of the indigenous people. Without being limited to raising awareness of a reachable population only, this group pursues a strategy of disseminating the information about among other organizations. In the case of the BUIs, the aim is not only to raise awareness but also to positively change behavior, stimulate community's involvement, combat waste pollution, and create economic value. So, even more significance is attached to trendsetting.

Trendsetting is crucial for cultivating and spreading pro-environmental behavior worldwide to address global environmental problems, as Workman, Lee, and Jung (2017) state. The idea of combatting the global problems rather than local ones is explicitly reflected in the mission statements of TBYW and Plastic Whale. This intention is aligned with the sustainability transition but also multi-level perspective theories (Bilali, 2019; Geels, 2002). In the context of this research, the BUIs represent niches, i.e., micro-level of a possible transition where an idea emerges. Bui, Cardona, Lamine, and Cerf (2016) regard niches as initiatives in which differing practices are created and applied by various actors. These initiatives must be robust enough to challenge the existing regime to enable sustainability transition (Bilali, 2019). The regime itself, i.e., meso-level, often means a conventional sector and its well-established practices and patterns (ibid.), which in this research refers to the current food and plastic systems.

However, Proka, Hisschemöller, and Loorbach (2018) describe the cases when niches are unwilling to change the existing regime. Some initiatives rather prefer to remain local satisfying the local needs of a small community and avoiding conflicts with the regime (Seyfang, Park, & Smith, 2013). This may be the case of WASTEDlab since it does not seem to concentrate on any sustainability transition other than the local one. As for InStock Restaurant, it may implicitly regard the system change as its goal, however, this assumption results exclusively from the statement of initiative's co-founder on trendsetting.

Finally, landscape or macro-level represents different external and sometimes international trends and factors affecting the sustainability transformation (Bilali, 2019). In the case of this research, the landscape might refer to the global pollution problem, climate change, consumerism, etc. The main role of the macro-level is thought to result in putting pressure on the regime thereby creating development opportunities for niches (ibid.). The visual representation of the multi-level perspective and the assumed role of the BUIs in it are depicted in Figure 2.

Figure 2 also shows a possible development pattern of innovations. Over time, a certain share of initiatives fails to sustain their functioning and ceases to exist. To prevent this situation as much as possible, it is important to consider internal niche processes, i.e., interactions within niches (Bilali, 2019). In this relation, Plastic Whale and WASTEDlab mention the involvement of other businesses and other actors in their activity which is supposed to stimulate their partnership relations. Moreover, at Dresden Nexus Conference 2020: Circular Economy in a Sustainable Society, different speakers, e.g., Kang (2020) and Lekan (2020), also pointed out the importance of interactions within a micro-level. Lekan (2020) also believes that the communication between initiatives is supposed to facilitate the development of each initiative rather than cause a rivalry among them. Such initiatives are situated at different meta-levels so they would be rather willing to collaborate (ibid.). This collaboration would allow the communication of the success and advantages among such initiatives essential for the circular transition and development of the initiatives themselves (van Buren et al., 2016).

Another problem identified at Dresden Nexus Conference 2020 is the proliferation of recycling initiatives. Anne van Bruggen, Sustainability and CE Researcher at the Dutch Institute for Public Health and the Environment (RIVM), suggested that in the Netherlands, the "activities in CE [...] are generally focused on increasing recycling... and less on rethinking and reducing". However, most of the BUIs in question do not reflect this trend. TBYW and InStock Restaurant close loops and create economic value

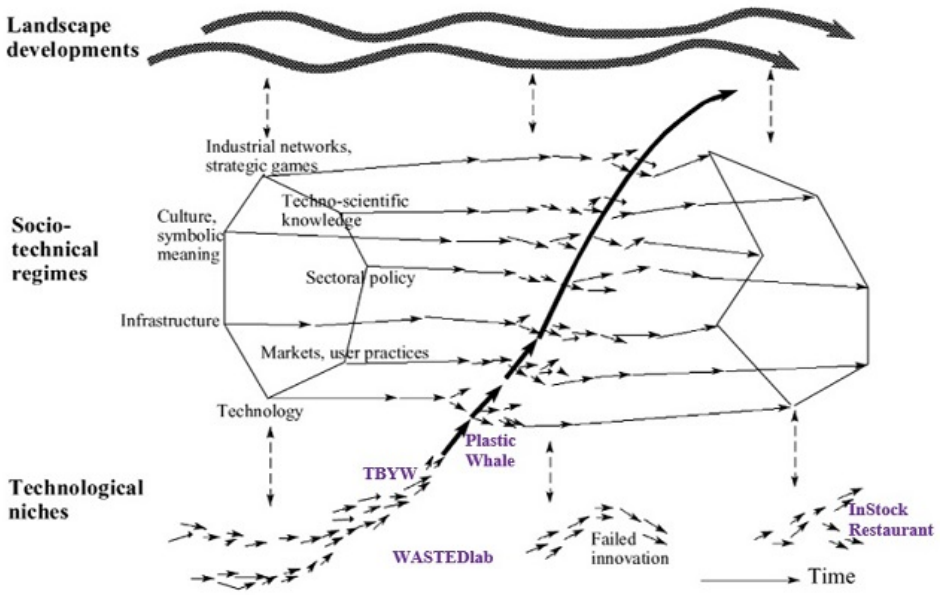

Figure 2: A dynamic multi-level perspective on technological transition (Geels, 2002) and the assumed role of the BUIs

through the food upcycling or reusing. These BUIs also proceed food waste in two most efficient ways: they prevent food waste and use it for human nutrition thereby valorizing it Besides that, these food waste initiatives aspire to educate people on how to prevent and reduce food waste. Plastic Whale also maximizes the value through the upcycling of PET-bottles thereby increasing their functionality. As for WASTEDlab, it does not strive for waste value maximization concentrating primarily on recycling, which is considered a part of the linear economy (see Kirchherr et al., 2017). Nevertheless, WASTEDlab as well as Plastic Whale dedicate much attention to more circular activities such as reusing, rethinking, etc. through their educational events.

But do, in the end, these enlightenment activities raise public awareness and incentivize people to opt for an eco-concerned behavior and pro-environmental involvement? Since the results communicate that the BUIs researched do not affect awareness and arguably have no significant influence on behavioral change, it may seem that BUIs' impact on the social dimension is relatively low. However, other studies on initiatives' social impact, e.g., Hofmeijer (2017) or Gotoh (2015), show opposite results. A possible explanation to a relatively low social impact may lie in the inconsistency between the priorities set in the mission statements of some initiatives and the actual goals pursued by these BUIs. Although the mission content analysis showed that all BUIs prioritize the social dimension above or at least the same as the other aspects, initiatives' representatives highlight other priorities as the most important ones. Surprisingly, TBYW and InStock Restaurant name the environmental and economic impact accordingly as the most significant goal of their activity; InStock Restaurant rated the social dimension as the least important out of all provided options (Martínez, 2016). So, the priorities set in the mission statements of at least two initiatives are not representative for their actual targets.

4.1 Limitations and recommendation for further research

To validate the findings of this research, it is necessary to exclude the limitations existing during this research. Firstly, the constrains for this research, mostly connected with the time restrictions but also with the COVID-19 outbreak and the following crisis, influenced the quantity of the BUIs studied. Although four BUIs were examined as the case studies, the actual number of local circular initiatives operating in Amsterdam is not known. In the "Resource cooperation" perspective, the media and financial aspects were fully omitted. In the "Community" perspective, the inclusiveness, i.e., social diversity, of the projects was not considered.

Secondly, the survey sample size is considered relatively small. There are some changes in the results possible if the survey covers a larger population. Due to the COVID-19 crisis, the case studies of this research were unable to contribute to the data collection and provide access to their participants, so the search for the study group respondents was manual.

Thirdly, not all case studies were transparent enough. Although transparency is a crucial element of any BUIs (Gotoh, 2015), some of the initiatives researched do not provide regular annual reports reflecting their performance. This issue also affects the accountability of the initiatives

since it is not always possible to track down their activities. It could be an interesting question for further research, namely how the lack of transparency and/or accountability influences the social dimension of the BUIs, for example, trust in BUIs or participation in their activities.

5. Conclusion

This article encompassed the contribution of the local bottom-up initiatives to the circular transition in Amsterdam and revealed four main insights.

Firstly, local circular bottom-up initiatives do not have a significant environmental impact on the waste problem in Amsterdam. Mostly, their scale is too small to affect the situation at the city level. However, a more important effect in relation to the environmental but also the other impacts may lie the inspiration of the community and other initiatives which is called trendsetting. This process helps to spread the influence of the initiatives across a larger scale.

Secondly, local bottom-up initiatives have a differing economic impact. In this study, the food waste initiatives are found to exert a low or medium influence on value creation. Meanwhile, one plastic waste initiative succeeds in creating a high value of waste collected thereby contributing to a circular transition. Another plastic waste case study has an uncertain economic impact due to a varying per each situation value. Nevertheless, most of the local bottom-up initiatives represent a positive trend in the process of circular transition since they do not concentrate on recycling but focus on reusing and upcycling while creating the value.

Thirdly, the case studies show ambiguous results regarding their social impact. The local circular initiatives have no significant positive effect on the public awareness but succeed to increase the public involvement in pro-environmental activities. There is no statistically significant impact on behavioral patterns found, although the respondents claim behavioral change did take place. Finally, all case studies prioritize the social dimension above or at least the same as the other aspects. However, the actual goals differ from the declared priorities in two out of four case studies which might have caused an arguably low social impact.

In conclusion, local circular bottom-up initiatives contribute to the circular transition in Amsterdam both directly and indirectly. On the one hand, through their events, local bottom-up initiatives stimulate public involvement and arguably behavioral change; most of them also create and maximize value of waste. On the other hand, they serve as example for other initiatives and citizens inspiring them to act against waste pollution in the city.

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