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Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of ***MSc Sustainable Urbanism*** at University College London:

I declare that this dissertation is entirely my own work and that ideas, data, and images, as well as direct quotations drawn from elsewhere, are identified and referenced.

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Abbreviations:

CE: circular economy

C2C: cradle to cradle

CLSC: closed-loop supply chain

RL: reverse logistics

EMF: ELLEN MACARTHUR FOUNDATION

CG: community garden

AD: anaerobic digestion

WTE: waste-to-energy

NPPF: National Planning Policy Framework

NPPW: National Planning Policy for Waste

GLA: Great London Authority

Chapter 1: Introduction

Food waste has become one of the major global problems, as FAO estimates that about one-third of food for human consumption is wasted in the world and causes about 400 billion dollars in losses (FAO, 2019). Food waste is generated at every stage of the food system-from agricultural harvest to household consumption. About 40 per cent of food waste is produced at the harvest stage in developing countries, while over 40 per cent of food waste is generated and lost at retail and consumer levels in developed countries (ibid.). While in London, nearly 2 million tonnes of food waste are produced (GLA, 2021).

The circular economy (closed-loop economy) has become popular in the academia and policy-making areas and is regarded as a pathway to achieving waste mitigation and social and environmental sustainability. Countries and cities have adopted the circular economy to address their environmental issues. However, some scholars pointed out that the implementation of the circular economy faces challenges in terms of policy and regulatory, institutional, economic, social and technical (Firth et al.,2011; Pan et al., 2015; Wesener et al., 2020; Van Keulen and Kirchherr 2021; Ada et al., 2021).

The circular policy package in the UK followed the EU circular policy. Meanwhile, in order to tackle the food waste issues domestically, the UK published the food waste hierarchy for waste reduction: prevention, redistribution, recycling, recovery and disposal (HM Government, 2018). In London, many charitable organisations have taken CE actions to reduce food waste. For example, ThisisRubbish starts educational campaigns to encourage Londoners to minimise waste. The Fliex Project repurposes surplus food for those who are in need in 32 Boroughs of London. In academia, there is research on developing local food-growing networks to reduce food waste to achieve sustainable agriculture. The London Plan 2021 also encourages local authorities to incorporate local food growing in regional planning, offers green space for Londoners to start growing practices as well as promotes healthy lifestyles. Additionally, waste-to-

energy has gradually replaced incineration, regarded as a green approach which could eliminate pollution and achieve economic benefits.

However, academia researched these initiatives, and advocacy is diverse. This research will be targeted in London to investigate the feasibility of closing the food loops in terms of local food growing, food reuse and food waste-to-energy. This research will be completed by examining the following questions:

Q1: where are the policy gaps in closing the food loops in London?

Q2: what challenges are faced in closing the food loops in London?

The above questions will be answered through the following research objectives.

1. Through the policy and regulation review identify the policy gaps and what policies or regulations support or undermine the food loops closes.
2. This research will identify the challenges the key actors faced in London . Before the empirical research, challenges in CE implementation will be identified and framed.

Chapter 2 will present the literature review and the framework of the challenges for further investigation and analysis.

Chapter 3 will determine the methods chosen to conduct the research.

Chapter 4 will analyse the UK and London policies and regulations to answer question 1.

Chapter 5 will analyse the challenges key actors faced in London to answer question 2.

Chapter 2: Literature Review and Framework

2.1 The Concept of Circular Economy (CE) and Circular Food System (CFS)

2.1.1 The Concept of Circular Economy (CE)

The concept of circular economy (CE), which is also referred to as closed-loop economy (Wysokińska, 2016), originated from Boulding's (1966) systematic thinking about the environmental impact of waste generated by economic activities and growth constraints (Geissdoerfer et al., 2017). CE is regenerative through design and intention, aiming at waste reduction (Schulte, 2013). Since 2010 research and attention have increased in academia, businesses and policy (Lieder and Rashid, 2016), which has seen the concept widely dispersed in various fields, supported by five pillars: performance economy (Stahel, 2010) and blue economy (Ogunmakinde et al., 2021), regenerative design (Geisendorf and Pietrulla, 2018), cradle to Cradle (C2C)(Huang et al., 2007; De Pauw et al., 2013), closed-loop supply chain (CLSC) (Porter and Kramer, 2011) and reverse logistic (RL)(Dominguez et al., 2020). While these five pillars differ in their operation, they are all deeply interweaved with CE to reduce wastage issues while creating economically and socially driven benefits.

Due to the features of CE often intertwined with other theories, Kirchherr et al. (2017) and Homrich et al. (2018) comprehensively reviewed definitions of CE in over 100 literature, acknowledging that the definition of CE is fuzzy. How defines CE depends on how it is approached practically (Korhonen et al., 2018). Considering that, the most used definition of CE is provided by EMF[1] (2016) as a guide for the general idea and practical concept. This definition refers to that CE as an economic model which utilises

[1] EMF: ELLEN MACARTHUR FOUNDATION

the reusability of products or raw materials to minimise waste through restorative and reproducible and identified two closed loops by which it is made up - the closed-biological loop and the closed-technical loop. The first of these loops refers to the eventual return of biologicals to the biosphere: bio-nutrients processed in anaerobic digestion/composting to generate renewable energy that returns to the biosphere (EMF, 2016). The second loop is focused on maintenance, reused/redistribution, or remanufacturing of product materials during their life cycle (ibid.).

Even though the definition of CE is varied, the practical principle of CE is based on the "R-typologies": 3R (reduce, reuse and recycling) (Wu et al.,2014) or 6R (reuse, recycle, redesign, remanufacture, reduce and recover) (Jawahir and Bradley, 2016).

2.1.2 The Concept of Circular food system (CFS)

There are three positions on the circular economy (closed loop) concept in the food system. Each aims to create environmental regeneration and social and economic benefit while eliminating food waste.

The first position employs the principles of regenerative design[2] to close the nutrient loops. The focus of the regenerative design is used in place-making and community-oriented local food growing to develop regenerative agriculture (Turner, 2011; Wesener et al., 2020). Such regenerative agriculture can help with waste management as sites of growing activity provide space for waste composting (Turner, 2011), allowing nutrients from the agriculture system can convert into healthy wastes (Moseletto, 2020), which in turn, can be the organic fertiliser for growing food (Kalmykova et al., 2018). Thus, the food nutrients loop could be closed. However, composting has not yet been

[2] Regenerative design: was proposed to create a community framework where energy and material supply systems can be renewed and regenerated by using local resources (Geisendorf and Pietrulla, 2018); it typically employed in the design of regenerative agriculture (Morseletto, 2020).

extensively discussed in the existing CE literature and has not been primarily implemented on a large scale.

The second position of the closed-loop food system is food reuse. Facchini et al. (2018) highlighted the food reuse strategy as being potentially address environmental, economic and social issues. It employs principles consistent with the closed-loop supply chain (CLSC)[3] and C2C[4] to close the technical loop of supply chain (circular food supply chain). The entry point of this position is to change the operational and supply model of current linear food systems (supply-sell-disposal). This lead to the food system generating more food waste (Jurgilevich et al., 2016). By redesigning the linear supply relationship which operates the food supply chain to supply-sell-recycle-reuse, eliminating the disposal step could close the technical loop while reducing food waste generation (Pacucci, 2021).

This idea reflects in food sharing and surplus food reuse initiatives in the market that businesses or organisations seek to create new flows of food resources (Morone et al., 2018) and repurpose surplus food for those in need (Michelini et al., 2018). One benefit of this was identified by Mourad (2016), who researched food waste in the US and France through semi-structured interviews and found that food sharing and reuse initiatives can reduce the environmental pollution of food waste and bring economic and social benefits. Economically, business participants involved in these initiatives can benefit from donation taxes and save disposal costs (ibid.). While socially, charitable

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[3] CLSC is a management system that involves designing, controlling and operating to maximise value creation through repurposing and recycling over the life cycle of products and creating new value over time (Guide and Van Wassenhove, 2009; Govindan and Soleimani, 2017).

[4] C2C focuses more on the micro-level, referring to reusing products after being recycled (Huang et al., 2007) or remanufacturing the product after recycling the end-of-life products (De Pauw et al., 2013). It is typically practised in architecture, manufacturing, and industrial design (Esposito et al., 2017), which aims to reduce the environmental damage of products through more sustainable production, distribution and disposal processes (Visser, 2010).

organisations engaged in surplus food redistribution could receive financial incentives from the government, which can be reinvested in furthering their causes more effectively (ibid.).

The third and last position is food waste-to-energy (WTE), which targets changing how food waste is treated, which aligns with the principle of C2C. Specifically, it refers to recycling food waste through biotechnology to generate new resources and then returning them to the biosphere to develop a new ecological service system (Pacucci, 2021). For example, food waste (e.g., vegs, fruits and roots) can be sent into anaerobic digestion (AD) systems to generate biogas that can be used for food growing or being generated into electricity and connected to the grid (Xu et al., 2017; Armington et al., 2018). By converting food waste into energy in this way, the nutrient loop is closed. It offers a profitable solution that creates economic value as it increases the AD plant revenue while reducing pollution (Xu et al., 2017).

2.2 Challenges in closed-food loops implementation

Overall, the above three positions of closed food loops create economic and social benefits while reducing the environmental pollution of food waste. However, closing the food loops faces many challenges in their practical implementation.

2.2.1 Challenges in Local food growing

There are two patterns of urban regenerative agriculture in practice, as classified in the EU by Certomà and Notteboom (2017): allotments[5] and community gardens[6].

[5] Allotment: refers to public land provided, planned, designed, and managed by local authorities (Certomà and Notteboom, 2015)

[6] Community garden: citizens voluntarily carry out community gardening by using public or abandoned private lands that could enhance environmental value (Certomà and Notteboom, 2015).

Although both of these connect food to the land in urban areas (Witheridge and Morris, 2016), the land sources for these two differ. This study will focus on community gardens and the challenges they face. In the process of citizen groups seeking abandoned land or vacant land to design CGs, lands are typically constrained by local administrations and private owners (the model of CG planning is shown in figure 1), while public administrations primarily plan the land for allotment. Due to the difficulty in full identification of the challenges posed to closing the food loop by land accessibility about allotments, this study primarily focuses on the challenge faced by CGs.

Figure 1. The model of the community garden planning (Certomà and Notteboom, 2015).

The community garden (CG) concept is embedded in various social practices that change with actors, time, and lands and are often interwoven with urban development policies (Drake and Lawson, 2014). In order for to food can be grown, the land is required. Thus support from government policy is key to building community gardens practices as the political framework affects land-use planning and other relevant policies (Witheridge and Morris, 2016).

Furthermore, Martin and Marsden's (1999) research on urban food production in England and Wales also highlighted that land use planning is the central issue in creating linkages between urban food production. The support from local authorities, involvement of community members, and integration of urban production into planning policies can promote urban food production. Urban food production cannot survive without these key factors (ibid.). In addition to planning and government challenges, obtaining social capital such as funding for garden infrastructure equipment, and volunteers to participate in planting activities represent challenges to the building of CGs and enabling food growing in CGs (Pearson and Firth, 2012), besides Firth et al.

(2011) researched food growing in two CGs in Nottingham in England and presented that trust from local people and the support of external groups are also the key factors in enabling food growing in CGs.

Therefore, it can be seen that in the UK, the current study of CGs seems to mostly revolve around the challenges raised by land-use planning, policy, funding and volunteers, and generally lacks comprehensively identifying all challenges which affect food growing in community gardens. However, Wesener et al. (2020) provide a broad scope in their research on 103 cases and empirically investigated the challenges in CG practices in New Zealand and Germany. They discussed physical (infrastructure and technical), socio-culture (including individual skills, knowledge and information), economic (economic and financial viability), and political and administrative (including land-use and tenure, spatial policies and local government and public administration) that challenged community gardening (ibid.). Based on the above literature, this study will combine the above-mentioned UK studies and Wesener et al. (2020) in its framework, as outlined in section 2.4.

2.2.2 Challenges in Food Reuse

In the related literature, the challenges in food reuse in the circular food supply chain have been broadly investigated. However, changes in actors in the food-related part of the circular supply chain are rarely identified in the literature as the actors involved in the circular actions are the key component in changing the operational model of the circular food supply chain and transitioning to circular food systems (Ciulli et al., 2019; Thapa Karki et al., 2021; Sundgren, 2022). In the circular food supply chain, food waste generated by one type of actor becomes the resource for another type of actor (Murray et al., 2017). Thus, In the process of food reuse, the relationship between actors in the circular food supply chain changes from the traditional food supplier-consumer/waste receivers to food suppliers-food redistribution charities or organisations (Sundgren, 2022). This means that the operational model and supply relationship in the food supply

chain changed-the reuse of food relies on the links between organisations to transfer surplus food resources. Thapa Karki et al. (2021) identified food donors, collectors and distributors as three key actors in the food supply chain in the UK (The system of actors and their relationship is shown in Figure 2). Moreover, distinguishing the actors in the circular food supply chain from the traditional linear supply chain can help to identify challenges faced by key actors in the supply chain, for example, actors' accountability.

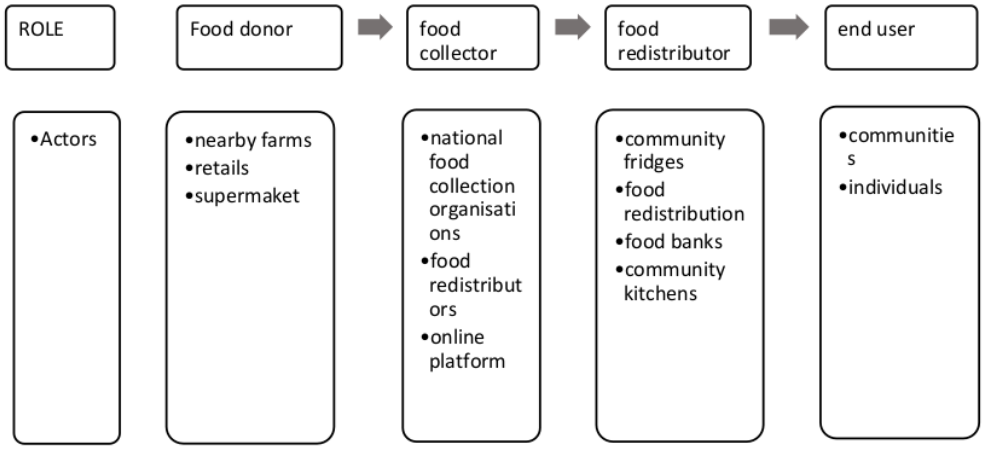

Figure 2: The system of actors and organisations and their relationship in the surplus food supply chain (Karki et al., 2020).

To review more generally, the challenges facing the practical application of food reuse in CE-based supply chain has been studied widely. Both systematic reviews (Govindan and Hasanagic, 2018; Ada et al., 2021) and content analyses (Batista et al., 2018) of the circular supply chain, with the research conducted by Govindan and Hasanagic (2018) on challenges to implementation of the circular supply chain being of the special one. They broadly clustered challenges covering government challenges, the effect of economic, technical, knowledge and skill, management, CE framework, culture and social issues, and market barriers. While this research has been cited many times in relevant empirical studies, it primarily focuses on adopting CE in the whole supply chain and does not analysis of clusters by industries. Ada et al. (2021) reviewed 136

literature with a special focus on the food industry and highlighted similar clusters as Govindan and Hasanagic (2018) whilst conducting non-empirical research.

In addition, other studies identifying and investigating economic, infrastructure, social, cultural and technology challenges to food reuse showed that they were common in the employment of semi-structured interviews, whilst those focus on policies and regulations challenges typically carried out by using the policy review method (Sharma et al.,2019; Thapa Karki et al., 2021; Van Keulen and Kirchherr, 2021; Papargyropoulou et al.,2022).

Although the current literature on challenges of food reuse was carried out deeply, most analyses choose to discuss challenges from the sustainability or supply chain perspectives or CE implementation rather than from the closed-loop perspective, thus a gap in the research the current study would fill.

2.2.3 Challenges in Food waste-to-energy

Anaerobic digestion (AD) for food waste has replaced incineration and landfill in practice and has become a new green food waste treatment method. Nevertheless, it is not widely applied in practice, and challenges in setting up AD treatment have not been extensively empirically investigated.

As with food reuse, the influence of actors in food reuse initiatives shares the same goal: redistributing surplus food to those who need it (Sundgren, 2022). In contrast, the actors in food waste recycling and treatment systems are composed of various actors, and every actor has their own goals, values, and background (Armington et al., 2018). These actors were identified by Caniato et al. (2014) in their research on Bangkok waste recycling management by employing the social network theory. They are public administrations, private sectors, academia, civic society and other stakeholders. Similarly, Armington et al. (2018) teased out actors in the same system (food waste generators, actors in collection and transportation and actors in waste-to-energy

facilities) to analyse operation modes to identify the challenges in waste management functions.

Policy and regulations are common challenges in waste recycling management literature. If policies and regulations are not implemented to regulate actions related to stakeholders, they would not be fully engaged in relevant circular actions. Thus, CE-related waste management goals and food loops are difficult to be achieved and closed (Morone and Imbert, 2020).

In light of the analysis of actors and policy in waste management from Armington et al. (2018), Caniato et al. (2014) and Morone and Imbert (2020). The actors in the waste recycling management system as shown in Figure 3.

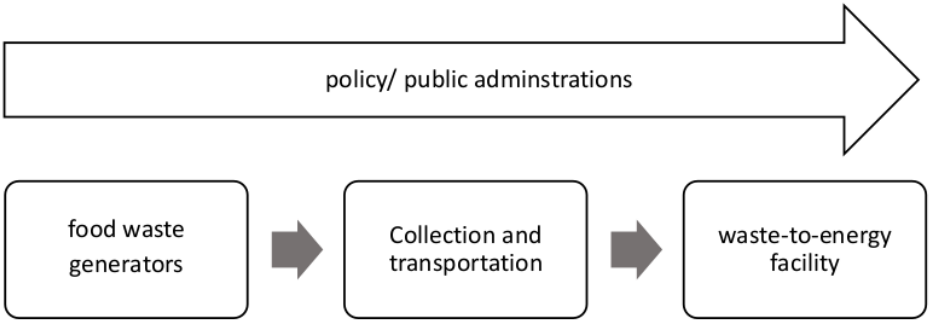

Figure 3: The actors in the waste recycling management system (Caniato et al., 2014; Armington et al., 2018; Morone and Imbert, 2020). Policy and public administration are involved in the whole process.

The research on food waste-to-energy and the challenges in its promotion have continued to rise over the past five years (Ren et al., 2018). Policy, regulatory, technological, financial and economic challenges each have obstacles to overcome in implementing the food waste converted to energy.

The technology challenge found that is one of the key challenges in setting up AD plants (ibid.), as choosing cost-effective techniques is difficult that would determine the quality of converted energy (Pan et al., 2015). For example, the poorly performing

technology and waste treatment plant will generate waste when converting energy, while those generated waste also requires technology and infrastructure to deal with (Iakovou et al., 2010), thereby increasing the possibility of financial challenges. Moreover, high investment costs and benefits of generating energy connected to grids (Pan et al., 2015) and the cost of transporting food waste (Ohnishi et al., 2018) were categorised as financial challenges. The technology and financial challenges have been ground investigated in the UK (Jones and Salter, 2013; Walker et al., 2017; Ackrill and Abdo, 2020) and the US (Dalke et al., 2021). However, research on anaerobic digestion in the UK was primarily farm-based rather than city-based (Jones and Salter, 2013; Ackrill and Abdo, 2020). Although Walker et al. (2017) studied a micro-AD plant in London, this study employed an experimental approach to explore the economic feasibility of setting up a micro-AD plant without discussing technology, policy and regulations challenges.

Finally, Pan et al. (2015) highlighted a variety of institutional challenges in their systematically of the challenges in waste-to-energy implementation strategies, identifying the value of social acceptance and participation in policy decisions in contributing to setting up waste-to-energy systems locally. If low social acceptance of WTE is low and the cooperation between public authorities and stakeholders is weak, it would be difficult to move forward with food waste-to-energy plants set up in the city.

2.2.4 Research Gap

Considering the above review of the challenges in food-related waste reduction practices, the following gaps in the current literature can be identified:

- Although most of the above empirical research was carried out within the UK, little research has been carried out on the case of London.
- Many of the challenges surrounding food growing in community gardens, food reuse initiatives, and food waste-to-energy discussed above have not been

thoroughly investigated in the UK. The existing study of challenges facing these three aspects and analysed from the circular development perspectives in London can be found in the study by Williams (2021).

- Most of the studies discussed the challenges from a sustainability transition perspective. Even though some challenges were identified from the circular economy approach, they rarely did analyse from the closed-loop perspective.

This chapter first gave three positions for closing the food loops, followed by the challenges identification section. In this section, the key actors in local food growing, food reuse initiatives and food waste-to-energy were identified first, which were for the selection of interviewees for Chapter 3 and analysis of interview content for Chapter 5. The challenges faced by local food growing, food reuse initiatives and food waste-to-energy practices also were identified for framing the framework for Chapter 5 analysis. The framework will be shown in the next section.

Overall, this study will be based in the London Boroughs with the intent to analyse the challenges of community garden food growing, food reuse initiatives and waste-to-energy implementations in the city from the closed-loop perspective.

2.3 Coding framework of Challenges to implementation in Closed-Food Loops

Given that many of the above challenges could be classified in the same category, this research will synthesise the identified challenges to avoid repetition, mainly select the identified challenges in the UK and consider integrating the challenges identified in the EU, forming the framework for further guide and analysis. This research will be based on the five main categories which were identified and explained as the following (sub-categories will be shown in Appendix 4).

Table 1: Coding framework of Challenges to implementation in Closed-Food Loops

Category	Explanation	References
Policy and Regulatory	Policy and regulation framework that undermine or support the closing food loop actions	Ada et al. (2021); Van Keulen and Kirchherr (2021); Sharma et al. (2019); Pan et al. (2015);
Institutional	The structure that institutions rooted for many years and lacks CE cognitive	Firth et al. (2011); Wesener et al. (2020); Witheridge and Morris (2016); Russell et al. (2020); Pan et al., (2015)
Economic	Market supply and financial viability for closed food loops	Firth et al. (2011); Wesener et al. (2020); Thapa Karki et al. (2021); Santagata et al., (2021); Xu et al., (2018);
Social	Social group awareness, participation and attitude toward closing food loops	Firth et al. (2011); Wesener et al. (2020); Papargyropoulou et al., (2022); Van Keulen and Kirchherr (2021); Santagata et al., (2021); Xu et al., (2018)
Technical	Skills for closing food loops among the public and private sectors	Firth et al. (2011); Wesener et al. (2020); Sharma et al. (2019); Russell et al. (2020); Pan et al., (2015); Santagata et

	al., (2021); Xu et al., (2018)

Chapter 3: Methodology

3.1 Study focus

Challenges of closed-food loops related to community gardens, food reuse and food waste-to-energy, and key circular actors have been identified in the literature in Chapter 2. This study explored the challenges of closing food loops in London Boroughs. To achieve this aim, this research adopted a qualitative research method. The qualitative approach highlighted investigating people's words, actions, and records to look for the significance and reason of emerging phenomena from collected data (Anon, 2007) so that researcher can deepen their understanding by linking the literature. While quantitative research aims to quantify results to provide a richer knowledge base in the field (ibid.), many independent organisations in the UK already provide data to authorities to enrich the knowledge base. For example, there are 1172 food banks operating across the UK, and 78 per cent of organisations experienced a decrease in financial donations (IFAN, 2022). Besides, community gardens, food reuse and food-waste-energy are performed by key actors, and the circular economy is emphasised as small-scale and localised activities. As such, it is not likelihood to quantify circular activities and understand the challenges and reasons for actors taking circular actions through data Therefore, the qualitative method was chosen for this research to investigate the challenges faced in London.

3.2 Research design

This research employed a two-stage qualitative research design, drawing on policy analysis and semi-structured interview methods. As Lieder and Rashid (2016) proposed

the review of circular economy implementation from up to bottom and bottom to up could review CE actions comprehensively.

3.2.1 Policy Content Analysis

The policy review aims to review policies, regulations and legislations to unpack food governance landscapes concerning urban food growing, food reuse and waste-to-energy at the national and regional levels, analysing how the policy gaps undermine food loops closing. All policy documents were downloaded from the UK government and GLA websites. Specifically, this study reviewed policies as the following:

The national level documents and Laws and Directives: National Planning Policy Framework; Resources and Waste Strategy for England (RWS); Agriculture Act 2020; Waste (Circular Economy) (Amendment Regulations) 2020; Circular Economy Package; Directive (EU) 2018/851; National Planning Policy for Waste.

Regional level: London Plan 2021; London Food Strategy 2018; London Environment strategy 2018.

In this part of the policy analysis, the national level policies, laws and directives related to this topic were interpreted first and then reviewed London's spatially strategic policies were examined. This aimed to understand how London enacted the relevant policies in the food-related area and sought to analyse gaps between the existing policies and regulations to identify the factors that undermine closing food loops. The reason for researching policy gaps is that strategic urban planning can enhance sector and organisation networks in circular actions (Bolger and Doyon, 2019) and provide long-term usable space for low-value circular activities to achieve the localisation of resources as well as locating local producers and consumers of waste (Williams, 2020). Therefore, identifying gaps first in urban strategic planning is significant to achieving closing food loops and urban circular development.

3.2.2 Semi-Structured Interview

Although this research was grounded on past representative literature identifying five categories of challenges and sub-categorised them as shown in (table 1) which forms the basic understanding of challenges in closing food loops, the challenges were described and summarised in the literature based on different actors' perceptions who were from different backgrounds. In addition, social rules and norms influence individuals' experiences and social and cultural expectations (Wesener et al., 2020). Furthermore, research in the literature is mostly not based in London, which purposes are different from this study. Hence, this research adopted a semi-structured interview method to identify challenges faced in closing food loops in London Boroughs (Chapter 5).

Interview design:

Based on the analysis of key actors in circular actions in Chapter 2 (figure 1, figure 2 and figure 3), about 116 emails were sent to actors requesting participation in this research by attaching participant information sheets (Appendix B). Actors were chosen from community gardens, food collectors, food redistributors and food end users, public administrations and private companies. Finally, 15 participants agreed to participate in the interviews (Overview of key actors, see table 2).

According to the initial coding framework for the challenge to the implementation of interview questions outlines for semi-structured interviews shaped (Interview questions samples see Appendix C). The interviews asked interviewees to talk about how their organisations, project or work functioned first and then share their experiences if they encountered any challenges in their past projects. This helped the interviewer identify challenges and ask more in-depth questions. The semi-structured interviews were conducted online from 26th July to 25th August and each interview lasted between 30-70 minutes. All interviews were recorded after getting permission from the interviewees. The transcripts were analysed based on the coding framework in Chapter 2 (Table 1).

Table 2: Overview of key actors.

Type/ Category number	**Interviewee coding number**	**Organisations/ Roles/**	**Working Mechanism**
Community garden (A)	A1	Founder	Hackney-based community garden; setting up a network of other community gardens in Hackney; growing food and composting; providing space to bring people together; providing opportunities for people to gain skills and knowledge.
	A2	officer	Developed local food growing in London Boroughs
	A3	officer	Local food growing and sustainable food growing consultation
	A4	Chair	community food gardens in Tower Hamlets; providing training for volunteers; taking care of crops together, and when food is ready to be picked, then sharing it between growers; making compost from food waste and leaves; sell grown food nearby.
	B1	Co-founder (online	Connecting any kind of business (shops, hotels, restaurants,

Food reuse (B)		redistribution platform)	pubs, schools, airports large catering companies) that has surplus food to charity and do this using an online platform. Businesses and charities can register and on any given day that a business has got surplus food. The online platform posts notifications and the notification gets emailed out to charities in the local community and the charities can claim the food on a first come, first serve basis.
	B2	Project coordinator (food redistribution organisation)	Distributing surplus food in 32 London Boroughs. running a community kitchen Working with Fareshare, creating the link between the food industry and food distribution centres. Distribute food to community charities, food banks, community kitchen
	B3	Project coordinator (community fridge)	Set up community fridges in any place (church, café, community centre);

			Open to everyone, individuals and businesses can donate or share surplus food, and then anyone can collect that food. Running community fridges in London 32 Boroughs
	B4	Chief Executive Officer (Food bank)	Community charity running in Southwark. Receive food from charities, community groups
	B5	manager (the community kitchen)	A national food charity, cooking and provide free and hot community meals
	B6	Project coordinator (community fridge)	Set up community fridges in any place (church, café, community centre); Open to everyone, individuals and businesses can donate or share surplus food, and then anyone can collect that food. Running community fridges in London 32 Boroughs
	B7	Senior Analyst (charity)	Working with government, delivery partner and individual to reduce food waste; Help to develop food voluntary agreements.

	B8	Project coordinator (surplus food educational organisation)	Works to reduce industry and supply chain food waste using education and public events
Food waste-to-energy (C)	C1	Education, communication and outreach officer (private company which provide waste, waste, and energy service)	Research, develop and deliver projects to promote effective recycling to Camden communities. Currently leading a fly-tip reduction project in St. Pancras and Somers Town.
	C2	GLA AM; Deputy chair of the environment commitment; member of the Housing Committee;	Advising on environmentally sustainable business, energy and waste efficiency analysis, waste minimisation and biodiversity, with a focus on the skills needed to develop a low carbon circular economy in London. Focus on developing anaerobic digestion plants to reduce and manage food waste in London.
	C3	Project directors of one of London	Developing in sustainable, waste and recycling management solutions.

		waste Authority	

3.3 Ethics and Risk

This research project posed a low ethical risk to prospective participants and fully complied with the research ethics guidance at University College London (Risk assessment form see Appendix A). Interviews were conducted fairly and transparently, ensuring that participation was voluntary, and responses were anonymous. The detailed research objectives of this research have been made clear to all participants by sending participation information sheets and declaring to all participants that the interview results are only for academic purposes. In addition, before conducting interviews, the researcher promised each participant that no personal information of any participants would be mentioned in this study. According to UCL data management and protection, all data is legal, accurate, honest, confidential, and securely stored.

Chapter 4. Policy Review

This section aims to identify the policy or regulatory challenges by reviewing the policy to find the policy or regulatory gaps in closed food loops.

Local food growing

The policies about local food growing are mentioned in National Planning Policy Framework (NPPF), the London Plan 2021 and London Food Strategy. The National Planning Policy Framework (NPPF) policies support local food growing to promote healthy and safe communities (HM Government, 2021, p.27). Specifically, it encourages local authorities to promote and support healthy lifestyles through access to healthy food and allotments. In addition, NPPF recommended that strategic policies recognise that some undeveloped land could be used for other functions, such as food production (ibid, p.35). The policies in the London Plan 2021 are more specific than that in NPPF. London Plan 2021 (Policy G8) highlighted that London boroughs should encourage the provision of space for urban agriculture, including community gardening (GLA, 2021, p.331). It also suggested incorporating local food growing into community plans, such as development projects, while highlighting the provision of food growing skills and employment opportunities for Londoners. Moreover, the London plan 2021 also supports incorporating food growing in playgrounds to provide educational opportunities (Policy S3, p.226) and considering food growing in London's green infrastructure networks to achieve social value (Policy G1, p.313). The London Food Strategy (GLA, 2018) offers more in-depth advocates for London's food growing. These policies indicate that the London government supports the development of local food growing and provides a regulatory framework while promoting a healthy lifestyle for Londoners and achieving social and environmental goals.

Additionally, Government policies are typically regarded as efficient methods to overcome the land accessibility challenges, growing skills challenges, and start-up funding of community food growing activities (Turner, 2011). Although the provision

of space has gained support from the London plan 2021 and the London Food Strategy, the Agriculture Act 2020 emphasises offering financial assistance to agriculture. However, funding for local food growing is not reflected in the city plan, despite it is essential to build local food growing and can help CGs to obtain insurance (Mintz and McManus, 2014). Without funding, starting local food growing activities would be challenging and potentially hinder closing food loops in London.

Overall, local food growing is considered in policies and laws and gets support from a regulatory framework in the London Plan 2021 and London Food Strategy. Lacking financial assistance is a challenge for local food growing to close the food loop in London. However, there are no regulatory frameworks that support food reuse, which will be presented and discussed in the following section.

Food reuse

Regarding policy review and policy challenges faced in food reuse in London, the first one is that the London policy and national policy are mismatched, and the London policies lack participation in the circular economy and governance. At the national level, the Resources and Waste Strategy for England (2018) suggested food distribution before it would become waste and provided grassroots funding support in 2019 (HM Government, 2019, p.101). In contrast, the London Plan 2021 does not have a specific requirement for surplus food redistribution. On the other hand, London's strategy for food reuse is primarily reflected in the London food Strategy (2018), which targets low-income households aiming to tackle household food insecurity. It suggested that local authorities, businesses and communities collaborate to promote community food initiatives and encourage businesses to donate more surplus food or offer monetary support (GLA, 2018). There are no specific planning requirements or further guidance on food redistribution beyond encouragement.

In general, due to this lack of consistency in policy and a general lack of participation in circular actions, food reuse initiatives in London are more likely to be self-governed

by redistribution actors, only cooperating with local authorities at the local level. This causes an issue as if there is a lack of participation in circular economy action at the policy level, and policymakers would gradually lack awareness of the circular economy transition. They may not understand that governance issues need to be reflected (Feindt and Weiland, 2018). From the policy strategy perspective, without high-level policy support, it is not likely to help manage and eliminate unsustainable production and consumption system (Kautto and Lazarevic, 2020), ultimately making it difficult for food reuse activities to develop further, thereby challenging circular economy transition and the ability to close food loops.

In addition, almost no policy and regulatory frameworks explicitly focus on food reuse. Although the regulations, policies and strategies are related to resource reuse, they are often mixed with waste management policies at the national and regional levels. In the UK, the circular economy policy package followed the EU circular economy package, in which the directive about waste management is Directive (EU) 2018/851. Both Directive (EU) 2018/851 and the Waste (England and Wales) Regulations 2011 highlighted the strengthening of urban waste reuse and recycling but without indicating the type of waste. While at the national level, the Resources and Waste Strategy for England (2018) suggested food distribution before it would become waste. Despite that, regulations and directives on surplus food reuse are rarely specific.

Furthermore, the Waste Framework Directive (EU) 2018/851 requires that member states of the EU set goals for waste reuse to support the circular economy transition (article 3) and also state requirements on producers' responsibility: defining a clear role and responsibilities of all actors involved, including re-use operators and social economy enterprises (EU, 2018, article 8a (1a)). UK circular economy policy package includes this directive, whereas no policies require the definition of the actors' responsibilities and roles, nor do the London Plan 2021 or the London Food Strategy (2018). Thus, there is no corresponding regulatory framework for the accountability of actors for food reuse.

The Lack of a regulatory framework on food reuse has resulted in a lack of clarity about the responsibilities of actors involved in food reuse actions, as it is difficult to distinguish the role of actors in a circular food supply chain. While the regulations focus more on consumer protection in linear food systems (Zurek, 2016). However, from the perspective of the closed-loop system, the actors' relationship in the circular food supply chain changed. For example, as shown in table 2 in Chapter 3, some interviewers are involved in food redistribution and the consumption of surplus food (community kitchen). This means that some actors are involved in both food redistribution and the consumption of surplus food and are responsible for both roles. The multiple roles of actors make it difficult to identify the consumers in the circular food supply chain. This further adds to the unclear accountability and introduces legal risks. In turn, actors are unwilling to engage in food reuse initiatives as they may face legal risks, thereby challenging closed food loops.

Food waste-to-energy

In London, food waste management is often mixed with policies on general waste management. Within these regulations, most attention is paid to waste management and recycling rather than converting food waste into energy.

There is the main policy and regulatory framework challenge for food waste management. There are no uniform measurement methods that would potentially undermine closing food loops. While the Waste Framework Directive (EU) 2018/851 requires monitoring food waste levels and adopting legislation on food waste measurement. The UK circular economy policy follows Directive (EU) 2018/851 for domestic waste management, but the food waste measurement methods requirement and legislation for food waste are not reflected in policies and regulatory frameworks at the national and regional levels. In the UK, food waste has not been considered separately in the waste policies and regulations. The National Planning Policy for Waste (NPPW) required local planning authorities to monitor and report existing stock, changes in waste management facilities, and the amount of waste recycled, recovered

or going for disposal (HM Government, 2014). Additionally, establishing qualitative or quantitative benchmarks or targets and indicators to assess the value of waste prevention programmes is required at the national level (the Waste (England and Wales) Regulations, 2011, part 2). Whereas although the London Plan 2021 sets a monitoring requirement, there are no indicators and measures requirements for waste (Chapter 11). Similarly, the London Environment Strategy (2018) requirements for monitoring and reporting waste are aligned with that of the Waste (England and Wales) Regulations 2011, which is that the London Government would establish an easy-to-use and understandable mandatory data reporting system for municipal waste (Chapter 7, p.306), but no measurement methods for waste published.

Overall, it is clear that the regulations regarding food waste measurement and legislation for the London region are lacking. This lack of unified measurement methods makes it difficult to close the food loops in London. Inconsistent data from different sectors and authorities may lead to the under-reporting of waste, and the level of uncertainty in measuring food waste is between 12 per cent and 20 per cent in the UK (Corrado et al., 2019). Ideally, the closed-loop system should maximise the use of materials to eliminate waste at every stage (production-reuse-remanufacturing/redistribution-recycling). However, if the amount of food waste is not clear in the food waste flowing and there are omissions of food waste, then in principle, the food waste cannot be eliminated entirely at every stage in the closed-loop system, thereby undermining the food loop closing.

On the other hand, If there were clearly outlined and unified measurement methods, proper policy and decision-making could be facilitated. Clear data provides evidence for policymakers to enact governance more effectively, allowing them to maximise resource utilisation and minimise environmental impacts (Lawford, 2019) and closed loops. More specifically, the measurement methods of food waste can help the government food department to monitor the quantity, quality and type of food waste in the food chain (Corrado et al., 2019), which could help determine the direction of policy

action and the most effective way to reduce food waste (Hartikainen et al., 2019) in the policy formulation process, and reducing food waste generation from the source. Therefore, from the policy perspective, without such a unification of measurements, there would be difficult to monitor food waste and formulate corresponding waste prevention policies, thereby undermining closing food loops.

Chapter 5. Findings and Discussion

This chapter will present the challenges organisations involved in circular actions faced in London, which were organised based on the framework categories in chapter 2 (Table 1). Policy and regulation gaps have been presented and discussed in the previous chapter based on analysing policy documents and legislation articles. This chapter will be organised based on the framework categories (Table 1) and will analyse and discuss the interview contents of the interviewees presented in chapter 3 (Table 2). According to the interview content, this research found that the food loops are closed in London to some extent. However, there are some challenges in closing loop actions, which were identified by semi-structured interviews and will be summarised and analysed in this chapter.

Policy and Regulatory Challenges

Land use and Land tenure

The land use and long-term land tenure have been identified as a challenge in a community garden in Hackney, London. The interviewed community garden organisation in Hackney used to grow food, use food to make vinegar, and make compost from food waste and leaves for ten years. In principle, the Hackney community garden closed the food loops: they grow vegetables, share food between volunteers, reuse food to make useful products, and compost. However, the original CG was interrupted, and now the gardeners have to work in different CGs due to the land being taken by the landowner. As the interview A1 said:

"I think that most of the land is owned by the Council. But we never really think part of the problem was we didn't know the ownership, you know, it was quite difficult to find out who owned the land, so we don't have the lease."

From the perspective of the community gardens, the reason CG is unclear about land tenure rights might be because the CG lack links to social capital (i.e., local authority) (Firth and Pearson, 2011). Building bridges of social capital is important to CG building when it comes to accessing resources and helping to start CG. To be more specific, without the link with the authorities, the CG founder would not understand of the ownership of the land, the procedures required for land application, and the support of resources that can be obtained from the authority (e.g., financial assistance). Ultimately leading to informal use of the land, thereby facing the challenges of land use and undermining food loops closed.

On the other hand, the building of CG is related to local planning. Although Hackney Borough updated the requirements for CG development application in April 2022, the requirements for CG before 2022 were not found on the council website. This implied suggested that social capital and CGs were not closely linked before 2022. Hackney authority updated the application requirements for community garden development: Hackney authority would arrange meetings with CG applicants at the proposed site and review the proposed area to ensure environmental safety; if the CG application is approved, the local authority would support the search for funding and provide training in growing skills (Hackney Council, 2022). This shows that Hackney has incorporated CGs in local planning and encouraged and supported the development of more CGs. Therefore, from a local planning perspective, the local council clearly provide a pathway for CGs to connect with social capital. It is recommended that CGs can strengthen communication with the authority to achieve CG building and closing food loops.

Institutional Challenge

Lack of responsibility

Policies and regulations set local authorities involved in circular actions. In London, local authorities involved in the food loops are local authorities, waste authorities, planning authorities, and communities.

The Local authority lacks responsibility for food reuse actions that identified a challenge in closing food loops in London. In food redistribution activities in London, expanding the distribution scope of surplus food and finding suitable warehouses are part of the work of charitable organisations. These charities sometimes would seek help from local authorities to help them find warehouses, and local authorities are willing to help them. However, one interviewed food redistributor suggested that sometimes the warehouses were unsuitable because they could not meet requirements for storing and transporting surplus food. As a surplus food redistributor said:

"We need proper warehousing. There I'd say probably 30% of the London Councils got it. They created the warehousing that was necessary. But the other councils said these organisations would represent us and these (warehouses) could deliver. But it wasn't a proper warehouse. It couldn't store a capacity, so the one they got is that it's just not fit for its purpose. (warehouses) are underneath the swimming pool, and the access is terrible once you get the food in, and you can't take a pallet in, so you have to move it down round corners. All the rest of it, you get it in, and then when it goes out the other end, there's an area with no parking. And there's about 30-degree ramp that you have to push up trolleys that weigh about 150 kilos isn't in minutes, so it's not fit for purpose." (Interviewee B2).

A food bank in London also faced a similar challenge. When asked if the food bank talked to local authorities to help find a warehouse, the chief executive officer of the food bank said:

"That's the problem we're facing. We are going to pick up that conversation again with them (local authority). They (local authority) did offer us a place and then realised they (local authority) needed to use it (the offered place). So it all fell through. And by the

time we got to the end point of it, they said you could use this (warehouse) a little bit if that's useful. And it wasn't. So we will come back to them on that conversation. It is the biggest headache of what we do" (Interviewee B4).

Insufficient awareness of circular activities in institutions with severe bureaucracy (Kazancoglu et al., 2020) and the current social-technical construction of infrastructure (Roelich et al., 2014) would lead to that institution's lack of responsibility. The current UK regulatory framework and the London strategic plan have not shown the need to reuse resources. Then institutions would not integrate the design and operation of infrastructure required for the reuse of surplus food into changes to the current urban infrastructure. Thus, lacking responsibility would result in less available infrastructures being provided, potentially leading to unstorable surplus food and generating new waste, which may be hindering closed food loops.

Economic Challenge

Market Supply

Surplus food supplies from suppliers potentially affect food loops closed. In previous literature, the supply challenge from suppliers was identified primarily because donating surplus food depends on suppliers' social responsibility (Luo et al., 2021). However, this research found that the supply challenge differs from previous years. Most surplus food for community fridges or kitchens comes from retailers or supermarkets. At the same time, many suppliers reduce their surplus food supplies instead of selling food that is about to expire at a discount. This leads to an unstable supply of surplus food in the market. As a project coordinator of the community fridge project said:

"There are loads of challenges, the quality and the quantity of food is reduced, particularly this year, businesses are not sharing as much food as they used to like, you'll get surplus food from the supermarket, and the fruit or veg will be like watery

and smelly it's in a really poor state. So that's been happening to a lot of fridges. It's coming close to its (surplus food) end date. So by the time it comes to fridges, it'll be when it's almost not usable for them either." (Interviewee B3)

The community kitchen faced a similar dilemma. When asked about any challenges faced in the manager's collaboration work, the manager said:
"There are lots of challenges. Our supply of surplus food can vary, and obviously, we have found that the supermarkets have less waste than they did before, which means our supply is smaller, which is causing us to have to buy some stuff. And recently, there have been a few instances where we've had to buy food that is usually donated." (Interviewee B5)

The cost of living and fuel price in the UK has increased in 2022 (Khan, 2022), and supermarkets are discounting more near end-of-date items for more financial returns as the transportation costs have increased, thus this has led to more people choosing to buy discount products. Thus, the amount of food donated by supermarkets drop. The market supply of surplus food in the market also will be decreased. There are two roles of surplus food redistributors, one is to reduce food waste and another one is to repurpose food for those in need. Reducing the market supply of surplus food means those who are in need would not get enough food, which would be a challenge for surplus food redistributors and alleviate food poverty. On the other hand, although reducing market supply quality may mean that the loop can be closed faster as food is consumed at the consumption stage and food waste is reduced, in the UK, household waste is the leading source of food waste (HM Government, 2018). From the cause of food waste perspective, reduced market supply may potentially lead to more household food waste generated, thereby undermining food loops closed. Whereas the impact of reduced market supply on the amount of food waste requires continuous quantitative metering and tracking.

Financial Issues

Inadequate funding to support loop actions was identified as a challenge for community gardens building and waste-to-energy plants to set up. In contrast, funding is not challenging for actors involved in food reuse in this research. It is difficult for community gardens to continue operating their growing activities when they lack funding. As the co-founder of a community garden said:

"We failed to get funding to run that (community garden), so it's pretty much just a Whatsapp group now" (interviewee A1)

Financial is a challenge for anaerobic digestion plants as the cost of investing in land in London is much high. As the GLA member said:

"London is a very expensive city. It's expensive if you want to rent somewhere. Land in general in London is expensive, so using land for the disposal of waste can be difficult to find anywhere appropriate to position an anaerobic digester. You have to have the land needs to be zoned for that kind of industrial type use via collectors, operate out of an industrialist state". (Interviewee C2)

In terms of local food growing, lacking the connection with social capital, for example, local authorities, social groups, organisations, and individuals mean that they would potentially get insufficient financial assistance from society. As community gardens are typically non-profit, they rely on financial aid from national organisation and donations. If CGs could create relationships with local social-economic teams, they would get financial support. Therefore, disconnecting with social capital would lead to lacking funding support, consequently failing in CG building, thereby preventing food loops closed in community gardens.

In contrast, the economic cost of setting up a waste-to-energy plant is a big challenge for investors because the initial investment cost of setting waste treatment plant is much high (Pan et al., 2015; Santagata et al., 2021). Besides, before waste is processed, it needs to be recycled, sorted and transported, which all incur additional costs (ibid.).

Additionally, currently, no public procurement subsidies or financial incentives for food waste treatment in the UK, which means that the cost of setting up waste treatment plants needs to be borne by inventors. Furthermore, with less food waste treatment implemented in cities, it is difficult to know the economic benefits of organics produced by waste treatment plants. Beyond that, the land rent in London is high, and the rental cost of building a large factory is about £70, 000 to £2 million (vary from borough) (Statista, 2022). In general, high investment costs, unclear financial returns and land costs would be the financial challenge in setting up waste treatment for investors.

Social Challenge

Maintaining Volunteers

Maintaining a steady number of volunteers is a common challenge for community gardens, surplus food redistributors, and the community kitchen. Volunteering at these organisations is volatile and flexible. At any time, there are many people who sign up to volunteer for organisations, and they can choose their shifts when these organisations are on a small scale. Also, managers in organisations could talk to and manage volunteers face to face at their venues. However, when the scales of organisations were up, the volunteering work became busy, making it difficult for organisations to manage volunteers. A lot of volunteers were less long-lasting. (interview content summarise).

From a circular supply chain operation perspective, volunteers are essential to the circular actions as they carry out various charitable organisations daily. Organisations rely heavily on volunteers (Bolaños-Palmieri et al., 2021) for daily operations. Volunteers often take on different roles (Thapa Karki et al., 2021). They connect upstream in the supply chain, acting as intermediaries between suppliers and food distributors, collecting food from suppliers and then transporting products to warehouses. Also, volunteers as distributors, operating surplus food distribution within the community and providing surplus food to the community. Volunteers act as intermediaries between institutions in circular activities throughout the circular food

supply chain. Insufficient volunteers would significantly reduce the efficiency of distributor operations, leading to the less efficient distribution of surplus food and ultimately less efficient distribution of surplus food, which might cause new food waste generated, thereby undermining closed loops.

Technical Challenge

Lack of skills among the public

Lacking food growing capacity in community gardens was identified as a challenge to community garden operations and closing the food loop in this research. This study found that even a community garden that has closed the food loop in their daily activities will also face the challenge of lacking food growing skills from outer participants. Interviewee A4 is a chair of a community garden in the borough of Tower Hamlets in the east of London who did not face land use, funding, volunteers and institutional challenges. The community garden is built in a vacant area provided free of charge by the local authority. Members of the community garden do not need to pay any fees. They only need to sign a permit every five years, which has been going on for 13 years. The local authority provided the initial funding. Members are growing food in the garden, sharing part of the food among members, and opening the garden to every nearby resident.

Additionally, they make jams and chutneys using their grown food, which is sold to the shops at the garden gate for income. A portion of income is used for annual insurance expenses, purchasing seeds, composting materials and water and electricity fees and the maintenance fees of planting tools. They grow various food according to the seasons to ensure food provision throughout the year. All members are trained in growing and compost-making skills. They make compost, of which materials from surrounding waste leaves and food waste, to ensure the maximum use of natural waste possible. This community garden in Tower Hamlets Borough closes the food loops (both nutrient loop and technical loop): they are growing food, consuming it by themselves, selling it

nearby, reusing waste converting it into nutrients and returning it to the soil for food growing. However, the lack of growing skills among external visitors became a challenge for them to operate the garden. As the interview A4 said:

"Sometimes, somebody comes in (community garden) and thinks these bad need weeding, so they'll pull up like little seedlings that someone else has planted, for example, when you plant leeks when they first grow, they look like a blade of grass, once I was showing someone how to read. And she was pulling out all leeks. I said no, those are leeks, but she kept pulling that. So that kind of thing happens quite a bit" (interviewee A4)

The development of the local food production network is mostly done by informal groups and individuals, followed by deepening ties with organisations, private companies and stakeholders, and social and government institutions, finally forming a network of niches[7] building for local food production (Rut and Davies, 2018). For individuals, if they lack connection to the food network, individuals would disconnect with these actors, and then they lack the knowledge of food growing practices. Individuals' food growing practices ability is improved through embedding small-scale collective learning[8]. If individuals lack collective learning, they eventually lack food growing ability and hurt grown food without knowing it, thereby hindering the food loop closed.

[7] Niche means implementation, data and learning through accumulation. Learning could be learning by doing or learning from others (Schot and Geels, 2008; Rut and Davies, 2018).

[8] Collective learning is regarded as a reflection space where questioning, discussing, comparing and thinking about sustainable alternatives (Raven, 2012).

Chapter 6: Conclusion.

This study aims to research how the feasibility of closing the food loops in London Boroughs. To conclude, closing the food loops in London is feasible. Food loops have been identified to be closed in one of the community gardens. However, food reuse activities and waste-to-energy challenges undermine closing the food loops.

This research achieved the study goal of a comprehensive policy review first to find the policy gaps and the policies or regulations that undermine or support closing the food loops in London, which is question 1. To answer question 1: local food growing policies in the London Plan 2021 and London Food Strategy (2018) support closing the food loops in London and provide a regulatory framework to regulate local food growing activities in London. However, the policies and regulatory framework for food reuse are almost lacking, which would undermine closing the food loops in the near future because the accountability of actors for food reuse is unclear. Lacking the measurement method in policies and regulatory frameworks for waste management at the regional level is the main issue that would hinder closing the food loops. This is because no uniform measurement methods would not be likely to reduce food waste entirely, so in principle, the food loops are less likely to be closed.

This research also interviewed the key actors' taken loop actions in London through semi-structured interviews to identify the challenges key actors faced in London. To conclude, to answer question 2. In London, policy and regulatory, institutional, economic, social and technical challenges are the five primarily challenge key actors to face in closing food loop actions, and the sub-categories of the five main challenges will be shown in table 3 incorporate with the challenges in policy analysis chapter (Identified challenges in closing food loops in London).

There are also some new findings in this research. There is a community garden that entirely achieves the closed-food loop, which has consisted for about ten years. The reasons for market supply for surplus food differ from previous years, mainly because

the UK's cost of living increased this year. Additionally, financial issues were mentioned many times in literature that challenges circular actions, whereas, in this research, the organisation for food reuse showed great economic viability.

The closing food loop system is a complex system that requires all stakeholders and actors involved to change the system. Any part that is missing would not be likely to achieve food loops closed completely. It is suggested that taking a holistic urban strategic approach to close food loops in London requires any stakeholders and actors to sit together to negotiate face to face.

Table3: Identified challenges in closing food loops in London

Challenges	**Sub-categories**	**Local food growing**	**Food reuse**	**waste-to-energy**
Policy and regulatory	Lack of regulatory framework		**x**	**x**
	Land use and land tenure	**x**		
Institutional	Lack of responsibility		**x**	
Economic	Market supply		**x**	
	Financial issues	**x**		**x**
Social	Maintaining volunteers	**x**	**x**	
Technical	Lack of skills among the public	**x**		

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Appendix A

RISK ASSESSMENT FORM

FIELD / LOCATION WORK

DEPARTMENT/SECTION: **BARTLETT SCHOOL OF PLANNING**

LOCATION(S): LONDON, UK

PERSONS COVERED BY THE RISK ASSESSMENT: Tong DONG

BRIEF DESCRIPTION OF FIELDWORK (including geographic location): Online interview in London

COVID-19 RELATED GENERIC RISK ASSESSMENT STATEMENT:

Coronavirus disease (COVID-19) is an infectious disease caused by coronavirus SARS-CoV-2. The virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Droplets fall on people in the vicinity and can be directly inhaled or picked up on the hands and transferred when someone touches their face. This risk assessment documents key risks associated fieldwork during a pandemic, but it is not exhaustive and will not be able to cover all known risks, globally. This assessment outlines principles adopted by UCL at an institutional level and it is necessarily general.

Please use the open text box 'Other' to indicate any contingent risk factors and control measures you might encounter during the course of your dissertation research and writing.

Please refer to the Dissertation in Planning Guidance Document (available on Moodle) to help you complete this form.

Hazard 1: Risk of Covid -19 infection during research related travel and research related interactions with others (when face-to-face is possible and/or unavoidable)

Risk Level - Medium /Moderate

Existing Advisable Control Measures: Do not travel if you are unwell, particularly if you have COVID-19 symptoms. Self-isolate in line with NHS (or country-specific) guidance.

Avoid travelling and face-to-face interactions; if you need to travel and meet with others:

- If possible, avoid using public transport and cycle or walk instead.

- If you need to use public transport travel in off-peak times and follow transport provider's and governmental guidelines.

- Maintain (2 metre) social distancing where possible and where 2 metre social distancing is not achievable, wear face covering.

- Wear face covering at all times in enclosed or indoor spaces.

- Use hand sanitiser prior to and after journey.

- Avoid consuming food or drinks, if possible, during journey.

- Avoid, if possible, interchanges when travelling - choose direct route.

- Face away from other persons. If you have to face a person ensure

that the duration is as short as possible.

- Do not share any items i.e. stationary, tablets, laptops etc. If items need to be shared use

disinfectant wipes to disinfect items prior to and after sharing.

- If meeting in a group for research purposes ensure you are following current country specific guidance on face-to-face meetings (i.e rule of 6 etc.)

- If and when possible meet outside and when not possible meet in venues with good ventilation (e.g. open a window)

- If you feel unwell during or after a meeting with others, inform others you have interacted with, self-isolate and get tested for Covid-19

- Avoid high noise areas as this mean the need to shout which increases risk of aerosol transmission

of the virus.

- Follow one way circulation systems, if in place. Make sure to check before you visit a building.

- Always read and follow the visitors policy for the organisation you will be visiting.

- Flush toilets with toilet lid closed.

-'Other' Control Measures you will take (specify):

NOTE: The hazards and existing control measures above pertain to Covid-19 infection risks only. More generalised health and safety risk may exist due to remote field work activities and these are outlined

in your Dissertation in Planning Guidance document. Please consider these as possible 'risk' factors in completing the remainder of this standard form. For more information also see: Guidance Framework for Fieldwork in Taught and MRes Programmes, 2021-22

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.

If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.

Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low ? **The locations are all low risky places**
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	work abroad incorporates Foreign Office advice
	only accredited centres are used for rural field work
	participants will wear appropriate clothing and footwear for the specified environment
	refuge is available
	work in outside organisations is subject to their having satisfactory H&S procedures in place
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EMERGENCIES	**Where emergencies may arise use space below to identify and assess any risks**
e.g. fire, accidents	Examples of risk: loss of property, loss of life **The locations are all low risky places**

NO listed risk

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
☑	contact numbers for emergency services are known to all participants
58 58☑	participants have means of contacting emergency services
	a plan for rescue has been formulated, all parties understand the procedure
	the plan for rescue /emergency has a reciprocal element

	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

FIELDWORK 1 May 2010

EQUIPMENT	**Is equipment used?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ? **The locations are all low risky places**		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for equipment is followed
	participants have been provided with any necessary equipment appropriate for the work
	all equipment has been inspected, before issue, by a competent person
	all users have been advised of correct use
	special equipment is only issued to persons trained in its use by a competent person
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	**Is lone working a possibility?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. alone or in isolation *lone interviews.*	Examples of risk:	difficult to summon help.	Is the risk high / medium / low?

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	the departmental written Arrangement for lone/out of hours working for field work is followed
	lone or isolated working is not allowed
	location, route and expected time of return of lone workers is logged daily before work commences
	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
	all workers are fully familiar with emergency procedures
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

FIELDWORK	**2**	May 2010

ILL HEALTH	**The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.**
e.g. accident, illness, *personal attack, special personal considerations or vulnerabilities.*	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? **The locations are all low risky places**
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

☑	all participants have had the necessary inoculations/ carry appropriate prophylactics
☑	participants have been advised of the physical demands of the research and are deemed to be physically suited
	participants have been adequate advice on harmful plants, animals and substances they may encounter
	participants who require medication should carry sufficient medication for their needs
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

TRANSPORT	**Will transport be required**	**NO**	**NO**	**Move to next hazard**
		YES		**Use space below to identify and assess any risks**
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training			

	Is the risk high / medium / low?

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	only public transport will be used
	the vehicle will be hired from a reputable supplier
	transport must be properly maintained in compliance with relevant national regulations
	drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
	drivers have been trained and hold the appropriate licence
	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
	sufficient spare parts carried to meet foreseeable emergencies
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	**Will people be dealing with public**	**YES**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low? The risk of being misinterpreted has been informed to each participant at the beginning of interview if any misinterpreted happened during the interview, participants can corrected interviewer directly, thus the risk is very low.		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

☑	all participants are trained in interviewing techniques
	advice and support from local groups has been sought
☑	participants do not wear clothes that might cause offence or attract unwanted attention
☑	interviews are conducted at neutral locations or where neither party could be at risk
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

WORKING ON OR NEAR WATER	Will people work on or near water?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk

	lone working on or near water will not be allowed
	coastguard information is understood; all work takes place outside those times when tides could prove a threat
	all participants are competent swimmers
	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
	boat is operated by a competent person
	all boats are equipped with an alternative means of propulsion e.g. oars
	participants have received any appropriate inoculations
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	**Do MH activities take place?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	the departmental written Arrangement for MH is followed

☐	the supervisor has attended a MH risk assessment course
☐	all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
☐	all persons performing MH tasks are adequately trained
☐	equipment components will be assembled on site
☐	any MH task outside the competence of staff will be done by contractors
☐	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	**Will participants work with substances**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	the departmental written Arrangements for dealing with hazardous substances and waste are followed
	all participants are given information, training and protective equipment for hazardous substances they may encounter
	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
	waste is disposed of in a responsible manner
	suitable containers are provided for hazardous waste
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	**Have you identified any other hazards?**	**NO**	**If 'No' move to next section** **If 'Yes' use space below to identify and assess any risks**
i.e. any other hazards must be noted and assessed here.	Hazard: Risk: is the risk		

CONTROL MEASURES	Give details of control measures in place to control the identified risks

Have you identified any risks that are not adequately controlled?	NO	☑	Move to Declaration
	YES		Use space below to identify the risk and what action was taken

DECLARATION	The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

☑ I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk

☑ I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR

FIELDWORK	**5**	May 2010

Appendix B: Participant Information Sheet

Dear Mr./Ms./__ team,

Project Title:

How feasible is it to close food loops in London boroughs

Department:

Bartlett School of Planning, University College London

Name and Contact Details of the Researchers:

Tong Dong, Tel: +44 7398600995; E-mail: tong.dong.21@ucl.ac.uk

Introduction

You are being invited to take part in a research project being undertaken by a postgraduate student from the Bartlett School of Planning, University College London (UCL).

Before you decide it is important for you to understand why the research is being conducted and what participation will involve. Please take time to read the following information carefully, and feel free to ask the research team for clarification or

further information. Please take time to decide whether or not you wish to take part. Thank you very much for reading this.

Why is this research being conducted?

This research will be targeted in London to investigate the feasibility of closing the food loops in terms of local food growing, food reuse and food waste-to-energy. This research will be completed by examining the following questions:

Q1: where are the policy gaps in closing the food loops in London?

Q2: what challenges are faced in closing the food loops in London?

Why am I being invited to take part?

You are being invited to take part in this research because you have been working on and participating in the process of local food production or/and food reuse/redistribution or/and food waste composting and energy recovery, or the promotion of food-related strategy and policymaking.

Do I have to participate?

Participation is entirely voluntary. If you decide to take part you will be given this information sheet to keep and be asked to sign a consent form if you would like to. If

you do choose to participate and then change your mind, you may withdraw from the research at any time with no consequences and without having to give a reason.

What will happen if I choose to take part?

If you do choose to participate, you will be invited to an online interview to explore the questions highlighted above. The interview will be conducted at a mutually agreed schedule. The interview is expected to take approximately 30-50 minutes. To ensure the accuracy of the information, the interview will be audio recorded (and transcribed at a later date).

The audio recordings of your activities made during this research will be used only for analysis. No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. You will have the opportunity to see the interview transcript and agree any amendments with the researcher after the interview is concluded.

What are the advantages of taking part?

There are no immediate benefits for participating in this project and no financial incentive or reward could be offered. However, it is hoped that this project will inform and identify the barriers or challenges in transitioning the circular food system and make a little contribution to London's sustainable food system development. If participants would like to receive an electronic copy of any outputs stemming from this project, please ask the contact below who will be happy to provide this.

What are the possible disadvantages of taking part?

We anticipate no significant disadvantages associated with taking part in this project. If you have any complaints about the project in the first instance you can contact any member of the research team using the contact details on page 3 of this information and consent sheet.

If I choose to take part, what will happen to the data?

The interview data will be anonymised at the point of transcription and identified by a general identifier (e.g. 'Planning officer A' or 'Planning consultant B' or a suitable pseudonym). A record of participant identities and any notes will be kept separately and securely from the anonymised data. All data and information affiliated with this project will be securely stored on an encrypted computer drive, and physical documents will be stored securely on University property.

The data will be only used for the purposes of this research and relevant outputs and will not be shared with any third party. The anonymised data may be utilised in the written dissertation produced at the end of this project, and this dissertation may then be made publicly available via the University Library's Open Access Portal. However, no identifiable or commercially sensitive information will be accessible in this way.

What will happen to the results of the research project?

It is anticipated that the data collected in this project will be included in the dissertation produced at the end of this project, and submitted for the award of a Masters degree at University College London (UCL). You will not be personally identified in any of the outputs from this work, and attributions and quotations will

be anonymised. If you would like to receive an electronic copy of any outputs stemming from this project, please ask the contact below who will be happy to provide this.

Contact Details

If you would like more information or have any questions or concerns about the project or your participation please use the contact details below:

Primary contact Tong Dong

Role MSc student

Email tong.dong.21@ucl.ac.uk

Telephone 44 7398600995

Supervisor1 Professor Joanna Williams

Role MSc dissertation supervisor

Email joanna.williams@ucl.ac.uk

Telephone 44 (0)20 3108 9557 (59557)

Supervisor 2 Dr Tse-Hui Teh

Role MSc dissertation supervisor

Email t.teh@ucl.ac.uk

Telephone 44 (0)20 31089567

Concerns and/or Complaints

If you have concerns or complaints about any aspect of this research project please contact the MSc student in the first instance, then escalate to the supervisor.

Thank you for reading this information sheet and for considering taking part in this research study.

Appendix C-interview questions samples

1. Interview questions for community gardeners-Interview A1, A2

Introduction:

Introduce myself first.

Highlighted to the interviewee that this research is anonymous

Ask if I may record this interview

First question:

Would you mind introducing how your garden functioned?

Planning:

Would you mind sharing the land ownership of your garden? How did you access the land? Any challenges?

Individuals/Skills

Would you mind sharing your drivers or motivations for doing this work?

Would you mind sharing how you attract members/volunteers and what you usually do? Any challenges when you work with members/volunteers?

Is the number of volunteer stable? How do volunteers get the growing-related skills?

Any challenges when you are doing training work?

Food Growing:

Would you mind sharing what kind of food you are growing?

Is that food you grow for your member consumption or sale?

Would you mind sharing how you make compost on your site?

When you are making compost, do you need professionals to guide you?

Any challenges faced in your growing work?

Funding and financial:

May I know how you keep the financial viability of your garden?

Are there any challenges?

Closing question:

Are there any other challenges you have ever faced that you would like to share?

Are there any questions you want to ask me?

2. Interview questions for food reuse actors -Interview B1-B8

Introduction:

Introduce myself first.

Highlighted to the interviewee that this research is anonymous

Ask if I may record this interview

First question:

Would you mind introducing how your project functioned?

Which boroughs are you working in?

Collaboration/ food source and choice

Which donors (upstream) are you working with? What kind of food are you accepting?

Any challenges faced working with donors?

Would you mind sharing how you work with local charities? Communities? (downstream)

Any challenges?

Could you please talk about how you found the storage warehouse?

How do you work with local authorities?

Any challenges?

Management:

How do you preserve the food?

Would you mind sharing how you are working with volunteers?

Any challenges faced?

May I ask if the number of volunteers is stable? How do you train volunteers?

Any challenges?

Financial:

I know that redistributing food efficiently and safely require storage infrastructure, transportation, equipment such as freezers or refrigerators, and volunteers, all of which need the operation costs. May I ask if your financial resources can support these?

Any challenges?

Closing question:

Are there any other challenges you have ever faced that you would like to share?

Are there any questions you want to ask me?

3. Interview questions for food reuse actors -Interview C1-C3

Introduction:

Introduce myself first.

Highlighted to the interviewee that this research is anonymous

Ask if I may record this interview

Questions:

Setting up AD plants

Would you mind sharing your thoughts about the challenges moving forward with food waste being sent to AD plants?

The feasibility of setting up AD plants in London Boroughs?

Financial viability?

What other challenges are facing do you think in setting up anaerobic digestion plants?

Collaborations:

Setting AD facilities requires policymakers, researchers, urban planners, and private sectors to work together, so do you think there are any challenges in this collaborative process?

Waste recycling and collection:

What challenges of waste recycling do you think in London?

Are there any challenges facing food waste collection in all boroughs?

Do you think there are any other challenges to food waste reduction?

Closing question:

Are there any other challenges you have ever faced that you would like to share?

Are there any questions you want to ask me?

Appendix 4: Identified Framework from Literature.

Table 4: identified framework from literature for reference.

Category	Sub-category	References
Economic and Financial	Economic and financial viability High fees and maintenance costs High investment costs Supplier supply/ Competition with other suppliers	Firth et al. (2011); Wesener et al. (2020); Facchini et al. (2018); Ada et al. (2021); Wie and Giebler (2013); Pan et al., (2015); Meghana and Shastri (2020); Thapa Karki et al. (2021); Mousa and Freeland-Graves (2017); Papargyropoulou et al., (2022); Santagata et al., (2021); Xu et al., (2018); Dalke et al., (2021); Ackrill and Abdo (2020); Jones and Salter (2013)
Socio	Volunteers and paid professionals' participation Lack of knowledge and information	Firth et al. (2011); Wesener et al. (2020); Papargyropoulou et al., (2022); Van Keulen and Kirchherr (2021); Santagata et al., (2021); Xu et al., (2018)
Institutional	Lack of responsibility Local governments and administrations' attitudes Coordination and cooperation of the policy enacting authority Low social acceptance	Firth et al. (2011); Wesener et al. (2020); Witheridge and Morris's (2016); Pan et al., (2015)
	Lack of legal systems	DeLorenzo et al. (2019); Russell et al. (2020);

Policy and Regulatory	Taxation, financial incentives and funding Existing loose environmental regulations Different focus between central and local governments Lack of standard system for CE performance Unclear vision and goals Not comprehensive and appropriate policies Lack of policy enforcement and compliance Lack of standard for quantitative measurement Availability and access to land Planning systems, regulations, and policies	Mena et al. (2011); Patel et al., (2021); Ada et al. (2021); Van Keulen and Kirchherr (2021); Sharma et al. (2019); Yetkin Özbük and Coşkun, (2020); Accorsi et al. (2017); Davies et al.,(2019); Hermsdorf et al., (2017); Pan et al. (2015); Pauliuk (2018); Dalke et al., (2021); Edwards et al., (2015)
Technology	Facilities, equipment and materials gardening resources. Technical limitations of recycling Need for data integration Technologies made locally available Lack of proper waste infrastructure Lack of Skills	Firth et al. (2011); Wesener et al. (2020); Sharma et al. (2019); Russell et al. (2020); Parfitt et al. (2010) Facchini et al. (2018); Pan et al., (2015); Santagata et al., (2021); Xu et al., (2018)

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GRADEMARK REPORT

FINAL GRADE

/100

GENERAL COMMENTS

Instructor

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