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Food and the Global Biodiversity Challenge:

An exploration of how urban food governance can be part of the solution

Master thesis

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Abstract

Worldwide biodiversity is declining faster than any time in human history. This threatens the proper functioning of ecosystems and ultimately human existence itself. Food production is one of the main drivers of biodiversity loss. As cities accommodate the majority of the world population and thus constitute centres of resource consumption, the urban food system is a potential point of intervention to address the global biodiversity challenge. So far, answers to the question which role cities can play in the solution to halt biodiversity loss beyond their own jurisdictional boundaries are limited. To understand how cities can become active players in the global biodiversity challenge, this research explores urban food governance in relation to urban, regional, and global biodiversity. Based on the discourse coalition approach, it examines eleven urban food strategies (UFSs) from cities that are members of the Milan Urban Food Policy Pact. The analysis results in four problem frames that the UFSs make use of: a *productionist* frame, a *dietary change* frame, a *resource efficiency* frame, and a *welfare frame*. While all UFSs use these four frames, they tell different storylines to interpret and connect them with each other. For a smaller sample of three cities – Cologne, Copenhagen, and London – I conducted an in-depth analysis of urban food governance instruments in place in the cities that have a direct or indirect effect on biodiversity either in or outside of the city. In the context of the different problem frames and storylines in urban food governance, four main findings emerge. (1) Cities have a strong public health mandate and most of the UFSs emphasise the importance of a healthy diet. Accelerating the protein transition (reducing the amount of animal proteins in our diets) offers potential for synergies between biodiversity conservation and health. (2) Many cities are in favour of a stronger regionalisation of their food system, however, as scientific evidence of environmental benefits of local and regional food is thin, regional food should always be coupled with other characteristics, like seasonal food production or environmental criteria such as organic agriculture. (3) Cities should incorporate food more strongly into their work on the circular economy to diversify instruments tackling food waste. Lastly, (4) urban agriculture offers a lot of opportunities for citizens: It offers room for education, relaxation, and community building. Cities that see urban agriculture primarily as a means for local food production, should also recognise these social benefits. The results show that except for urban agriculture, these instruments address regional and global biodiversity loss. This confirms the potential of cities to become transformative actors in the global biodiversity challenge and the importance of further research on this topic.

Keywords: *biodiversity loss · urban food governance · discourse coalitions · problem frames · co-benefits*

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1 Introduction

Worldwide, our ecosystems are degrading and biodiversity is declining faster than any time experienced in human history (IPBES, 2019). According to the planetary boundaries framework by Steffen et al. (2015), failure to halt biodiversity loss poses a severe threat to human existence. We rely upon the services that ecosystems provide for us for a good quality of life – healthy ecosystems are needed to provide various resources like energy, medicine, or food (Díaz et al., 2006; IPBES, 2019; Sunderland, 2011). Particularly the latter is strongly interlinked with biodiversity (Crenna et al., 2019; Willett et al., 2019). In this work, I focus on the impact of food production and consumption on biodiversity and the role of cities within this relationship.

1.1 Societal problem description

The causes for the decline in biodiversity are manifold, but human activities are the main driver for the degradation of natural systems (IPBES, 2019). The most prominent cause for biodiversity loss in terrestrial and freshwater systems are direct drivers in form of land use change (LUC) (e.g. related to expanding agricultural production), but also direct exploitation like logging or fishing plays an important role. Indirect drivers for the decline of biodiversity are climate change, pollution, or invasive species (IPBES, 2019). The decline in biodiversity has negative effects on the various ecosystem services that depend on intact natural systems. Importantly, the decline in biodiversity threatens food security, as the agricultural system relies on biodiversity dependent ecosystem services such as pollination, water retention, or soil fertility (Sunderland, 2011). At the same time however, food production is one of the main drivers of biodiversity loss due to the amount of land that is needed and impacts resulting from the cultivation itself (Crenna et al., 2019; IPBES, 2019; Willett et al., 2019). In other words, food is related to both direct drivers of biodiversity loss, as it needs land for agricultural activities or directly harvests natural resources, like fish, but also indirect drivers because food production contributes to climate change and pollution. Sunderland (2011) states that “although long considered mutually exclusive (…), biodiversity conservation and food security are two sides of the same coin” (p. 266). A trade-off is taking place between food production and biodiversity (Perrings et al., 2006).

A growing world population, most of which is concentrated in cities, is driving up the resource demand such as food, thus accelerating the problem of biodiversity loss (IPBES, 2019). Cities are centres of consumption, yet they “neither supply their bulk resource needs nor have the capacity to assimilate their wastes within their borders” (Goldstein et al., 2017, p. 151). Therefore, when looking at the connection between food and biodiversity, the consumption taking place in cities is important to consider; it affects direct and indirect drivers of food related biodiversity loss. Food consumption is one of the “largest components of a city’s environmental footprint (McDonald et al., 2020, p. 22; see also Goldstein et al., 2017) and it depicts one of the main inflows into cities that is associated with biodiversity loss (Singh & Kennedy, 2018). As the impact of cities on biodiversity is not limited to biodiversity within a city itself but can be observed “well beyond municipal boundaries, inducing environmental stress in distal geographies” (McManamay et al., 2017, p. 9581), three different levels of where the urban food system affects biodiversity can be identified: (1) Urban biodiversity, i.e. concerning biodiversity action within city boundaries, (2) regional biodiversity influence, i.e. actions targeting biodiversity that is in close proximity to cities, and (3) global biodiversity influence, i.e. actions targeting biodiversity in faraway places that is linked to urban production and consumption processes (Puppim de Oliveira et al., 2011). However, questions remain open what actions are taken by cities to

address the link between different levels of biodiversity and the urban food system. I elaborate on this knowledge gap in the following section.

1.2 Scientific relevance and knowledge gap

The impact that cities have on biodiversity due to their position as centres of resource consumption is evident. For this reason, cities have in the past been framed as 'parasites' even though this metaphor has become less relevant among urban scholars (Castán Broto et al., 2012). Nevertheless, cities are generally perceived as a threat to biodiversity, rather than as a potential venue for transformative action (Bulkeley et al., 2021). Consequently, there is a need to recognise potential opportunities that cities offer in connection to biodiversity (Frantzeskaki et al., 2019; Oke et al., 2021). However, particularly research how cities can become actors for positive change in biodiversity outside of their city boundaries is lacking (McDonald et al., 2020; McManamay et al., 2017; Puppim de Oliveira et al., 2011).

Research linking cities and biodiversity has focused on the direct drivers that cities exert on biodiversity, mainly land use change attributed to growing urbanisation but "relatively few studies (…) explicitly looked at indirect impacts of urban areas on biodiversity" (McDonald et al., 2020, p. 22; see also Bulkeley et al., 2021). While food production is directly related to LUC, it also indirectly influences biodiversity, for instance due to the high need for fossil fuels or eutrophication (Crenna et al., 2019). As the majority of food is consumed in cities, they can potentially become active players in addressing the link between food and biodiversity. Urban food governance has only recently gained traction in terms of sustainability and often, the focus of research has been food security (e.g. Coulson & Sonnino, 2019; Mendes & Sonnino, 2018; Morgan, 2015; Morgan & Sonnino, 2010). Despite the strong connection between food and biodiversity, so far, it is unclear how biodiversity concerns are addressed in urban food governance. This low prioritization of the environmental impact of the food system on the urban agenda represents, according to Goldstein et al. (2017), "a lost opportunity to address significant urban environmental pressures as cities continue to grow in size and wealth" (p. 152).

1.3 Research aim and research question

Looking at the link between urban food governance and biodiversity, this thesis not only addresses the lack of research on the connection of the two, but also provides insights into the knowledge gap that exists on the transformative potential between cities concerning biodiversity outside of city boundaries. The aim of this research is to foster an understanding of how cities can become active players in the global biodiversity challenge by analysing biodiversity in urban food governance. I hereby looked at actions mainly pursued or implemented by public actors, i.e. local governments. The focus is on European cities for several reasons. First, the environmental impact of food consumption in the Global North is – in generalised terms – higher than in the global South, due to various circumstances (e.g. more meat-based diets, higher amounts of food waste on household level (see FAO, 2011; FAO & WHO, 2003)), and is additionally less well studied than Anglo-Saxon countries (Doernberg et al., 2019). Second, the issue of food security – while by no means being absent in the Global North (e.g. Morgan, 2015) – is more pressing in the Global South and therefore I expect it to be dominant in a lot of urban food governance interventions. Finally, living in Europe, the context is closer to my own life experience and I believe that I can conduct more meaningful research in a familiar than an unfamiliar context.

The main research question guiding the thesis is:

How and with what consequences are cities considering biodiversity in urban food governance?

I start with setting the theoretical stage that this research is based on, introducing the concepts I used for answering the research question. Afterwards in section 3, I break down the main research question into four sub-questions that guided my analysis. Section 4 explains the methodological approach I chose, including how I selected my cases and what data I used, the methods I used to analyse my data and the analytical framework that I used for operationalisation. In section 5, I present my results and discuss them in the context of the theoretical background but also additional literature consulted. Section 6 outlines some limitations and directions for future research before I summarize the main takeaways from my analysis.

2 Theoretical Background

With growing urbanisation, the nature of the socio-economic problems that cities are facing becomes more and more complex. To understand how specific sustainability challenges, like biodiversity, are addressed within these problems, the concept of urban environmental governance is a useful starting point. The urban food system can be subject to urban environmental governance. To understand how food is problematised and addressed in the city, the concepts of storylines in context of the discourse coalition approach, problem framing and their translation into governance instruments are used in the theoretical backbone of this work. This section starts with defining urban food governance as a specific form of environmental governance and subsequently explains what storylines are and how they emerge from discourse coalitions, what the role of problem framing is thereby and lastly, this section finishes by introducing the concept of governance instruments in connection to the problem framing.

2.1 Urban environmental governance

The term governance can be defined as the "institutional arrangements and mechanisms that have been established in order to govern any particular domain" (Bulkeley & Marvin, 2014, p. 21). Making use of the definition of Wu et al. (2018), urban environmental governance then "refers to the process through which […] the range of stakeholders in cities […] make decisions about how to plan, finance, and manage urban environmental issues together" (p. 344). The definitions suggest that urban environmental governance is not exclusively determined by public actors, but governance in its core is the recognition that multiple actors participate purposely in actions addressing a specific societal problem. These actors include public actors, the private sector, and civil society (Castán Broto, 2017; Castán Broto & Bulkeley, 2013; Driessen et al., 2012). Moreover, urban environmental governance is also of multi-level nature: local action can be shaped by national as well as supra-, trans- or international actors (Betsill & Bulkeley, 2004; Bulkeley, 2010; Castán Broto, 2017). A well-researched example in urban environmental governance are transnational city networks (TCNs) (e.g. Betsill & Bulkeley, 2004; Bulkeley, 2010; Busch et al., 2018; Kern & Bulkeley, 2009; Rashidi & Patt, 2018).

Research on urban environmental governance gained traction in the early 1990s, when the growing popularity of the concept of sustainable development came along with a "first wave of municipal responses to climate" in urban governance (Bulkeley, 2010, p. 231). The increasing recognition of the importance of local climate action on a city level was based on the rationale that cities are responsible

for a large percentage of global greenhouse gas (GHG) emissions (Bulkeley, 2010). Until now, a majority of the research carried out in urban environmental governance has focused on climate action (Bulkeley, 2010; Castán Broto, 2017; Wu et al., 2018). However, the local level is not only an appropriate sphere for climate related action but more generally for addressing global environmental concerns (Bai, 2007). Local potentials for addressing biodiversity concerns have largely remained unexplored thus far, but urban food governance as a related governance field has gained more attention lately (Bulkeley et al., 2021; Doernberg et al., 2019).

2.2 Urban food governance

Food is a relatively new field in urban environmental governance. Even though the various interconnections between our food system and environmental pressures are clear, food has long been largely absent in urban environmental policies (Goldstein et al., 2017). One possible explanation is that food and agriculture-related questions were regarded as predominantly rural issues and consequently received little attention on the urban agenda (Wiskerke, 2015). In recent years however, cities have been identified as "the appropriate sphere for political and planning action" as many of the problems stemming from the modern food system "are becoming apparent or originating at a local level" (Doernberg et al., 2019, p. 2). The question how to transform urban food systems in a sustainable way has moved into the focus of more research (e.g. Blay-Palmer et al., 2016; Davies & Evans, 2019; Halliday, 2019; Ilieva, 2017; Moragues-Faus & Morgan, 2015). Doernberg et al. (2019) and Wiskerke (2015) observed that this task is taken on by a diverse range of actors – showing that the urban food system is subject to governance.

Consequently, for the purpose of the thesis, drawing onto the definitions of environmental governance, I understand urban food governance as purposeful action on behalf of different actors on different scales, including actors from the public and the private sphere, as well as civil society and transnational organisations, to address the unsustainability of the urban food system in various ways. Actors from all spheres are already visible in urban food governance, e.g. civil society groups (e.g. Surian, 2020) and private actors (e.g. Huidobro Giménez, 2019). Also city authorities are becoming increasingly invested and often join forces with civil society and the private sector for instance in the form of urban food councils (e.g. Baldy, 2019; Coulson & Sonnino, 2019; Doernberg et al., 2019; Halliday, 2019; Moragues-Faus & Morgan, 2015; Sonnino et al., 2019). The connection between food and sustainability also became a subject in either already existing TCNs (like the C40 Food System Network) or city authorities organising themselves in new TCNs (e.g. over 100 cities signed the Milan Urban Food Policy Pact (MUFPP) in 2015 (MUFPP, 2020b)).

With many actors involved in urban food governance, actions in this field follow many a variety of different goals. Table 1 shows a (non-exhaustive) overview of different aims pursued in urban food governance. In academic research, food security receives a lot of attention (e.g. Coulson & Sonnino, 2019; Mendes & Sonnino, 2018; Morgan, 2015; Morgan & Sonnino, 2010). According to Davies and Evans (2019), a lot of research has focused "on how cities might become more self-sufficient in meeting their food needs through increasing the scale and intensity of urban

Table 1: Examples of aims addressed in urban food governance based on Halliday (2019)

Examples of aims addressed in urban food governance
• *Regeneration*
• *Economic development*
• *Food supply and resilience*
• *Food security and access*
• *Environmental protection*
• *Public health*
• *Food safety*
• *Social inclusion*
• *Food culture*

agriculture" (p. 154). However, currently the level of self-reliance in cities is very low and while higher self-reliance is feasible for some foods like fresh produce, other foods will need to continue to be sourced elsewhere (Grewal & Grewal, 2012; Hume et al., 2021; Mok et al., 2014). Hence, urban food governance is intrinsically linked to areas outside of the city itself (Puppim de Oliveira et al., 2011; Singh & Kennedy, 2018). Due to this character of the food system, the urban in urban food governance becomes a "political unit able to produce change" rather than be seen as a scale of intervention (Cretella, 2016, p. 314). This idea is also put forward by Sonnino (2016) who sees urban food governance as creating a 'relational' local. In this sense, action undertaken in UFG can influence places that are far away from the city.

A large variety of possible interventions in urban food governance exists. Examples range from food sharing initiatives (e.g. Davies & Evans, 2019), to DIY-governance on food waste (e.g. Surian, 2020) or marketing of sustainable food consumption (e.g. Huidobro Giménez, 2019). However, Doernberg et al. (2019) state that most popularly, urban food councils, which include stakeholders from all three governance spheres, and urban food strategies (UFSs) are implemented "for governing food issues in multi-actor partnerships at the local level" (p. 3). The latter are a form of policy intervention based on a public-sector mandate and are being increasingly adopted in a European context (see also Baldy, 2019; Cretella, 2016; Halliday, 2019; Hebinck & Page, 2017; Sonnino, 2016). Not all cities committed to tackling the unsustainability of the urban food system have adopted such targeted policies however, but interventions can also occur in related policy fields like spatial planning or public procurement (Doernberg et al., 2019; Sonnino et al., 2019).

Within their policies, a city can employ varying sets of policy instruments in order to reach their public policy objectives (Howlett, 1991). Which instruments are perceived as useful therefore depends on which aims a city pursues in relation to food. Oke et al. (2021) argue that "biodiversity conservation is often an ad hoc co-benefit of other actions, rather than an explicit strategic priority that is systematically planned across the whole city" (p. 2; see also Puppim de Oliveira et al., 2011). This suggests that biodiversity is not prominent in urban governance discourse[1]. Yet, as food and biodiversity are closely connected, action to enhance the sustainability of the urban food system may have explicit as well as inexplicit co-benefits for biodiversity. Puppim de Oliveira et al. (2011) argue that a better understanding of these co-benefits would positively influence cities interest in biodiversity issues.

Translating this to the aim of this research, analysing the instruments adopted by cities targeting the food system can help to understand how biodiversity benefits are already present in urban food governance. Yet, "developments in environmental politics critically depend on the specific social construction of environmental problems" (Hajer, 2002b, p. 2). This means that depending on how a specific issue is perceived, different policy responses become more likely. Food sustainability is a complex problem and can be perceived in various different ways, prompting different sets of solutions (Garnett, 2013). The goals pursued in urban food governance and the policy instruments employed thus depend on the definition of the problem of food within a city. The concept of storylines, which dates back to Davies and Harre (1990) and was then taken up by Maarten Hajer in his discourse coalition approach, can help to make this interplay tangible (as cited in Peters, 2003). In the following,

[1] Discourse describes an "ensemble of ideas, concepts, and categorizations that are produced [and] reproduced" Hajer (2002b, p. 44). For instance, by rooting biodiversity in different types of environmental discourses, different meanings of the term unfold, which has consequences on "how biodiversity is understood and managed" Gustafsson (2013, p. 39).

I introduce the concept of storylines in light of the discourse coalition approach as a way to analyse the discursive mechanism in place in urban food governance and subsequently elaborate on why problem framing is important, and how this relates to the use of policy instruments in urban food governance.

2.3 Storylines and the discourse coalition approach

In the field of governance, various theories emerged studying the policy process, policy change and stability (Sabatier & Weible, 2014). One underlying idea of governance is the presence of policy networks, where a multitude of actors participate in the policy arena, all shaping and influencing the policy process. When analysing policy processes and policy change, it is important to look at "ideological factors, discourse, rational arguments, and belief systems" (Jordan & Greenaway, 1998, p. 670) that exist in and between those policy networks. The problem definition of the policy issue at hand is depending on these factors; the actors involved in the policy process enter a situation of constant re-negotiating about the policy problem. Finding a consensus equals creating a coalition around this definition of the policy problem. Therefore, coalition building is a significant element in explaining policy processes (e.g. Bulkeley, 2000). The discourse coalition approach, which was proposes to use the concept of storylines to account for this process of finding a common understanding and interpretation of the problem at hand.

Hajer (2002a) describes storylines as "the medium through which actors try to impose their view of reality on others, suggest certain social positions and practices, and criticise alternative social arrangements" (p. 47). He defines storylines, or narratives, as a tool to combine elements of various discourses "into a more or less coherent whole" (Hajer, 2002a, p. 47). They thus help to conceal discursive complexity. The importance of the concept within the discourse coalition approach becomes visible in Hajer's description of what constitutes a discourse coalition. According to Hajer (2002a), "the discourse coalition approach suggests that politics is a process in which different actors from various backgrounds form specific coalitions around specific story lines" (p. 47). He accordingly mentions three defining features for a discourse coalition: (1) a specific storyline, (2) a group of actors that shares this storyline, and (3) practices that institutionalise the storyline. Bulkeley (2000) points out that "interests and beliefs, with respect to the policy issue at hand, are not necessarily pregiven and uniform across the coalition" (p. 734) but that the finding of a consensus is accomplished through the policy process itself. This also means that different actors can be driven by different sets of concerns but still agree on a storyline defining the policy problem. Rantala and Di Gregorio (2014) make clear which role frames play in these storylines. According to them, storylines "are essentially narratives of the reality as constructed by social actors, who assemble frames" (p. 2), therefore using specific information on an issue to explain causality between the problem and expected outcomes (see also Czarniawska, 1997 as cited in Welch et al., 2021).

The policy process itself reflects "a struggle for discursive hegemony in which actors try to secure support for their definition of reality" (Hajer, 2002b, p. 59). Different discourse coalitions can coexist around a certain issue, however for a discourse coalition to reach discursive hegemony – becoming the dominant discourse coalition – two conditions need to be fulfilled. First, discourse structuration needs to take place. This means that "storylines and agents of a discourse coalition achieve coherence and credibility" (Bulkeley, 2000, p. 735) and it "occurs when a discourse starts to dominate the way a society conceptualizes the world" (Hajer, 2002a, p. 46). The second condition is discourse

institutionalisation, meaning the discourse "will solidify into an institution, sometimes as organizational practices, sometimes as traditional ways of reasoning" (Hajer, 2002a, p. 46). This includes that the ideas that are brought forward by a discourse coalition via their storylines become enacted in the policy process and prior understandings of the problem at hand are pushed out of the dominant discourse. When analysing the policy process using the discourse coalition approach there are therefore different entry points for an analysis. To examine the discursive struggle, an analysis of on-going debates will be effective, for instance in public meetings. There, actors try to persuade others of their problem perception and coalitions are built (Scott, 2017). Conversely, policy documents are usually an indicator for the institutionalisation of storylines and their according discourses (Rantala & Di Gregorio, 2014; Scott, 2017). In urban food governance, food strategies adopted in cities can be seen as an output of the latter. By analysing the storylines conveyed in UFSs, the discourse coalition approach therefore offers a way to see how the discursive tools and problem frames that are at place in urban food governance are assembled and interpreted.

2.4 Problem framing

> "Political problems are socially constructed" (Hajer, 2002a, p. 44)

According to Hajer (2002a) political problems are of a constructivist nature. This means that an issue does not become a political problem by itself but because an actor takes this issue and frames it in a specific way. Therefore, the "process of constructing, or framing, political problems is a highly significant element of the political process" (Hajer, 2002a, p. 45). The use of the term framing indicates that the problem definition depends on which aspects of an issue are emphasised and which aspects are (intentionally) left out. I understand framing as a way to make certain information about an issue tangible (e.g. Moschitz, 2018). Frames "generate meaning and action" and are "powerful elements in understanding the political debate" (Moschitz, 2018, p. 182). Hence, their analysis is "one way to scrutinise the main message of […] policy documents" (Uggla, 2018, p. 102).

As Peters (2005) points out "the assumption that policy problems must be recognized and identified in order to be usable within the political process is central" (p. 353). The problem definition has implications for the proceeding stages of the policy process; it "will set the stage for the final determination of the policy and therefore is crucial for shaping the final resolution of the problem" (Peters, 2005, p. 353).

An impressive example for this concerning the issue of food has been brought forward by Sen (1982). He looked at different framings of the problem of food in relation to starvation and malnutrition and argued that the problem of food can be interpreted from a nature-focused view or a society-focused view. The former is based on the assumption that there is a causality between starvation and malnutrition on the one hand and the available food per capita on the other. Corresponding to this problem definition, monitoring of food availability gives an indication whether food insecurity is present or not. Sen (1982) argues that this view dominated in the 20st century and led to the aggravation of Bengal Famine of 1943. The British Indian government at the time then defined food insecurity from a nature-focused view, as the availability of food per capita. The monitoring of food stocks did not show any significant changes, which led the government to ignore the famine that was developing in Bengal. Sen (1982) suggests that framing the problem of food from a society-focused view would have led to a different policy outcome. In a society-focused view "starvation is seen in terms of a failure of entitlement rather than within the [nature focus] of food supply per head" (p.

452). Accordingly “a more discriminating analysis focusing on entitlements could have led to early identification and possibly even vital anticipation before the event, providing scope for remedial public policy” (Sen, 1982, p. 454).

Another example of different problem framings of food in relation to sustainability can be found in the work of Garnett (2013). She specifies three different interpretations of the food sustainability problem. First, she identifies a productionist framing of the problem, which tells a story of production efficiency – the need for a growing food supply that at the same time exerts less pressure on the environment. It thus sees technological innovation as the main way to address the problem. Second, Garnett points out a consumption challenge, where emphasis is placed on the need for a dietary transition towards a more sustainable food consumption. With viewing the problem from this perspective, consumer psychology and changing consumer behaviour becomes prominent in terms of solutions. Lastly, the author mentions a socio-economic problem definition, focusing on a change in our approach to govern the food system. Importantly, the food system is complex and the problem “requires a multifaceted approach” meaning that in reality, often a mix of these three perspectives is present in the definition of the sustainability problem of food (Garnett, 2013, p. 31). However, according to Garnett (2013), “there are certainly differences of emphasis: stakeholders tend to feel more comfortable with one framing of the problem over the other, and argue for action accordingly” (p. 31).

These two examples show the importance of the problem framing in terms of the solutions that are seen as useful in the policy response. Peters (2005) states that even though the connection between policy problem framing and policy instruments applied has been neglected in research on policy instruments thus far, taking the problem definition into consideration is highly important: “By labeling the problem in that particular way, the political process tends to assume that there is some defined set of tools that the policy organization in question tends to bring to bear on the problem” (p. 354). This means that the social construction of the problem translates into the instruments chosen to tackle the problem.

2.5 Governance Instruments

When a discourse coalition becomes dominant, the storylines including the different discourses they tap into, and the frames used to make the problem tangible become institutionalised in the policy arena. When there is agreement on the problem, action can be taken to improve the situation. In the academic policy field, policy instruments are researched as one output of the policy process. They can be defined as “myriad techniques at the disposal of governments to implement their public policy objectives” (Howlett, 1991, p. 2). Even though, in this definition the focus is on the government to take action, policy instruments are also able to reflect governance settings and research has looked at the question of how the presence of governance influences the choice of policy instruments (e.g. Howlett, 2000; Jordan et al., 2005).

To reflect the shift from government to governance, many researchers make a distinction between two types of instruments, e.g. old and new policy instruments (Jordan et al., 2005), substantive and procedural policy instruments (Howlett, 2000), or hard and soft policy instruments (Zehavi, 2012). Even though there are small differences in their definitions, they all reflect a varying extent of authority that the state takes on in a chosen instrument. Zehavi (2012) argues that hard and soft policy instruments “co-exist and complement each other” (p. 244). The application of softer measures prompts that a higher degree of governance is present in the instrument. The definition of policy instruments excludes

instruments solely implemented by private actors or civil society, albeit research on policy instruments partly including such measures (e.g. Doernberg et al., 2019; Schinkel, 2019). To account for instruments that do not include a public actor, I use the term 'governance instruments' for my research.

To summarise, urban food governance as a sub-field of environmental governance can be led by different objectives with different kinds of actors working on the implementation of these objectives. As set out by the discourse coalition approach, these actors come together in their work on urban food governance by sharing the same set of storylines, assembling discourses under different problem frames and like this define the policy problem in a certain way. Depending on this definition, certain governance instruments become more likely as political solutions than others.

3 Research questions

With the main research question in mind, looking at the storylines that are present in discourse structuration and conveyed in institutionalised output of a discourse coalition can be used as a first step to understand how and with what consequences cities are considering biodiversity in urban food governance. Here, an analysis of the problem frames used in urban food governance can give insights into how the urban food problem relates to biodiversity in a city. The governance instruments applied in urban food governance are influenced by the problem framing dominant in urban food governance and as such, relate to the practices in which the storyline of the discourse coalition becomes visible. Thus, in order to answer the research question, the present research looks at the storylines including the problem framing present in the urban food governance landscape in different cities, the governance instruments that are applied, and what this means for biodiversity issues addressed in urban food governance. To achieve this, I asked the following for sub-questions:

Sub-question 1: How is the problem of food framed in urban food governance?

As has been shown in sections 2.3 and 2.4, discourse coalitions make sense of an issue by assembling problem frames into a storyline. This influences the outcomes of the policy process. Understanding the dominant problem framings present in relation to the storylines told in the cities enabled me to select a sample of cities with dissimilar perceptions of the urban food problem for the consequent steps of my empirical analysis.

Sub-question 2: Which governance instruments adopted by local governments in urban food governance have a direct/indirect effect on biodiversity?

I collected and analysed policy documents and supporting material of my case studies that mention governance instruments concerning the food system. The aim is to show which types of instruments are already used in cities that directly or indirectly relate to biodiversity.

Sub-question 3: Which of the frames identified earlier do those governance instruments belong to?

This sub-question connects the governance instruments to the different problem frames found in sub-question 1 and as such, sets them into relation of the wider context of urban food governance within the city.

Sub-question 4: What do the findings imply for the potential of urban food governance to address biodiversity in- and outside of the city?

This last sub-question addresses the divide into urban biodiversity, regional as well as global biodiversity influence. Based on the storylines and problem frames, I aim to make potential co-benefits and win-win situations that exist between biodiversity and other objectives addressed in urban food governance visible. I looked at the implications this has for cities as potentially active players in biodiversity action relating to these different locations.

By answering the four sub-questions, I hope to give holistic and structured insights into the main research question and therefore reduce the knowledge gap described in section 1.2.

4 Methodological design

In line with the research aim, the proposed study follows an exploratory logic to understand how cities can become active players in the global biodiversity challenge. As the idea is to analyse how cities implicitly consider biodiversity in their food governance instruments, the research covers breadth rather than examining in-depth how biodiversity is considered in one specific city. I used a nested and comparative methodological design, starting with a large-scale study of a sample of cities for my first sub-question, selected from the Milan Urban Food Policy (MUFPP), and then continued with a smaller sample of cities for the second step of my analysis. I chose this approach to select cities where a certain amount of activity in urban food governance could be expected due to their membership in an according international city network. To ensure that the problem frames are applicable across cities and my findings are relevant for a larger number of cities, I conducted a two-step analysis. I started with a bigger sample of cities for finding the dominant problem framings in sub-question 1. Afterwards, I looked at three cities that are dissimilar in their storylines on urban food governance, with the aim to find a larger number of different governance instruments. Figure 1 illustrates how I conducted my analysis.

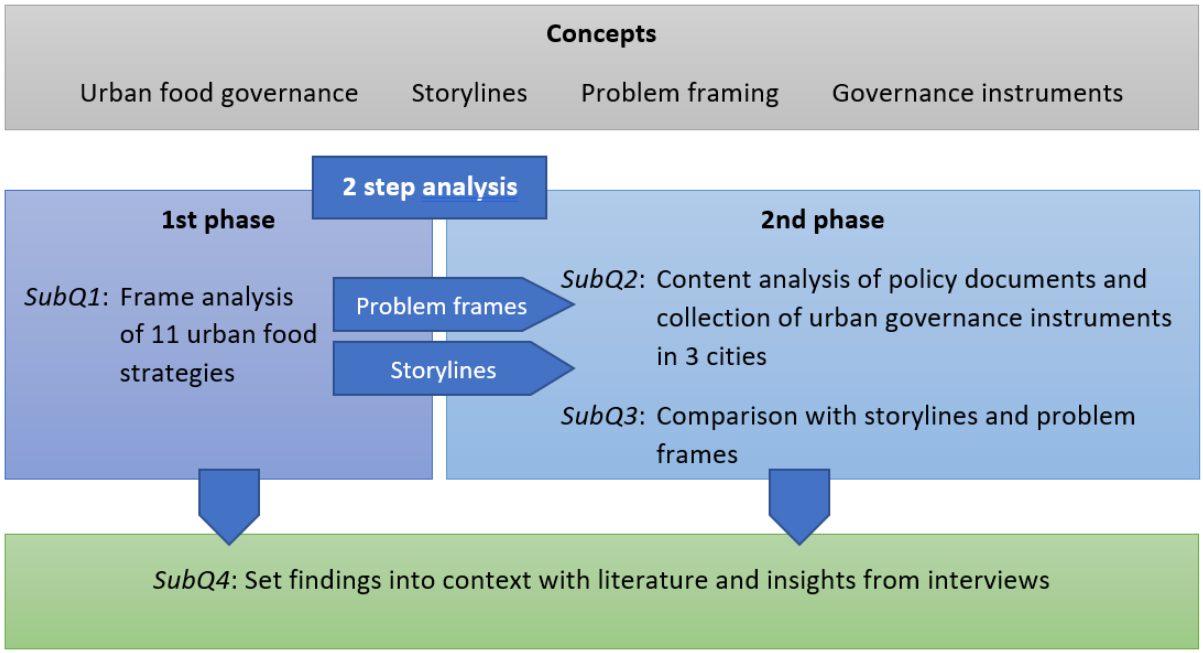

Figure 1: Research framework

4.1 Case study selection and data collection

I looked at different TCNs and their vision for a sustainable transition of the food system, specifically the C40 Food System Network, the Ellen MacArthur Food Initiative, the Organic City Network, the ICLEI CITYFOOD network, and most popularly, the MUFPP.

4.1.1 Milan Urban Food Policy Pact

As I mentioned in section 2.1, governance is of multi-level nature and transnational city networks are important players in urban environmental governance. Research on transnational city networks suggests that membership in TCNs shapes internal processes of the cities in the according policy areas as well as that networks play an important role in encouraging and supporting cities in the adoption of policies (see also Bulkeley, 2010; Rashidi & Patt, 2018). For this reason, this research looks at cities that are a member of a TCN on food policy, to make an initial selection on cities that may have relevant policies adopted in this area. In urban food governance, a handful of transnational city networks exists (see above). The Organic Cities Network Europe (2021) as well as the Ellen MacArthur Foundation (n.d.) food initiative both have specific foci on the solution to a more sustainable food system, by cultivating more organic food and by accelerating the transition towards a circular economy respectively. Because I want to find different storylines, problem framings and governance instruments, the focus on a specific area for the solution defeats the purpose here. Moreover, except for the Ellen MacArthur foundation, all other networks refer to the MUFPP[2], indicating that across other TCNs, agreement is present concerning the goals of the MUFPP. The vision of the MUFPP includes an explicit focus on biodiversity:

> "Launched by the Milan Municipality in 2015, the Milan Urban Food Policy Pact is an international agreement among cities from all over the world, committed to develop sustainable food systems that are inclusive, resilient, safe and diverse, that provide healthy and affordable food to all people in a human rights-based framework, that minimize waste and conserve biodiversity while adapting to and mitigating impacts of climate change" (MUFPP, 2020a)

The MUFPP is the largest of the networks mentioned, with a membership of over 200 cities all around the world and for the reasons mentioned was used as an initial demarcation point for case selection.

[2] C40 (2021): „Building on the work commenced by the Milan Urban Food Policy Pact, the Food Systems Network supports citywide efforts to create and implement integrated food policies that reduce greenhouse gas (GHG) emissions, increase resilience and deliver health outcomes."
Organic Cities Network Europe (2021): „As a consequence, there is a wealth of expertise and experience at the local level on how to contribute to a European agricultural policy that pursues food security and sustainable development, improves the quality of life of local and regional residents, and contributes to achieving the objectives and targets set out in the Paris Agreement on Climate Change, in the Sustainable Development Goals (SDGs) and in the Milan Urban Food Policy Pact."
ICLEI (2021): „CITYFOOD is open to local and regional governments, whether they are engaging with the issue for the first time or working to implement the Milan Urban Food Policy Pact and at the frontier of innovative food systems work."

4.1.2 Selection criteria

To have a feasible sample size for my analysis, I chose the cities according to the following selection criteria. The city:

1. Is a member of the MUFPP;
2. Is located in Europe[3];
3. Has a population greater than 500,000 people and/or is a capital city;
4. Has an urban food strategy available either in English, German, French, or Dutch ;
5. The urban food strategy was published between 2015 (year of MUFPP) and 2021.

The criterion of urban food strategy represents the institutionalised policy output of the dominant discourse coalition.

4.1.3 Urban food strategies

As explained in section 2.3, policy documents constitute the written output of a discourse coalition that has reached discursive hegemony. I therefore looked at urban food strategies (UFSs) as the accepted vision for a more sustainable food system amongst the dominant discourse coalition in an urban food governance setting. Cretella (2016) attempts to conceptualise UFSs and defines them as:

> *"municipal policy documents that problematize food in its social, economic and environmental dimensions by reframing it as part of the urban realm, and by acknowledging and organizing the activities of civil society and institutions within specific administrative or geographic limits."* (p. 314)

A growing number of cities has been adopting UFSs (Doernberg et al., 2019). Candel (2020) found that a total of 41 cities who are part of the MUFPP have published UFSs.

4.1.4 Final list of case studies

The selection criteria applied resulted in a final list of 11 cities:

- Amsterdam
- Berlin
- Brussels
- Cologne
- Copenhagen
- Glasgow
- London
- Lyon
- Milan
- Paris
- Zurich

4.1.5 Choosing the three case cities

In the first part of my empirical analysis, I examined the problem framing present in the UFSs of these cities. Subsequently, I selected three cities for the next step of the analysis, that use different storylines to assemble to frames found. The storylines and interpretation of the frames should be as dissimilar as possible, in order to find different sets of governance instruments employed in the cities. The cities used for the second part of the analysis are:

- Cologne
- Copenhagen
- London

[3] The reasons for why I focus on Europe as a geographical area were set out in section 1.3.

4.1.6 Data collection

For sub-question 1, I used the cities' UFSs as data for my analysis. For sub-question 2 and 3, I searched for documents that provided information on governance instruments in the urban food governance of the respective cities from section 4.1.5. I started the search by looking at the policy linkages to other municipal documents or other initiatives mentioned in the cities' food strategies. If this search did not provide me with sufficient material, I additionally searched the municipal website, supported by a Google search on food governance instruments in the city.

4.1.7 Question list for cities

For the last sub-question of this research, I sent out a list of questions to the three cities analysed in sub-question 2 and 3 via email to the city committee(s) mentioned in the urban food strategy as well as the authors of the food strategy, where contact information was provided. My email included the following five questions:

1. Which aspects of enhancing the sustainability of the urban food system are most successfully addressed in [city]? Which aspects are more challenging to address as a city?
2. Which specific governance instruments that [city] is taking/supporting have so far been considered the most successful in making the urban food system more sustainable?
3. Which kind of changes do you consider most necessary for addressing the sustainability of the urban food system?
4. In your opinion, what kind of potential does a city have to address biodiversity protection inside and outside of a city's boundaries by adjusting the urban food system to become more sustainable?
5. Which actions that [city] is already taking/supporting do you see as most promising for biodiversity protection inside and outside the city's boundaries?

I received written answers from a representative of the Environmental and Consumer Protection Office in Cologne (referred to as *Interview Cologne* hereafter) and a representative of the Culture and Leisure Administration in Copenhagen (referred to as *Interview Copenhagen 2* hereafter). Additionally, I conducted a semi-structured interview based on the above list of questions with a representative of the Finance Administration in Copenhagen, who is working on the implementation of the food strategy in the city (referred to as *Interview Copenhagen 1* hereafter). I did not receive an answer from the city of London. A similar questionnaire was sent to the secretariat of the MUFPP but as I did not receive answers to my questions either, the perspective of the TCN is not included in the results.

4.2 Data analysis

In this section, the methods used to analyse the data are outlined.

4.2.1 Framing analysis

To answer sub-question 1, I used a framing analysis. A framing analysis is a type of discourse analysis and is therefore an interpretive approach that aims to create meaning from the language-in-use found in the unit of analysis (Lindekilde, 2014; Starks & Trinidad, 2007). As has been set out in section 2.4, depending on how the problem of food is framed, different policy outcomes can become more likely. The dominant problem framing is brought forward by the discourse coalition that holds discursive

hegemony in urban food governance. The framing analysis is a tool to make this visible: it "looks at how existing 'objects' or 'topics' are framed by different actors, bending their meaning in certain directions" (Lindekilde, 2014, p. 200).

A framing analysis can work with preconceived analytical frames, or it can be carried out inductively (Linström & Marais, 2012). For answering sub-question 1, I conducted an inductive framing analysis, following a frame-critical approach. This approach goes back to Rein and Schön (1996) and has been applied in the realm of policy-analysis. This approach sheds light on the variety of frames, which "underlie the positions taken by agents in [the] process of policy" including assumptional and value structures" (Rein & Schön, 1996, p. 94) and are "competing for both meaning and resources" in a certain policy field (Rein & Schön, 1996, p. 95). The studies carried out by Mah et al. (2014) and Moschitz (2018) are two examples of a framing analysis of food policy. Mah et al. (2014) stress that for a frame-critical analysis it is important to look at the issue "in terms of its definitions, causes, consequences, who should participate in deciding upon appropriate interventions, why intervention would be necessary or not, and if so, what type of intervention would be appropriate and effective" (p. 2). This can be related to the elements of a discourse coalition in terms of the storylines they utter to make the problem tangible, who is involved in the discourse coalition, and what practices are used to institutionalise the coalition. Candel et al. (2014) state that "the reason why stakeholders engage in framing in policy formation processes is to portray a current policy issue in such a way that it supports the interests of a particular actor or a coalition of actors" (p. 48). When frames are commonly accepted and supported, they "enable the institutionalization of a particular ideational constellation" (Candel et al., 2014, p. 48) and can thus be traced back in institutionalised objects of the dominant discourse coalition in urban food governance.

Inspired by van Gorp, who is well known for his work on framing in media studies, the frame analysis conducted in this research is based on two different elements: reasoning devices and framing devices. Reasoning devices hereby are "explicit and implicit statements that deal with justifications, causes, and consequences in a temporal order" (van Gorp, 2007, p. 64). Van Gorp bases this on Entman's (1993) four framing functions, i.e. "the promotion of a particular problem definition, causal interpretation, moral evaluation, and/or treatment recommendation" (van Gorp, 2007, pp. 64–65). Framing devices on the other hand "point at the same core idea" and thus "constitute the manifest part of a frame package" (van Gorp, 2007, p. 64). With regard to this research, the framing devices used by actors in a discourse coalition relate to and therefore convey the discourses in which the social construction of the food problem is rooted. The framing devices were analysed within the reasoning devices deployed by the dominant discourse coalition.

The reasoning devices that I analysed in the UFSs are listed in table 2. Causes and consequences, as well as the problem definition are coded as 'problem definition'. The code 'definition and vision of sustainable food' incorporates Entman's moral evaluation, 'goals' as well as 'opportunities' describes the causal interpretation and finally 'solutions' relates to the treatment recommendation. Table 2 shows the final list of codes. I arrived at this set of codes by combining a deductive and an inductive approach. Based on studies that applied a frame analysis, i.e. Mah et al. (2014) and Candel et al. (2014), as well as based on the concept of storylines, I developed an initial list of reasoning devices and consequently applied this list to two UFSs to test the codes. Based on this initial analysis, I adjusted the codes before coding the full data set. However, in the process of coding the full data set, some more adjustments were made.

Table 2: Overview of reasoning devices and explanation of the code

Reasoning device	Explanation
Definition of sustainable food	What is the vision of sustainable food in the UFS? How is the role of food in the city perceived? What does a sustainable food system look like? What characteristics are considered sustainable?
Goals	What are the goals described?
Opportunities	What are the opportunities that are seen in the transformation of the food system?
Problem description	What are the problems related to the current food system? What are the causes and consequences, what are the impacts and the reasons for it? Why do we need a more sustainable urban food system?
Solutions	What are described solutions to the problem? What actions should be taken?

The actual frame analysis followed two steps. First, I coded the UFSs for reasoning devices. Due to time constraints, I did not code the whole strategies, but only the introduction and conclusion, and potential introductions of sub-chapters. The parts of the strategies that explain the action plan of the city in detail were left out. Only the text items coded as reasoning devices were then also coded for framing devices. This step has been carried out inductively. This means that I constantly compared and re-coded the framing devices, along with the amount of material analysed. To make patterns visible, the framing devices needed to be continuously reorganised and categorised in the process. A list of common themes emerged, from which I inferred the frames.

For the frame analysis, I used the software NVIVO.

4.2.2 Content analysis of policy documents

The next step of the analysis focuses on biodiversity-related governance instruments applied in urban food governance.

For this, I conducted a qualitative content analysis (QCA). A QCA is an appropriate method to organize written or oral materials into a category system to extract information and systematically study the meaning of the selected data material in light of the goal of the research question (Schreier, 2014; Verschuren & Doorewaard, 2010). A QCA provides “subjective interpretations of the content of text data through the systematic classification process of coding and identifying themes or patters” (Hsieh & Shannon, 2005, p. 1278). In QCA inference plays an important role “to move from the text to the answers to the research questions” (White & Marsh, 2006, p. 27). This process can either be done inductively or deductively (Elo & Kyngäs, 2008). In the case of this research, I used the analytical framework presented in section 4.3, therefore following a deductive approach.

4.3 Analytical framework: governance instruments and biodiversity

For my analysis, biodiversity action needs to be operationalised on an analytical level, so that it becomes observable in practice (Verschuren & Doorewaard, 2010). A useful approach can be found in a paper written by Xie and Bulkeley (2020). They distinguish between three possible ways to tackle biodiversity: biodiversity action as (1) conserving biodiversity, as (2) restoring biodiversity, and as (3) thriving with nature. Different governance instruments adopted by city authorities can potentially have either of these three effects on biodiversity (see figure 2).

Figure 2: Operationalisation of biodiversity action (definitions cited from Xie and Bulkeley (2020, p. 12)

To categorise the different governance instruments, I employ a typology used by Doernberg et al. (2019) in their research on urban food policies in German cities[4]. They differentiate between four generic types of governance instruments:

- Regulative instruments
- Economic instruments
- Informational instruments
- Informal and procedural instruments

Employing this typology depicts "a systematic approach that allows insights into common and distinctive features regarding themes, strategies, and institutional and instrument-related practices" (Doernberg et al., 2019, p. 11). By combining it with the typology on biodiversity action by Xie and Bulkeley (2020), I use this analytical framework to identify actions that are undertaken in urban food governance, which directly or indirectly affect biodiversity.

4.3.1 How does food production & consumption impact biodiversity?

To identify possible relationships between governance instruments employed in UFG and biodiversity, these need to be related back to scientific research. The following part presents the main connections between food production and consumption and biodiversity.

Organic agriculture and biodiversity

Many studies show a positive effect of organic agriculture on biodiversity compared to conventional agriculture (e.g. Hole et al., 2005; Mäder et al., 2002; Pearce, 2018; Pfiffner & Balmer, 2011; Rahmann,

[4] This typology is partly based on the typology on governance instruments originally developed by Vedung (2010) introduced in the theory chapter. As Doernberg et al. (2019) point out in their paper, this typology has already been successfully applied in research on food and agriculture policy. Vedung (2010) originally only proposed the first three types of instruments, but Doernberg et al. (2019) added 'informal and procedural instruments' to include instruments where cities interact with other stakeholder. This last instrument aligns with the essence of governance.

2011; Scialabba, 2003; Tuck et al., 2014; Underwood et al., 2011). Bengtsson et al. (2005) conducted a meta-analysis of literature published on this relationship and found that on average, the species richness in organic farming systems was 30% higher than in conventional farming systems, despite some variability. This can be explained by the negative effects of chemical fertiliser and pesticides, that are not used in organic agriculture, on biodiversity on and around farmlands, but also on the biodiversity of aquatic communities (e.g. Beketov et al., 2013; Geiger et al., 2010; Rasmussen et al., 2015; Relyea, 2005). Despite these findings, Shennan et al. (2017) criticise the strict division between organic and conventional farming and argue that for environmental health, amongst other factors, "different systems will be appropriate in different contexts" (p. 317, see also Bengtsson et al., 2005). Nonetheless, they call for better incorporation of organic principles in agriculture.

Climate change, greenhouse gas emissions and biodiversity

Climate change is as a key driver of biodiversity loss (e.g. Bellard et al., 2012; Butchart et al., 2010; Jetz et al., 2007; Malcolm et al., 2006; Parmesan & Yohe, 2003; Sekercioglu et al., 2008; Thomas et al., 2004; Thuiller et al., 2011; Warren et al., 2013). "Agriculture and climate change are characterized by a complex cause-effect relationship" (Agovino et al., 2019, p. 525). This means that climate change has effects – of both negative and positive nature – on agricultural production, while at the same time agriculture significantly contributes to climate change by emitting large amounts of GHG emissions (Agovino et al., 2019; Vermeulen et al., 2012). There are several ways to reduce the emissions from agricultural production, such as soil carbon sequestration, reducing land-use change, decreasing food loss and waste, and shifting dietary patterns (e.g Agovino et al., 2019; Wollenberg et al., 2016). Organic agriculture, while not only being beneficial in its direct relationship to biodiversity, also has advantages in terms of its climate impact: it performs better in soil carbon sequestration and reduces emissions by refraining from synthetic fertiliser use (Scialabba & Müller-Lindenlauf, 2010). Reducing the consumption of animal products also has a positive climate effect, as omnivore diets cause a significantly higher amount of emissions than diets based on fewer animal products (e.g. Rabès et al., 2020; Scarborough et al., 2014).[5] Moreover, while GHG emissions cause climate change, they can also have a direct effect on biodiversity loss (Ahmed Bhuiyan et al., 2018).

Not only the emissions from agricultural production methods are relevant, but also those caused along the rest of the food supply chain (e.g. packaging, mode of transport, transport distance). The last example is often referred to as food miles. Local food products are usually seen as less polluting due to the shorter travel distance. Scientific literature on this however is less straight-forward. Pradhan et al. (2020) see a regionalisation of food systems for cities' food supply as crucial to climate change mitigation and keeping global temperature rise below 2°C. Kriewald et al. (2019) calculate that by increasing local self-sufficiency of cities, emissions from food transport can be cut by a factor of ten. However, as they mention themselves, their calculations neglect different local emission intensities of food production. Accordingly, Wilson (2007) criticises that the food mile concept neglects the emissions produced over the whole life cycle of food (see also van Passel, 2013). Locally produced food can cause high levels of GHG emissions in its production that are not offset by the reduced travel emissions.[6] Edwards-Jones (2010) concludes that there is no "support for claims that local food is

[5] I will use the term protein transition in this work when I refer to a dietary change from more animal-based diets to more plant-based diets.

[6] This claim can also be supported by research conducted by Weber and Matthews (2008) who show that the majority of food related emissions in the United States is connected to the production stage rather than transport, which accounts for 11% of overall life-cycle GHG emissions, even though food consumed in the United States generally travels long food miles.

universally superior to non-local food in terms of its impact on the climate" (p. 582, see also Avetisyan et al., 2014). Conversely, Avetisyan et al. (2014) find that for ruminants, domestic production in the EU reduces the emissions associated with the whole food supply chain greatly. This debate essentially shows that it is not possible to generalise climate benefits of local food.

Similarly, seasonal food production offers a possible solution for a more sustainable food system. Seasonality can be interpreted as global seasonality or local seasonality, with the former relying on seasonal food that is produced anywhere in the world and the latter only consuming locally grown seasonal food (Macdiarmid, 2014). Studies show that imported food that is grown in season often has lower GHG emissions than food that is grown domestically but stored to be sold at a different time or grown out of season using greenhouses (e.g. Foster et al., 2014; Hospido et al., 2009; Milà i Canals et al., 2007; Webb et al., 2013). This suggests that an increase of the demand and supply of local food can reduce GHG emissions if attention is given to which food is in season.

Urban agriculture and biodiversity

Food growing in the city is referred to as urban agriculture, urban farming or urban gardening. This can be in private spaces, like gardens or balconies, but also in communal spaces, like green roofs or bigger allotment sides in a city, that are publicly accessible. When a city converts sealed area or other abandoned land into spaces for food growing, urban biodiversity increases (e.g. Clucas et al., 2018; Lin et al., 2015; Orsini et al., 2014; Singh & Swami, 2015). Moreover, urban farms also execute social functions, like providing space for relaxation in the city, connecting citizens with nature, giving opportunities for education about food origins and thus contributing to the food literacy of citizens, contributing to food security, and furthermore, in the case of communal urban gardens, providing a space where citizens can strengthen social ties (e.g. Battersby & Marshak, 2013; Ferreira et al., 2018; Pearson et al., 2010; Valley & Wittman, 2019).

Plant-based diets, health and biodiversity

As has already been mentioned, reducing the meat and dairy consumption in our diets results in less GHG emissions, mitigating climate change. Next to this, livestock farming has a direct negative effect on biodiversity (e.g. Godfray et al., 2018; Henry et al., 2019; Leip et al., 2015; Maxwell et al., 2016; Meier & Christen, 2013; Pimentel & Pimentel, 2003; Sabaté & Soret, 2014; Tilman & Clark, 2014). Machovina et al. (2015) state: "The consumption of animal-sourced food products by humans is one of the most powerful negative forces affecting the conservation of terrestrial ecosystems and biological diversity" (p. 419). Next to contributing to climate change, livestock farming is the primary driver of habitat loss due to the large amount of land needed for feed production and the animal themselves (Steinfeld et al., 2006).

Furthermore, reducing meat and dairy consumption contributes to healthier diets. In high-income countries, the average intake of animal products is generally higher than suggested by dietary recommendations (Cocking et al., 2020). Consequently, shifting diets to the recommended healthy standards reduces diet-related emissions (e.g. Ferrari et al., 2020; Stehfest et al., 2009; Willett et al., 2019; Wollenberg et al., 2016). Furthermore, the link between healthy diets and climate and environmental benefits can be found for reducing obesity rates (Edwards & Roberts, 2009), breast-feeding compared to using infant formula (e.g. Joffe et al., 2019; Karlsson et al., 2019; Linnecar et al., 2014; Myr, 2008; Smith, 2019), and drinking tap water (van de Kamp et al., 2018).

Food waste and biodiversity

Of all food produced globally, around a third is either lost or wasted along the whole food supply chain (FAO, 2011). This creates unnecessary and preventable environmental costs. Reducing food losses and waste makes the food system more efficient and decreases the amount of food that needs to be produced to feed the world. Accordingly, scientific research shows how food waste adversely affects the environment and biodiversity (e.g. FAO, 2013; Grizzetti et al., 2013; Hall et al., 2009; Sabaté & Soret, 2014; Scherhaufer et al., 2018). Feldstein (2017) sees food waste as a 'conservation priority' for biodiversity. She argues that "stopping food waste before it happens on the farm can reduce greenhouse gas emissions, conserve water and land and help mitigate the negative effects of agriculture on wildlife" (p. 76).

Not only the food itself but also its packaging have environmental effects. Plastic waste that is not properly managed can eventually harm wildlife, particularly life below water (e.g. Derraik, 2002; Lasut et al., 2018). As the production of packaging also causes CO2 emissions, reducing the amount of packaging used in the food system can indirectly benefit biodiversity.

The link between our food system and biodiversity loss is evident. However, while scientific evidence for the effect of some factors is strong, for other factors, the connection is less clear. Literature shows that there is a clear connection between biodiversity loss and agricultural activities, as well as biodiversity loss and climate change. Thus, the amount of food needed, and the amount of area needed for food production, the cultivation methods, and the emissions related to the food system matter for the effect of the food system on biodiversity. Jungbluth et al. (2012) assessed the overall environmental impacts of different dietary choices in Switzerland, including buying locally, buying seasonally, eating vegetarian, buying organic food, reducing food waste, and reducing obesity. They found a focus on local and seasonal food only shows very minor environmental improvements. I include the latter two in my analysis being aware that the scientific foundation for these claims is rather thin.

In summary, for my analysis I included governance instruments that in theory address one of the following areas:

- Organic food production or other environmental standards (e.g. certification)
- Seasonal food production
- Regional/local food production
- Urban agriculture
- Protein transition
- Healthy diet (including breast feeding and water consumption)
- Food waste
- Food packaging
- Educational activities based on one of the above areas
- Other activities that aim to reduce emissions caused by the food sector
- Other activities that aim to reduce land use for agriculture

Except for the uptake of urban agriculture, all aims reduce the negative impact of the current production system on biodiversity, however, they do not actively restore biological diversity. For this reason, they fall under the category of biodiversity conservation. All of these activities primarily

influence biodiversity outside of a city's boundaries, either in its hinterland or in geographically far away regions.

The uptake of urban agriculture in the city can potentially actively restore biodiversity in the urban area, for instance when this happens on land that was previously sealed or uncultivated. As has been mentioned before, urban agriculture also provides different social functions. Thus, it falls into two categories: 'restore biodiversity' and 'thriving with nature'.

4.3.2 Tackling biodiversity with food governance instruments

Different governance instruments in urban food governance can target these connections between the food system and biodiversity. As mentioned in the introduction of the analytical framework, I distinguish between regulative, economic, informational, and informal governance instruments. This section shows some examples of different food governance instruments – not specifically in cities nor explicitly aiming for one of the goals mentioned in the previous section – to exemplify which types of governance instruments exist.

Examples for regulative instruments in food governance include zoning plans with specific requirements for contracting tenants on city owned land, for instance by only making new lease agreements for organic farming (Doernberg et al., 2019) or municipal waste management regulations, like a separate collection for biowaste (Nissinen et al., 2015). France implemented a law which prohibits large supermarkets from throwing away their food surplus (Schinkel, 2019). More generally regulatory instruments hence refer to regulatory standards, licenses, recycling requirements, product bans, or waste targets (Grubb et al., 2020). However, I understand regulatory as legally binding, so these are not strategic requirements but mandatory.

In contrast, voluntary agreements and strategic targets exist, which are not only focused on public actors but a multiplicity of actors across governments, the private sector, and civil society. Examples for these kind of informal governance instruments are the *Courtauld Commitment* in the UK or the *Sustainable Food Alliance* in the Netherlands, where the signatory parties or members agree on voluntary targets for CO2 emissions reduction or food waste reduction (Schinkel, 2019). Also projects in schools to increase the sustainability of school food are informal governance instruments (Doernberg et al., 2019).

Popular economic instruments are taxes and subsidies, or other forms of financial support or penalties, and the provision of services and infrastructure (Doernberg et al., 2019). According to Reisch et al. (2013), economic instruments are often applied at the production stage of the food system. Yet, according to Powell et al. (2013), "taxes and subsidies are increasingly being considered as potential governance instruments to incentivize consumers to improve their food and beverage consumption patterns" (p. 110). At the production stage, examples for economic instruments are subsidies for organic agriculture (Reisch et al., 2013), while at household level different types of taxes are more likely, like a junk food tax, a tax on certain food components, or a tax on sweets (Nissinen et al., 2015; Reisch et al., 2013). Another important economic instrument is imposing self-regulations on public procurement, thus stirring the demand of the city towards food production that adhere to certain sustainability criteria. This way, the city can give preference to organic, local and seasonal, plant-based, and healthy foods or food certifications (e.g. Doernberg et al., 2019; Grubb et al., 2020; Nissinen et al., 2015; Powell et al., 2013; Reisch et al., 2013).

Lastly, informational instruments aim to either provide information, train skills, or transfer knowledge to recipients of the governance instrument, e.g. pupils, citizens, kitchen staff, or result in additional knowledge of the actors implementing the instrument themselves. This can be the direct provision of information by the city on certain food topics (Doernberg et al., 2019), or food education in schools and kindergartens, encouragement of waste separation, or the running of campaigns as listed by Nissinen et al. (2015). Examples of awareness campaigns are the *Love Food Hate Waste* campaign in the UK or the *Too Good for the Bin* campaign in Germany, both aiming to inform and offer solutions on food waste (Schinkel, 2019). Another important informational instrument is the certification of food or food venues (Doernberg et al., 2019; Grubb et al., 2020; Reisch et al., 2013); "such labels constitute an important tool for raising consumer awareness about the health and environmental aspects of food and for facilitating informed decision making" (Eberle et al., 2011 as cited in Reisch et al., 2013, p. 16).

The literature shows that it is not always perfectly clear to which category a governance instrument belongs. While Grubb et al. (2020) understand public procurement policies as a regulatory or administrational governance instrument, Doernberg et al. (2019) and Nissinen et al. (2015) see public procurement as an economic instrument. For my analysis, I use regulatory instruments in a narrow way of binding the concerned actors to the instrument's objective and therefore classify public procurement guidelines for food purchase as economic if there is no binding regulation.

In my analysis, I looked for governance instruments similar to the ones mentioned in connection to the outlined areas (conservation, restoration, and thriving with nature), where food governance instruments align with biodiversity action. Table 3 exemplifies this by connecting some governance instruments with the three biodiversity operationalisations.

Table 3: Analytical framework connecting biodiversity action and governance instruments

Biodiversity action / Governance instrument	Conservation	Restoration	Thriving with nature
Regulative	• Mandatory food donation supermarkets		
Economic	• Subsidies for organic agriculture (Reisch et al., 2013)		
Informational	• Certification of environmental standards for food (Grubb et al., 2020)		
Informal	• Voluntary CO2 or food waste reduction targets (Schinkel, 2019)	• Urban gardening initiatives (Doernberg et al., 2019)	• Urban gardening initiatives (Doernberg et al., 2019)

5 Results

This section presents the findings from my analysis and sets them into context with relevant literature. I start by introducing four different problem framings that are used in the UFSs. Afterwards, I describe three different storylines that distinguish the cities of Cologne, Copenhagen, and London from each other. Based on this, I present the second part of my analysis, namely the exploration of the different governance instruments applied in the three cities. I connect these findings to the four problem frames and end up with four different governance instrument clusters that belong to urban food governance and directly or indirectly address biodiversity in and outside of the city. By connecting it to the framings and the storylines, I explore potentials for co-benefits and provide some recommendations how to make use of these findings.

5.1 Different problem framings in urban food governance

The analysis of the urban food strategies of the eleven cities selected – Amsterdam, Brussels, Cologne, Copenhagen, Glasgow, London, Lyon, Milan, Paris and Zurich – resulted in a list of different themes. These themes present the different discourses that are employed in the food strategies and contribute to the problem framing in urban food governance. Table 4 shows an overview of the most prevalent themes and some examples from the food strategies. Examples of the different sub-codes that I applied to the themes can be found in the annex. Throughout the results I quote from the different documents, where the original document was no in English, the quote is translated by me.

Table 4: List of themes addressed in urban food strategies

Theme	Examples from urban food strategies
Agriculture	• "Agricultural land, both local and regional, should be used for wet crops or other, more nature-inclusive (circular) agriculture" (Gemeente Amsterdam, 2020, p. 36) • "While the agro-industrial system as made it possible to enter an era of abundant food, it has environmental, economic, and health limits" (Grand Lyon, 2019, p. 8)
Certified food	• "This is primarily about the choice of ecologically and socially advantageous and certified products" (Ernährungsrat Köln und Umgebung, 2019, p. 30) • "Favour environmentally and socially friendly products; therefore choose products with a authorised certification" (Stadt Zürich, 2019, p. 12)
Circular economy	• "Therefore, we want to be a completely circular city by 2050"(Gemeente Amsterdam, 2020, p. 5) • "Brussels is the birthplace for many fruitful cooperative projects and its food system is an integral part of a circular economy process in which waste is almost non-existent" (Brussels Environment, 2016, p. 8)
Climate	• "The climate is on our plates, as the saying goes" (Gemeente Amsterdam, n.d.) • "In recent years, the relationship between climate change and food has become evident" (Københavns Kommune, 2019c, p. 5)
Community	• "More opportunities for communities to enjoy cooking and growing together" (GFPP, p. 5) • "Celebrated by engaging all Londoners in the enjoyable pursuits of food shopping, growing, cooking and eating together" (GLA, 2018b, p. 10)
Culture and food	• "The aim is to introduce a new food culture" (Brussels Environment, 2016, p. 12) • "And it is a central part of our cultural life" (GLA, 2018b, p. 7)
Economy	• "To increase access to healthy food for everybody, the Municipality is open to new forms of relationship between those involved in production, distribution and consumption" (Comune di Milano, 2015, p. 14) • "Promotion of local markets and an economy characterised by social and solidary structures" (Mairie de Paris, 2018, p. 11)
Education	• "Consumer education aims at the development of a responsible consumer behaviour" (Land Berlin, n.d.–b) • "Food education enables consumer to follow an independent, healthy, and responsible diet" (Ernährungsrat Köln und Umgebung, 2019, p. 28)

Emissions	• "New research shows that food consumption represents 25 per cent of the overall carbon footprint" (Københavns Kommune, 2019c, p. 5) • "Achieve carbon neutrality in 2050" (Mairie de Paris, 2018, p. 5)
Environment	• "What we eat, how we produce it, consume it and dispose of it, has huge impacts on the environment" (GLA, 2018b, p. 12) • "The food consumptions of inhabitants of the Lyon region generates significant environmental impacts" (Grand Lyon, 2019, p. 20)
Fairness	• "that Berlin's food policies are developed towards more regionality, sustainability, fairness, and with a stronger focus on food that promotes health for everyone, regardless of budget" (Land Berlin, n.d.–a) • "It ensures that food is produced in an ethical and responsible manner and is accessible to everyone" (Stadt Zürich, 2019, p. 14)
Food and waste	• "Scale up the separate collection of organic waste from households and businesses for high-quality processing" (Gemeente Amsterdam, 2020, p. 26) • "A third of food produced is never eaten, costing the average household around £440 per year" (GFPP, p. 7)
Food logistics	• "Today, food is grown and transported around the globe before it lands on our plates" (Ernährungsrat Köln und Umgebung, 2019, p. 5) • Paris: La Ville de Paris est également engagée pour le développement des circuits courts(Mairie de Paris, 2018, p. 10)
Food quality	• "A city which offers a wide range of healthy and good quality local products" (Brussels Environment, 2016, p. 8) • "Taste, quality and food appreciation must be in focus" (Københavns Kommune, 2019c, p. 11)
Food safety	• "Safe handling throughout the food chain" (GLA, 2018b, p. 10) • "For this reason, it promotes healthy and safe foods, which are produced in an environmentally sound manner" (Stadt Zürich, 2019, p. 14)
Food security	• "Tackle rising levels of household food insecurity" (GLA, 2018b, p. 17) • "To ensure that all citizens have access to healthy food" (Comune di Milano, 2015, p. 14)
Health	• "London also has one of the highest rates of childhood obesity in Europe" (GLA, 2018b, p. 5) • "Through improvements across our food system and food environment, health and wellbeing is improving" (GFPP, p. 23)
Locality Regionality	• "Not only regional growing of food, but also regional refinement and processing is possible" (Ernährungsrat Köln und Umgebung, 2019, p. 16) • "A stronger local anchoring of the food system, for the benefit of all actors, is necessary" (Grand Lyon, 2019, p. 21)
Organic food	• "Since 2001, we have implemented the most ambitious change to organic production in municipal meals in the world" (Københavns Kommune, 2019c, p. 16) • "75% of Parisian households buy organic products regularly" (Mairie de Paris, 2018, p. 18)
Plant-based diets	• "The development of a less carnivore diet aligns with the commitments made under the Paris Agreement in December 2015" (Grand Lyon, 2019, p. 20) • "Often, vegetarian and vegan diets contribute even more to environmental protection" (Stadt Zürich, 2019, p. 39)
Public procurement	• "The main objective of the food strategy is to improve the quality of public food procurement" (Land Berlin, n.d.–a) • "The strategy sets a clear direction for the 70,000 meals that are being prepared in the City of Copenhagen each day" (Københavns Kommune, 2019c, p. 9)
Resilience	• "A food system in Glasgow that is fair, resilient and environmentally sustainable" (GFPP, p. 5) • "An increase in food autonomy and resilience" (Mairie de Paris, 2018, p. 19)
Responsibility	• "Administrations have a special role model function for citizens" (Land Berlin, n.d.–a) • "In the case of 'sustainable consumption', consumers take ecological and social criteria into account in their consumption decisions" (Ernährungsrat Köln und Umgebung, 2019, p. 30)
Seasonality	• "Increased availability and use of seasonal, locally grown and produced food" (GFPP, p. 5) • "Buying seasonal products helps to avoid the need for greenhouses heated with fossil fuels" (Stadt Zürich, 2019, p. 12)
Societal aspects	• "It also involves things like wellbeing, sufficient leisure time, good health, a pleasant living environment and space for personal growth" (Gemeente Amsterdam, 2020, p. 17) • "Animal welfare is an important concern for consumers" (Stadt Zürich, 2019, p. 40)
Sustainability	• "The Region has chosen the "Good Food" concept to talk about the transition to a more sustainable food system" (Brussels Environment, 2016, p. 5) • "Also, there is social demand that clearly asks for a return to a more sustainable diet" (Mairie de Paris, 2018, p. 7)

Urban agriculture	• "The 'productive green' in the city plays an elementary role in food education" (Land Berlin, n.d.–d) • "The 'Good Food' initiative targets the development of new urban farming projects" (Brussels Environment, 2016, p. 3)
Water	• "Free drinking water should be widely available in all local authority-owned buildings" (GLA, 2018b, p. 32) • "Ensure access to healthy drinking water and sufficient food to all citizens" (Comune di Milano, 2015, p. 13)

Based on these themes and their discursive interpretations, I identified four different problem framings that the food strategies employ. As I set out in the theoretical background under sections 2.3 and 2.4, I inferred the problem framings based on aspects emphasised by the discourses and based on which discourses dominate over others in the food strategies. The four frames identified interpret the challenges of the current food system from different angles and thus, illustrate which perspectives exist in the political debate on food in the urban realm. I call those four frames (1) the *productionist frame*, which is concerned with how, where, and when food is produced and brought to the consumer, (2) the *dietary change frame*, which identifies food composition in terms of dietary composition as the main point of intervention, (3) the *resource efficiency frame*, where questions of how we use our resources in food production dominate, and finally (4) the *welfare frame*, that looks at the food system from a social and economic perspective, emphasising changes we need in our food culture and food economy. In reality, all of these frames are present in all food strategies analysed – but to varying extents. In the following, I explain the four frames with the help of examples from the food strategies.

5.1.1 The productionist frame

In the productionist frame, cities act to influence the way that food is produced and the way that it gets into the city and to the consumer. The frame describes the challenges related to food as located pre-consumer: our current model of food production has negative effects on our environment, our society, economy, and health. Lyon's food strategy argues: "even though the agro-industrial production system has allowed us to enter an era of abundant food, it has environmental, economic and health limitations which today raise important concerns" (Grand Lyon, 2019, p. 8). Cologne's food strategy states: "As in other regions, the intensification of agriculture (…) led to a significant decrease of biodiversity and abundance of insects on and next to agricultural land" (Ernährungsrat Köln und Umgebung, 2019, p. 12). Additional to the mode of production, the food strategies criticise where food is produced. Amsterdam's food strategy asks: "Where does this steak come from? What journey did the strawberry or the avocado take in November? The transportation of food is generally very harmful to the environment" (Gemeente Amsterdam, n.d.). There are more statements along the same lines, such as "[food] transportation causes environmental pollution due to the associated exhaust gases and greenhouse gas emissions" (Ernährungsrat Köln und Umgebung, 2019, p. 40), "the climate emergency has pushed the need to reduce food miles up the agenda" (GFPP, p. 6), "the imports of agrifood products generate most (around 2/3) of these environmental impacts [CO2-equivalents]" (Grand Lyon, 2019, p. 20), "transport, natural conditions, packaging and storage [of food] also have an impact on the environment" (Stadt Zürich, 2019, p. 39), or the industrialisation of the food system "had the effect of weakening the links between the city and its regional hinterland and increasing Parisian food dependence on more distant territories" (Mairie de Paris, 2018, p. 15). While the problem that is described therefore relates to the industrial production model of food, the distance that food travels, and the environmental impacts from out-of-season produce, solutions are presented as "giving priority to environmentally-friendly and healthy production techniques" (Brussels Environment, 2016, p. 9) and "increas[ing] local sustainable food production" (Brussels Environment, 2016, p. 14). This can be

achieved via “nature-inclusive land use, urban agriculture and circular agriculture [that] benefit the climate by using less chemical fertiliser and avoiding the import of feed products and fertilisers” (Gemeente Amsterdam, 2020, p. 36) or organic agriculture which “contributes significantly to nature, environmental and climate protection thanks to its particularly environmentally friendly way of farming” (Land Berlin, n.d.–c). Similarly, Cologne’s food strategy supports the choice for more organic food, but also for certified food, e.g. FairTrade or regionally produced food (Ernährungsrat Köln und Umgebung, 2019). In London’s food strategy, it is argued that “reductions in our carbon footprint could be made by encouraging a food system based on more local, seasonal, sustainably-produced food” (GLA, 2018b, p. 50) and also Milan promotes “local, sustainable food systems […] for the benefit of the local economy and as a tool for creating environmental quality” (Comune di Milano, 2015, pp. 16–17).

5.1.2 The dietary change frame

The dietary change frame focuses on the consumption patterns in the urban food system. It problematises our choice of food rather than the way of production and distribution. An environmental and health perspective is dominant in this frame and the current consumption model is criticised for being unhealthy, leading to avoidable food-related illnesses, and being detrimental for the environment. Accordingly, the frame is supported by text passages like “the current consumption model (…) is a major concern that has economic, social, environmental and health effects on a local and global level” (Brussels Environment, 2016, p. 10), “our diet has a significant impact on our health” (Ernährungsrat Köln und Umgebung, 2019, p. 3), “[food] affects our health” (GLA, 2018b, p. 7), “the choice of food we (…) consume (…) significantly influences the state of the planet, our environment, our health and the social ties that unite us” (Mairie de Paris, 2018, p. 1), or “nutrition is (…) an important factor for our health” (Stadt Zürich, 2019, p. 6). The negative health effects that inappropriate diets can cause are often mentioned: “Obesity is a problem both for people and for the National Health Service which quantifies in about 8 billion euros per year direct costs” (Comune di Milano, 2015, p. 20), and “unhealthy diet and obesity from overconsumption and poor quality foods are two of the most important causes of preventable diseases worldwide” (Land Berlin, n.d.–f). Amsterdam specifically mentions that “too much meat is unhealthy” (Gemeente Amsterdam, n.d.) and Cologne’s strategy criticises that for meat consumption “feed (…) is mainly imported from outside Europe” (Ernährungsrat Köln und Umgebung, 2019, p. 14). The main solutions proposed in this frame are adjusting our diets in a healthier way and increasing the consumption of plant-based food in place of animal proteins. In the food strategies, a synergy between these two aspects becomes visible: “Choosing vegetable proteins instead of animal proteins is not just a choice for other food, but also a choice for more animal welfare, less CO2 emissions and better health” (Gemeente Amsterdam, n.d.) and “to limit greenhouse gas emissions, a less carnivore diet, which is beneficial to health, is indispensable” (Grand Lyon, 2019, p. 20). Plant-based diets are perceived as more environmentally friendly because they “contribute to more efficient use of agricultural land and thus to the reduction of greenhouse gases, soil degradation, biodiversity loss and nutrient surpluses” (Gemeente Amsterdam, 2020, p. 40). That healthy diets are environmentally friendly is also recognised by the food strategies of Zurich and Copenhagen. Zurich’s food strategy suggests that “a balanced diet in the sense of the food pyramid is an appropriate mixture of environmental protection, health protection and feasibility” (Stadt Zürich, 2019, p. 35). Copenhagen claims that “a greener diet will have a positive effect on the health of the majority of citizens” (Københavns Kommune, 2019c, p. 17).

5.1.3 The resource efficiency frame

This third frame depicts the problem as a question of resource use and aims to increase the efficiency of the ways we use resources in our food system. Thus, the frame looks at the food chain as a whole, targeting all stages where resources can be wasted. Using the scarce resources we have more efficiently is not only a question of environmental protection but also relevant from an economic perspective: Everything that we waste are sunk costs, environmentally as well as economically. As is stated in Brussels' food strategy:

> "Every year, 134,000 tonnes of organic waste end up in the waste bin: an ethical problem (food meets a fundamental need), an economic problem (the cost of production is added to the cost of waste processing) and an environmental problem (natural resources are used for production and waste management)." (Brussels Environment, 2016, p. 32).

The ethical problem is also present in Paris' food strategy, which criticises the wastage of food vis-à-vis existing food insecurity (Mairie de Paris, 2018). Glasgow's food strategy addresses the economic aspect of food waste, stating that "a third of food produced is never eaten, costing the average household around £440 per year" (GFPP, p. 7) and Milan's food strategy points to the multicomplexity of the food waste problem, as "reduc[ing] surpluses and food waste during the different stages of the food chain [is] a form of preventing social and economic inequalities and (…) a tool for reducing the environmental impact" (Comune di Milano, 2015, p. 22). Copenhagen sets food waste in relation to climate change and states that "if food is not eaten, the climate impact throughout the chain has been in vain" (Københavns Kommune, 2019c, p. 16). The resource efficiency frame thus pays special attention to the large amount of food that is wasted. Another focus area is food packaging: "Packaging waste occurs along the entire value chain, from agricultural production to wholesaling and disposal" (Ernährungsrat Köln und Umgebung, 2019, p. 38). Zurich's food strategy emphasises the trade-off between shelf life and environmental impacts of food packaging and follows the principle "as little as possible, as much as necessary" (Stadt Zürich, 2019, p. 40). Solutions in this frame are related to the reduction of food waste as well as the proper handling thereof. Example quotes are: "An improved system for the collection and processing of organic waste will allow us to recover and reuse nutrients, thus reducing the need for artificial fertilisers" (Gemeente Amsterdam, 2020, p. 45), "according to study results, avoiding food waste is possible (…) it is important to use these potential in the next few years" (Land Berlin, n.d.–e), "preserving resources and fighting food waste" (Brussels Environment, 2016, p. 9), and "the Mayor is (…) committed to increasing recycling rates for inedible food waste" (GLA, 2018b, p. 51). Two examples from Copenhagen and Zurich emphasise again the environmental benefits associated with food waste reduction. Copenhagen's food strategy says: "We therefore get a direct positive climate change outcome when we limit food waste – an outcome that will increase when we avoid wasting food products with the greatest climate impact" (Københavns Kommune, 2019c, p. 17). Similarly, in Zurich it is said that "with completely using all food, the environmental impact of our diet could be reduced by 22%" (Stadt Zürich, 2019, p. 34).

5.1.4 The welfare frame

This last frame looks at the way that the food system affects citizens. Most of the food strategies recognise that food has a social component to it, which can be food access to support food security, offering new ways of revenues and stimulating the local economy for the benefit of the citizens, or social ties that food in community settings can strengthen amongst the citizens. The problem described in this frame can take on multiple shapes relating to different societal challenges. Food insecurity amongst vulnerable citizens is addressed as one important problem, which can be due to lack of

sufficient income, or due to special nutritional needs of elderly people or children. Another problem mentioned is our current economic model that "is at the expense of future generations" (Gemeente Amsterdam, 2020, p. 10). To exemplify this, Brussels explains that "access to good quality food is (…) a challenge at a time when 32,000 people are dependent on food aid and one third of Brussels residents live with an income below the poverty warning line" (Brussels Environment, 2016, p. 3) or Lyon's food strategy mentions that "food has become a major societal concern: globally, 11 million deaths are believed to be attributable to poor nutrition" (Grand Lyon, 2019, p. 5). Several food strategies provide examples for the inequalities that stem from the current food system: "underprivileged members of the population are often at risk of health problems resulting from poor diet (…) and the consumption of poor quality products" (Brussels Environment, 2016, p. 10), "whether people have access to healthy and fresh food and how they prepare such food depends on income, place of residence, and education" (Ernährungsrat Köln und Umgebung, 2019, p. 26), or "considering the health status in the city, the more prosperous [citizens], on average, enjoy significantly better health than the less prosperous residents" (Københavns Kommune, 2019c, p. 5). While the problem in this frame is dominantly described in terms of food access and health inequalities, possible solutions to improve social welfare are more diverse. Relating to the local economy, it is argued that regional agriculture preserves jobs in the region (Ernährungsrat Köln und Umgebung, 2019), that local food businesses support citizens through employment (GFPP; GLA, 2018b), and that new start-ups can develop in the food sector and food can boost tourism and attract investment to the local economy (GLA, 2018b). In the social sphere, new forms of production, distribution and consumption are able to stimulate access to healthy food for all citizens (Comune di Milano, 2015). Further, urban agriculture has a social function and makes citizen participation in the local food landscape possible, as well as providing opportunities for new connections (Gemeente Amsterdam, n.d.). As London's food strategy states: "Food can be a great way of bringing people together" (GLA, 2018b, p. 8).

Some aspects of these four frames hold similarities with earlier research on frames in urban food governance. Candel et al. (2014) studied the frames present in the reform debate of the EU Common Agriculture Policy concerning food security. One frame they identify is also labelled the 'productionist frame'. This frame is based on the idea that, to tackle food security in the EU, the Common Agricultural Policy needs to focus on the production of more food for an increased food supply. Even though the reasoning of food security behind the frame is different, likewise to the productionist frame here, problem and solutions are at a pre-consumer stage. Garnett (2013) describes three frames of food sustainability (see section 2.4). One frame sees food sustainability as a production challenge, that – as the productionist frame here – "places emphasis on the negative consequences of food production" (p. 31). According to Garnett (2013), this frame stresses production efficiency with the goal to produce more food "on existing farmland in ways that do not incur excessive environmental costs" (p. 32). Again, the frame is anchored in the question how food is produced. Both examples, Candel et al., (2014) and Garrnett (2013), describe the productionist perspective as dominant in the food security and food sustainability discourses respectively. This is in line with the findings from the food strategies here, where in over half of the cities analysed, the productionist frame is most dominant (see figure 3b).

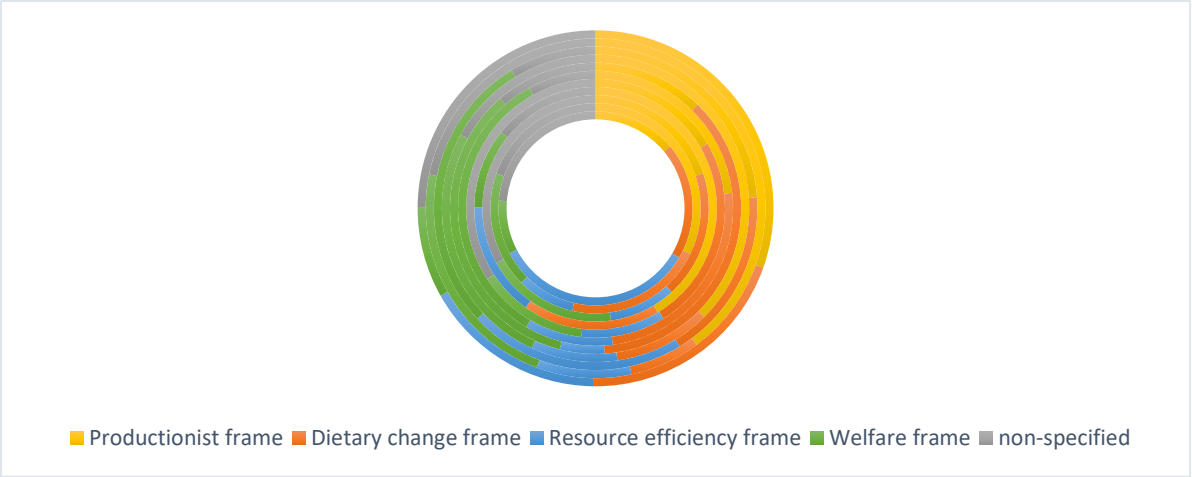

Figure 3a: Illustration of the frequency of the different frames in all eleven strategies

Figure 3b: Illustration of the frequency of the different frames per city

Garnett (2013) further describes food sustainability as a consumption challenge, where "excessive consumption, particularly of high-impact foods such as meat and dairy products, is a leading cause of the environmental crisis we face" (p. 33) and as a socio-economic challenge which is the "outcome of unequal relationships between and among producers and consumers, across and within countries and

communities" (p. 34). These two framings have similarities with the dietary change frame and the welfare frame found in the analysis of the food strategies. This shows that the main debates found in the UFSs align with prior findings from the literature. As frames "generate meaning and action" and "are powerful elements in understanding the political debate" (Moschitz, 2018, p. 182), they are representative of the broader political problem perception concerning the urban food system. Garnett (2013) argues that die to the complexity of the food system often a mix of the perspectives that she outlined is present. The finding of this research support this claim: Figure 3b depicts the coded text items categorised under the four frames. It shows how in different cities, different framings of the urban food problem can be more dominant than others. Furthermore, with the exception of Amsterdam, the strategies put less emphasis on the resource efficiency frame. The reason why Amsterdam is different in this respect is that the food strategy of the city is partly included in the circular economy strategy which has waste management and the efficient use, reuse and recycling of resources at its heart. Figure 3a illustrates that the productionist frame, as well as the dietary change frame are relatively strong overall, whereas the welfare frame is either referred to relatively often or relatively little within one strategy. The illustration of the findings shows that while overall, all food strategies make use of the same set of frames, there are visible differences concerning the balancing between them.

5.2 Storylines of food challenges in three European Cities

Throughout their food strategies, the cities tell different storylines that link the different frames together. These storylines have "important organisational potential" because they combine the different frames "into a more or less coherent whole" (Hajer, 2002a, p. 47). According to the discourse coalition approach, the frames and storylines become visible in the practices applied in the city. Therefore, In the second part of this analysis, I examine the governance instruments present in urban food governance and focus on how the cities make use of the different frames and present them in form of different storylines in the instruments. To find a diverse mix of governance instruments, the next part presents three cities with dissimilar storylines at place in their UFSs'.

All citations in the coming three sections are taken from Cologne's, Copenhagen's and London's food strategy respectively. For better readability, I will only include the page numbers for direct citations. The documents referred to are the following:

- Ernährungsrat Köln und Umgebung. (2019). *Impulse für die kommunale Ernährungswende: Eine Ernährungsstrategie für Köln und Umgebung - Hnadlungsfelder, Bestandsaufnahme und Zielvorgaben*. http://www.ernaehrungsrat-koeln.de/ernaehrungsstrategie
- Københavns Kommune. (2019c). *The City of Copenhagen's Food Strategy*. https://www.kk.dk/sites/default/files/uploaded-files/the_city_of_copenhagen_food_strategy_2019.pdf
- GLA. (2018b). *The London Food Strategy: Healthy and Sustainable Food For London*. https://www.london.gov.uk/sites/default/files/final_london_food_strategy.pdf

5.2.1 Cologne

The food strategy of Cologne looks at the food chain holistically, stressing challenges relating to the global character of the food system and reinforces several times a farm-to-fork understanding of the urban food system. Sustainability is understood in terms of ecological and social features of food, including local and regional produce, certification, protection of natural resources, seasonality,

affordability, and safety. Diets should be healthy, fresh, and culturally appropriate, and emphasis is also placed on waste and meat consumption. It envisions food being 'good for the people' and 'good for the planet'.

In the strategy, the productionist frame is dominant, particularly stressing a change for where food is produced. The storyline told throughout the strategy is one of a regionalisation of the food system, with a focus on food produced in the region. For instance, the strategy calls for fostering a "diet of short food miles" (p. 40) or criticises that "long food miles, often from outside of Europe, cause high GHG emissions" (p. 14). "The majority of agricultural businesses are integrated into global supply chains" (p. 14) so "fertiliser and feed should be increasingly regionally produced [to] reduce imports from outside Europe" (14). The strategy sees sustainable regional agriculture as a way to preserve ecology, biodiversity and increase life quality in the region. This shows that the idea of regionalisation is not only endemic to the productionist frame but also connects it to the welfare frame: it is mentioned that "regionally anchored agriculture (…) preserves good jobs in the region" (p. 10) and that alternative distribution models can support regional farmers. The strategy also reasons that there should be a dietary change to less meat consumption "to reduce imports from outside Europe" (p. 14) linking the storyline of regionalisation with the dietary change frame. With the demand for more local and regional food supply comes together an emphasis on urban agriculture as a way to grow food locally; one aim of the strategy is "realising the edible city Cologne" (p. 42).

5.2.2 Copenhagen

Copenhagen's food strategy aims to reduce the climate footprint of food, improve food quality, and reduce food insecurity for social and environmental benefits. The strategy showcases the successful organic transition in public procurement and demonstrates concern for health problems connected to an inappropriate diet as well as health inequalities between different socio-economic groups in the city.

The four problem frames are relatively balanced in Copenhagen's food strategy and are connected through a storyline emphasising the climate impact of our current food system and the aim to reduce the carbon footprint of the city's food system. The strategy explicitly states that it introduced "a significant climate focus in the new Food Strategy" (p. 5) and that "the relationship between climate change and food has become evident" (p. 5). Food "must be sustainable and climate-friendly" (p. 18) and the city aims at "a reduction in the carbon footprint" (p. 18) by including an emissions reduction target for food and meals. In this way, it aims to become "a climate-responsible city" (p. 9). Climate thus, plays an important role in the different frames. Accordingly, the strategy conveys ideas like "replacing specific food products with less climate-impacting food products in the same category" (p. 16) for a positive climate change outcome or "a greener diet will have a positive effect on health" (p. 17). The dietary change focuses on health and plant-based diets, but the strategy also states that "climate action concerning food and meals must take [nutritional requirements] into account" (p. 17). The strategy attributes public procurement an important role for changing the food system towards emission reductions and places emphasis on organic food, local food, seasonal food, plant-based food and food waste. This not only relates to the dietary change frame, but also the productionist and resource efficiency frame. Particularly when talking about food waste, the climate storyline is strong: "If food is not eaten, the climate impact throughout the chain has been in vain" (p.16), there is a "direct positive climate change outcome when we limit food waste" (p. 17). Alone in the welfare frame, the climate focus is not present even though the strategy states that "Copenhagen must be a green, healthy, and vital food city" (p. 24).

5.2.3 London

London's food strategy addresses inequalities in food access and health and thus provides a more societally concerned interpretation of good food. A particular concern towards children's health is prominent in the strategy regarding child obesity. However, good food is not only a question of access and health but also of other aspects like organic, seasonal, local, or plant-based food. The strategy also stresses the importance that the food sector has for London's economy and the opportunities that innovation can bring in terms of new businesses and job opportunities.

London's food strategy tells a less coherent story but is rather fragmented into different themes. Overall, the strategy shows a certain degree of intersectionality between social and economic welfare needs on one side, as well as environmental welfare needs on the other side. One example for this is urban agriculture: While the strategy states that "urban food growing has many environmental benefits" (p. 12), it also acknowledges that urban agriculture can "boost people's physical and mental health and wellbeing" (p. 12) and contributes to the local economy. The strategy aims to "promote the multiple benefits of food growing for individuals and communities" (p. 43). In contrast to Copenhagen and Cologne, the welfare frame plays a more important role in London's food strategy. The strategy conveys the idea that a food transition benefits the community, London's food culture and the economy. Accordingly, the strategy argues that "food has a crucial role to play in improving social integration" (p. 32) and "connects everything we do as a society" (p. 7), "it drives our economy" (p. 7). Every Londoner should "have access to healthy, affordable, good food" (p. 5). Even though many themes are addressed in London's food strategy, one delineating aspect is a strong concern about health, which connects some parts of the welfare frame with the dietary change frame. The strategy criticises the fact that health problems are related to food insecurity as "many Londoners are not able to eat well at home, in part because of issues relating to poverty and inequality" (p. 18). Thus, there is a call for reducing child obesity and related inequalities in the dietary change frame. Good food is important "for pregnancy and childhood" (p. 12) and "to [address] the rise of diet-related diseases" (p. 5). The strategy also calls for an improvement of the food environment to support healthy food choices for instance by "reduc[ing] children's exposure to junk food" (p. 12). The importance of healthy diets explains why the dietary change frame is relatively strong next to the welfare frame in London's food strategy.

Cologne, Copenhagen, and London are not the only cities where these storylines are present. The story of regionalisation told in Cologne's food strategy is particularly strong, but also Lyon, Paris, and Zurich show elements of this storyline. They all aim to increase their food autonomy with more local food production (Grand Lyon (2019): With regional food products, Lyon has the potential "to achieve 15% food self-sufficiency tomorrow" (p. 17), Mairie de Paris (2018): "An increase in food autonomy and resilience" (p. 34), Stadt Zürich (2019): "Calculations for Switzerland show a largely synergistic potential of resource conservation and greater self-sufficiency" (p. 41)). Similar to Copenhagen, climate change is an important concept in Amsterdam's food strategy even though it takes a more general approach to environmental problems. For instance, it states that "the climate is on our plates" (Gemeente Amsterdam, n.d.) and calls for a choice for more vegetable proteins and shorter food miles as they produce less CO2 emissions (Gemeente Amsterdam, n.d., 2020). The strategy sees the reduction of food waste and the uptake of more plant-based diets as opportunities to "contribute to more efficient use of agricultural land and thus to the reduction of greenhouse gases, soil degradation, biodiversity loss and nutrient surpluses (and shortages)" (Gemeente Amsterdam, 2020, p. 40). Similar

to London, Glasgow addresses many different themes in its strategy but also gives health and food security a more important role than other cities do, while in Milan no specific focus is visible. Berlin's food strategy connects the different frames via public procurement as a tool to deliver sustainable diets, and Brussels conveys a storyline of food as a means to achieve quality of life.

These three storylines – regionalisation, climate, and health – thus show that even with all four frames present in a food strategy, different narratives, which interpret and connect the frames in different ways, guide the strategies. The different storylines show how biodiversity as a challenge for food policies can be addressed in different ways. A storyline of regionalisation allows for implementing environmental principles in the region and also emphasises urban agriculture, contributing to regional and urban biodiversity. The climate storyline focuses on mitigating climate change via the means of food, and therefore targets climate change as a driver of global biodiversity loss. When a storyline focuses on health, environmental concerns in general and biodiversity concerns more specifically, might not be at the forefront and thus, less prominent in food policies taking place under such a storyline.

5.3 Governance instruments in urban food governance and biodiversity

The way a problem is understood in governance is important in terms of the solutions that will be seen as useful in the policy response (see sections 2.4 and 2.5). It is argued that the social construction of a problem translates into the governance instruments chosen to tackle the problem (Peters, 2005; see also Hajer, 2002b; Rein & Schön, 1996). This section explores how problem framing translates into governance instruments with a specific focus on instruments that directly or indirectly affect biodiversity, therefore answering sub-question 2 of this research. The aim is to learn about what governance instruments already exist in urban food governance that can also be used for biodiversity action.

In order to achieve this, I searched for different governance instruments applied in the cities belonging to urban food governance that have a theoretical relationship with biodiversity, as presented in sections 4.3.1 and 4.3.2. To briefly summarise this, I looked for instruments that either challenge the agricultural sector to use more nature-friendly production methods, e.g. organic agriculture or certification of other environmental standards, that aim at a reduction of the carbon footprint of food (for instance local or seasonal food produce, or a switch to healthier or plant-based diets), that reduce food waste, or that aim at an increased uptake of urban agriculture. I am including local/regional food production in this list despite the lack of scientific support for reducing emission on its own. Local and regional food production is an important topic within the food strategies analysed. Coupled with seasonal produce however, shorter food miles thanks to local and regional food production can have a positive climate effect. By including local and regional produce here, I can account for this connection and make a potential lack of attention towards this issue in the governance instruments visible.

As set out in the analytical framework in section 4.3, I use the governance instrument categorisation based on Vedung (2010) and Doernberg et al. (2019), differentiating between regulatory instruments, economic instruments, informational instruments, and informal instruments. As examples have shown in section 4.3.3, regulatory instruments include laws and other regulations or contracts that are binding for the city. Economic instruments are instruments that use market-based mechanisms, like changing the demand for certain products, providing financial support, for instance in form of subsidies, imposing fees for certain actions/products, or using taxation to influence demand and supply.

Economic instruments also include the provision of resources that are not in financial form, for instance by providing facilities or land. Informational instruments are any instruments with the goal to educate the recipient. Moreover, informational instruments include instruments with the aim to acquire knowledge about certain issues for the policy makers themselves and the use of certifications schemes to inform the consumer. Lastly, informal instruments include any kind of instruments that do not fall into the definitions of the former three categories. This can include forms of networking or campaigning, voluntary agreements, or roundtables etc., but also strategic targets that are not legally binding for the cities.

In the following, I look at the three cities separately, presenting the different governance instruments I found and which of the four problem frames they belong to. I compare this with how the frames were used in the UFSs and also set the governance instrument mix found into context with the storyline of the respective city's food strategy. The categorisation underneath the four problem frames is based on the aim of the governance instrument and/or the explanation of the governance instrument provided in the document where it is presented. Not all instruments are implemented yet, particularly strategic documents like the food strategies often show intentions of action. It can also be the case that a governance instrument has ended/is not applied anymore. I include both options – still to be implemented or phased-out – due to the exploratory character of this research. The governance instrument mixes are not exhaustive. I included some of the instruments mentioned in the food strategies that I considered important, and used the information on related strategies or initiatives and so on to add more instruments to the list. In the case of London, this provided sufficient examples for my analysis. For Cologne and Copenhagen, I conducted an additional search using the cities' websites and documents referred to in related policies.

5.3.1 Cologne

The governance instrument mix present in Cologne is focused on education of citizens about food and sustainability, the uptake of urban agriculture in the city, a more sustainable food procurement system, and environmentally sound regional agriculture. Table 5 presents the governance instruments, and indicates the type of instrument, as well as the frames that they belong to.

The department for education in Cologne has implemented *Wertschätzung von Lebensmittel* (English: Appreciation of food) in schools, a programme to educate pupils about food appreciation. The children can cook together with chefs and learn how to cook with leftovers and prevent food waste, but also how to cook locally, seasonally, and plant-based. The project further provides course material for learning about food waste (Stadt Köln, n.d.–j). The department for environment and consumer protection runs a campaign *SchadDröm* to inform citizens on food waste and the prevention thereof (Stadt Köln, n.d.–h). More generally, the municipality provides information on its website on how to shop and eat sustainably, based on consuming seasonal, regional, more plant-based, organic, and FairTrade certified food; limiting emissions of the last food mile by going shopping per foot or bike; drinking tap water[7]; and giving tips how to reduce the energy needed for food preparation and storage (Stadt Köln, n.d.–b). In line with this, the City Administration also built drinking water fountains across the city (Stadt Köln, 2020b).

[7] Water was included in this research as part of the urban food system as some food strategies included actions on drinking water, like London and Milan.

Table 5: Governance instruments applied in Cologne's urban food governance landscape

Document/Source	Governance instrument	Governance instrument type	F1	F2	F3	F4
Wertschätzung von Lebensmitteln	• School project cooking with chefs at schools	Informational				
	• Provision of school material about food appreciation and food waste	Informational				
Schad dröm	• Campaign informing about food waste (reduction)	Informational				
Essbare Stadt Köln	• Strategy to increase edible green in the city	Informal				
	• Public workshops about urban gardening	Informational				
Biostädte Netzwerk	• Membership to strengthen organic and regional agriculture	Informal				
Public procurement regulation	• Purchase preferably agricultural products that are certified as fair	Regulatory				
Environmental Committee resolution AN/1661/2019	• Increase percentage of (preferably regional) organic food, as well as regional and seasonal food in public kitchens, schools, kindergartens and city events dynamically	Economic				
	• Assessment of how to change food supply in public kitchens with a perspective objective of 90% organic food in 2030	Informational				
	• Assessment about possibility to include legally binding criteria for organic, regional, and seasonal food in future tenders	Informational				
Fair Trade Town Köln	• Informational resources about Fair Trade products for citizens	Informational				
	• Improve access to fair trade products for citizens	Economic				
City website	• Provision of information about how to shop and eat sustainably	Informational				
	• Funding of food council	Economic				
	• Provision of drinking water fountains	Economic				
	• Provision of information on school gardens	Informational				
	• Provision of information on urban farming	Informational				
	• Adopt a shared greenspace for urban farming	Economic				
Gärtnerns mit Pänz – Pauken, Pause, Pastinake	• Provision of information on school gardens • Programme for a school garden network	Informal				
Obstwiesenkommission	• Assessment and mapping of meadow orchards on city-owned land	Informational				
Gartenlabore	• Project to further develop urban gardening including food production	Informal				
Environmental Committee resolution AN/1785/2018 and AN/0988/2019	• Criteria catalogue for agricultural use of city-owned land	Regulatory				
	• Develop strategy how future lease agreements consider criteria catalogue	Informational				
Food strategy	• Non-specified support for organic agriculture in the region, including participatory agriculture	Informal				
	• The city sets target criteria for organic agriculture and biodiversity on city owned land	Regulatory				
	• Non-specified support of food variety in agriculture and animal husbandry	Informal				
	• Educational opportunities about more variety diversity in diet	Informational				
	• Voluntary commitment to vegan and vegetarian offers in HORECA	Informal				
	• Foster synergies between regional brands and organic certification	Informational				
	• Public information about regional, sustainable, and healthy food	Informational				
	• Non-specified support for food venues to redistribute food surpluses	Informal				
	• Research on linkages between dietary habits, overproduction and food waste	Informational				

Urban agriculture is fostered via the development of school gardens. Specifically, the municipality has information available on its website on how to successfully build a school garden and how education can take place there, and it runs a network, *Gärtnern mit Pänz*, that offers employees of schools a platform to exchange their knowledge and experience on school gardens (Stadt Köln, n.d.–f, n.d.–i). Furthermore, information on urban agriculture is available on the city's website, not only on gardening at home but also in community gardens. Citizens can take on foster care/sponsoring for urban green, helping to make Cologne an edible city (Stadt Köln, n.d.–c, n.d.–g). The *Essbare Stadt Köln* (English: edible city Cologne*)* is the most far-reaching project in this area: Cologne's food council works together with the municipal government to implement an action plan aiming to increase the number of edible plants in public green; to increase the number of urban community gardens with focus on edible plants; to foster the planting of edible plants in private allotments, as well as private gardens and business gardens; to promote the concept of participatory agriculture and improve the accessibility of citizens to it; and to promote urban agriculture in educational institutions (essbare-stadt.koeln, 2021a). Several environmental organisations, the food council and the department for environment and consumer protection joined the so-called *Obstwiesenkommission,* a taskforce that is responsible for assessing, mapping and taking care of meadow orchards in the region of Cologne and Leverkusen on city-owned land (Stadt Köln, n.d.–a). Another project in the realm of urban agriculture is called *Gartenlabore*. This project implemented by Cologne's department for green spaces and now run by a civil society organisation aims to further develop urban gardening, including food production with focus on the social benefits it has for citizens involved in it (essbare-stadt.koeln, 2021b; Stadt Köln, n.d.–a).

Cologne's public procurement regulation prescribes that in procurement, fair trade products are to be preferred, based on independent certification schemes like the FairTrade or the Rugmark label (Stadt Köln, 2019). The city also has been accredited a *FairTrade Town* which means that, additionally to fair-trade products in public procurement, the municipal government is active in informing citizens about fair-trade and improving the access to fair-trade products. For instance, it provides a fair-trade shopping guide to help citizens find relevant businesses (FairTrade Deutschland, n.d.; Stadt Köln, n.d.–d, n.d.–e). Furthermore, the Environmental Committee published a resolution to increase the percentage of organic food, preferably from the region, seasonal food and regional food in public kitchens, schools, and kindergartens, aiming for a share of 90% organic food in 2030. For this, assessments are carried out on how to reach such a target and how to include legally binding criteria concerning organic, regional, and seasonal food in future tenders (Ausschuss für Umwelt und Grün, 2019b).

Some governance instruments also target agricultural activities in the peri-urban area around the city. Cologne is a member of the *Biostädte-Netzwerk* (English: Organic Cities Network). The network aims to foster demand for organically produced food, shorten food miles, and create value in the region (biostaedte.de, n.d.). More directly, the Environmental Committee also adopted a resolution introducing a criteria catalogue for agricultural use of city-owned land. These criteria include measures to increase biodiversity and species protection, fostering of organic and sustainable agricultural methods, reduced fertiliser and pesticide input, ban on glyphosate, support of local direct marketing concepts, and close-to-the-city-production. For this, the committee asked the city to develop a strategy on how future lease agreements can include these criteria (Ausschuss für Umwelt und Grün, 2019a).

Finally, Cologne's food council suggests several instruments in Cologne's food strategy. Some relate to instruments already in place and mentioned before, however, it additionally mentions support for

more food variety in agriculture as well as educational resources about food varieties, voluntary commitments of food serving businesses to offer vegan and vegetarian meals, redistribution of food surpluses and better understanding of the link between diets, overproduction and food waste, and fostering synergies between regional brands and organic certification (Ernährungsrat Köln und Umgebung, 2019). The municipal government provides funds for the food council, which was responsible for the development of the urban food strategy, to strengthen its work in this field (Stadt Köln, 2020a).

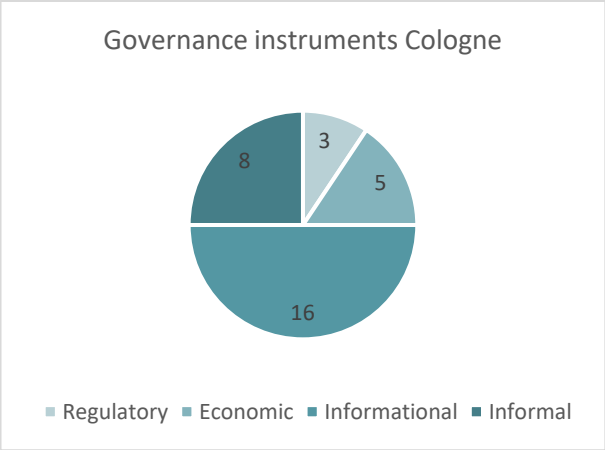

Figure 4: Frequency of governance instrument types in Cologne

Most popular in the governance instrument mix are informational instruments, followed by informal instruments, economic instruments, and finally regulatory instruments (see figure 4). Along with what could be expected from the food strategy, the productionist frame is dominant across the governance instruments and many of the governance instruments in this frame also feed into the story of regionalisation from Cologne's food strategy. However, the governance instruments often mention regional food together with other criteria, like seasonal or organic (for instance *Biostädte Netzwerk* or targets for public procurement).

Figure 5 provides an overview of the frames used by the governance instruments. Particularly when the city provides information, these instruments usually use several problem framings. For instance, the informational guide on how to shop and eat sustainably gives tips on what to pay attention to concerning the production of food, but also concerning the equipment used for cooking and storing, as well as for a climate-friendly diet. Thus, it uses the dietary change frame and the resource efficiency frame. The welfare frame, with the exception of the provision of drinking water fountains, is solely applied in governance instruments that concern urban agriculture. The resource efficiency frame is mostly present in governance instruments that educate citizens about food waste.

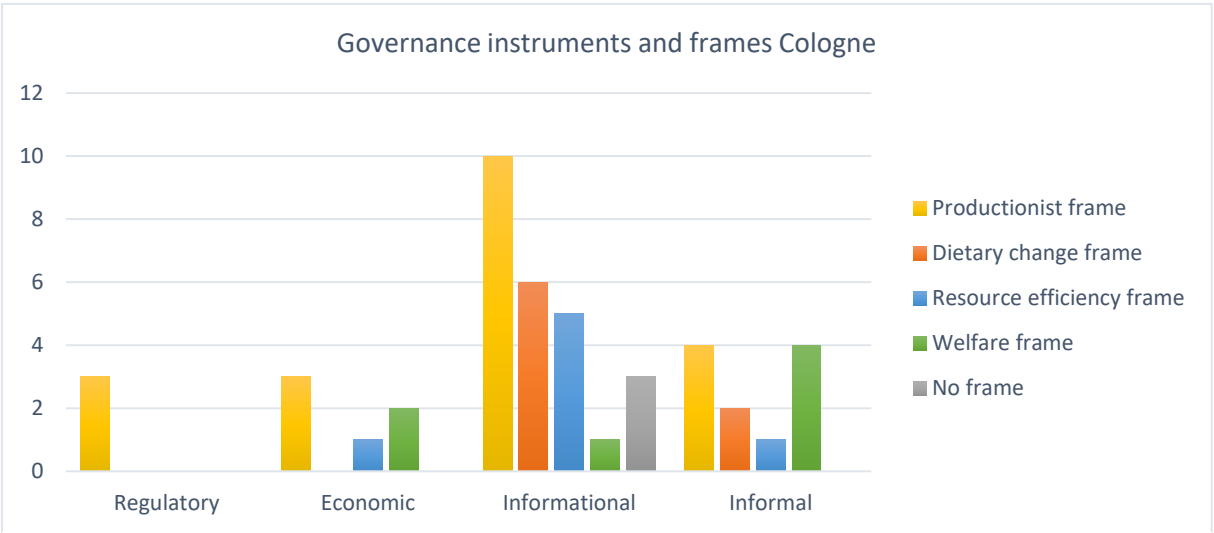

Figure 5: Occurrence of problem frames per instrument type in Cologne

The dominance of informational instruments also resonates with the city's food strategy, which places a lot of responsibility on the individual. For instance, "in the case of 'sustainable consumption', consumers take ecological and social criteria into account in their consumption decisions" (Ernährungsrat Köln und Umgebung, 2019, p. 30). By educating the individual about how to make their own food choices more sustainable, the citizen can act on this responsibility.

5.3.2 Copenhagen

The governance instrument mix present in Copenhagen focuses on the sustainability of public food procurement and the reduction and recycling of food waste. But it also mentions the establishment of more green edible spaces in the city. Table 6 presents the governance instruments, and indicates the type of instrument, as well as the frames that they belong to.

There are several governance instruments that the city applies to make the meals that they serve in public kitchens more sustainable and climate-friendly. Additionally to the municipal government's own public procurement policy and *EAT school food*, which targets the food procurement in the city's schools, the city government has committed to several procurement agreements - the *SKI*[8] and the *Partnership for Green Public Procurement*[9]. Specific actions concern increasing the share of organic food, plant-based meals, certified food and certified food-related products, and seasonal food in public procurement (EAT-Skolemad, n.d.; Københavns Kommune, 2019d; Partnerskab for Offentlige Grønne Indkøb, 2014, 2018; SKI, 2020a, 2020b). The municipal government has already introduced the aim to increase the share of organic food in public meals to 90% in 2001, which makes Copenhagen a leading city in this regard (Københavns Kommune, 2019d). Public procurement also tackles food waste. The *SKI* provides advice on activities to address food waste reduction in public kitchens and the *Partnership on Green Public Procurement* requires their suppliers to provide information how they minimise food waste in their production process (Partnerskab for Offentlige Grønne Indkøb, 2018; SKI, 2020a). Finally, *Meyer's Madhus* under a tender with the city administration delivers *Good Meal Courses* and *Køkkenløftet* (English: kitchen promise): free courses and advisory resources for municipal kitchens and kitchen staff on climate-friendly, organic, seasonal, fair-trade, local or fresh food, the protein transition, sustainable fish, and food waste (Københavns Kommune, n.d.–a, 2021; Københavns Madhus, 2008). Municipal kitchens can strive for organic food accreditation under the *Økologiske Spisemærke*, a certification scheme run by the Danish Ministry for Food, Agriculture and Fishery (Økologiske Spisemærke, n.d.). With the *CoolFood Pledge,* the municipal government has committed to a general goal of reducing GHG emissions associated with food procurement by 25% in 2030 (WRI, 2021).

In its culture and food policy, the municipal government mentions that it is pilot testing sustainability criteria for leasing contracts of city-owned food venues, like spaces for cafés (Københavns Kommune, n.d.–b). Similarly, the food strategy proposes to develop and introduce sustainability criteria for food served at festivals that receive funds from the city (Københavns Kommune, 2019c). However, in both cases, it is not clear what exactly is meant with sustainability criteria. In light of the understanding of sustainable food in the food strategy, which is also reiterated in the governance instruments in public

[8] The *SKI* is a public sector procurement service and knowledge centre.

[9] The *Partnership for Green Public Procurement* is a collaborative effort of public organisations to reduce the environmental impact associated with public procurement that was initiated by the Danish Ministry of Environment and the municipalities Copenhagen, Aarhus, and Odense.

Table 6: Governance instruments applied in Copenhagen's urban food governance landscape

Document/Resource	Governance instrument	Governance instrument type	F1	F2	F3	F4
Public procurement policy 2019-2022	• Economic committee decision: Demand organic food in public procurement (organic goal 90%)	Economic				
	• Member proposal to promote plant-based food in the City of Copenhagen: Increase share of plant-based foods in public procurement Cook more plant-based food in public procurement	Economic				
KBH 2025	• Analysis and assessment of treatment technologies for biogasification and collection methods for organic waste	Informational				
SKI website	• Procurement agreement Consumables: Certification for food and baking paper, tea and coffee filters	Economic				
	• Procurement agreement Food and Disposable Items: sets a large number of minimum requirements for food	Economic				
	• Good advice on green shopping	Informational				
Partnership for Green Public Procurement	• Shopping objectives with sustainability criteria	Economic				
	• Require supplier to state how they minimise food waste in the process of handling food	Economic				
	• Food procurement objective for more efficient packaging	Economic				
Circular Economy Copenhagen	• Mandatory collection of biowaste	Regulatory				
	• establishment of biogasplant close to city	Economic				
	• Research on refining solutions for biogasification, retrieve raw materials from biowaste, new treatment solutions to reach 70% recycling target and carbon neutrality	Informational				
The Good Meal courses	• courses for municipal kitchen staff on different topics to make public procurement more sustainable	Informational				
Økologiske Spisemærke	• organic food accreditation for municipal kitchens	Informational				
Children and Youth administration	• School farm visits	Informational				
Department for Sustainable Development	• Skraldehelten project: teaching children in day care institutions about food waste	Informational				
Culture and food policy	• Establish green and edible urban spaces	Economic				
	• Pilot-testing leasing contract requirements for city-owned venues that strengthen food quality, ecology and social responsibility	Informational				
Greening with edible trees	• Plant edible trees, bushes etc. in the city and fund operation	Economic				
Kokkenloftet	• Initiative to assess quality of public kitchens and canteens and provide further training	Informational				
EAT scheme	• School food concept: Provision of vegetarian lunch option, organic and seasonal food	Informal				
Cool Food Pledge	• Cool food pledge: target of reducing the greenhouse gas emissions associated with the food they serve by 25% by 2030	Informal				
Food strategy	• Upgrading of skills and support for municipal kitchen staff regarding a green and nutritionally balanced diet	Informational				
	• Development of indicators for greener and more climate-friendly diets in municipal kitchens (not clear framing)	Informational				
	• Upgrading of skills and support for municipal kitchen staff regarding food waste	Informational				
	• Map areas with a high degree of food waste	Informational				
	• Development and implementation of indicators for green and healthy food at festivals and events supported or funded by the City of Copenhagen	Informal				
	• Establish green and edible urban spaces	Economic				

procurement, criteria could include organic food, certified food, seasonality and locality, as well as meat reduction.

Furthermore, several governance instruments target the reduction of food waste. As mentioned, *Køkkenløftet* and the *Good Meal Courses* aim for an upgrade of skills of kitchen staff in relation to the prevention of food waste (Københavns Kommune, 2021; Københavns Madhus, 2008). With *Skraldehelten* (English: Waste Heroes), the city's department for sustainable development runs a project to educate children about the issue of food waste (Departement for Sustainable Development Copenhagen, n.d.). The circular economy strategy and the climate plan introduce some instruments concerning the handling of food waste. The municipal government wants to collect more information concerning the proper handling of organic waste via the analysis and assessment of treatment technologies for biogasification and collection methods for organic waste. In relation to that, it establishes a new biogas plant close to the city. The city government has also implemented a mandatory collection of organic waste – this all contributes to more recycling of food waste and reduces its incineration in landfills (Københavns Kommune, 2012, 2019b). It thus helps to reduce GHG emissions related to the food system, as biogas is generally perceived as a carbon-neutral form of fuel, but also contributes to resource efficiency by retrieving new raw materials from food waste like fertiliser.

Finally, several documents – namely the food and culture policy, the food strategy, and a decision of the citizen's representation – refer to the municipal government's commitment to establish more green and edible urban spaces as well as funding the operation of them (Københavns Kommune, n.d.–b, 2019a, 2019c). This not only increases local food produce but also gives citizens the opportunity to participate in food production. Lastly, the Children and Youth Administration Copenhagen (n.d.) offers the opportunity to experience food education through visiting farms with school classes.

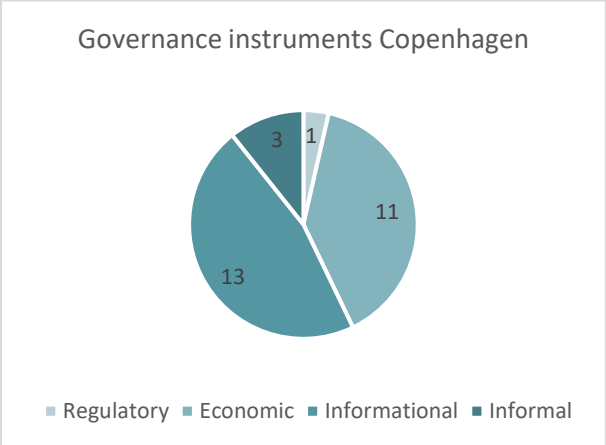

Figure 6: Frequency of governance instrument types in Copenhagen

In Copenhagen, economic and informational instruments are most prominent. Only very few instruments are regulatory or informal (see figure 6). A large number of governance instruments targets public procurement. As public procurement stirs the demand of the city for certain products, this explains why economic instruments are more frequent here than in Cologne's governance instrument mix. The instruments most often belong to the productionist and the resource efficiency frame. Like in Cologne, the welfare frame is almost solely present in governance instruments concerning edible green in the city. The dietary change frame is only used in governance instruments concerning public procurement and guidelines for food served at publicly funded festivals. This is in contrast to the use of this frame in Cologne, where the dietary change frame often belongs to instruments targeting consumer behaviour directly.

Copenhagen's prominent use of the productionist and the resource efficiency frame in the governance instrument mix is in line with its food strategy (see figure 7), which places an emphasis on the climate

impact of food waste and puts forward its successes in the organic transition of public procurement. The city's circular economy strategy, as well as the climate plan, reiterate the climate focus of the food strategy in their governance instruments and reasons actions on food waste on the city's goal to become carbon-neutral in 2025 (Københavns Kommune, 2012, 2019b).

The use of the dietary change frame differs significantly between Copenhagen and Cologne. While in Cologne, the frame is present in governance instruments that target the consumer directly, in Copenhagen the dietary change frame is used in instruments that target food provision. This difference can also be detected when comparing the food strategies of the two cities. As mentioned, Cologne's food strategy places some responsibility on the consumer. In contrast, Copenhagen's food strategy states, that the city "must lead the way and change how food products are produced today" (Københavns Kommune, 2019c, p. 18).

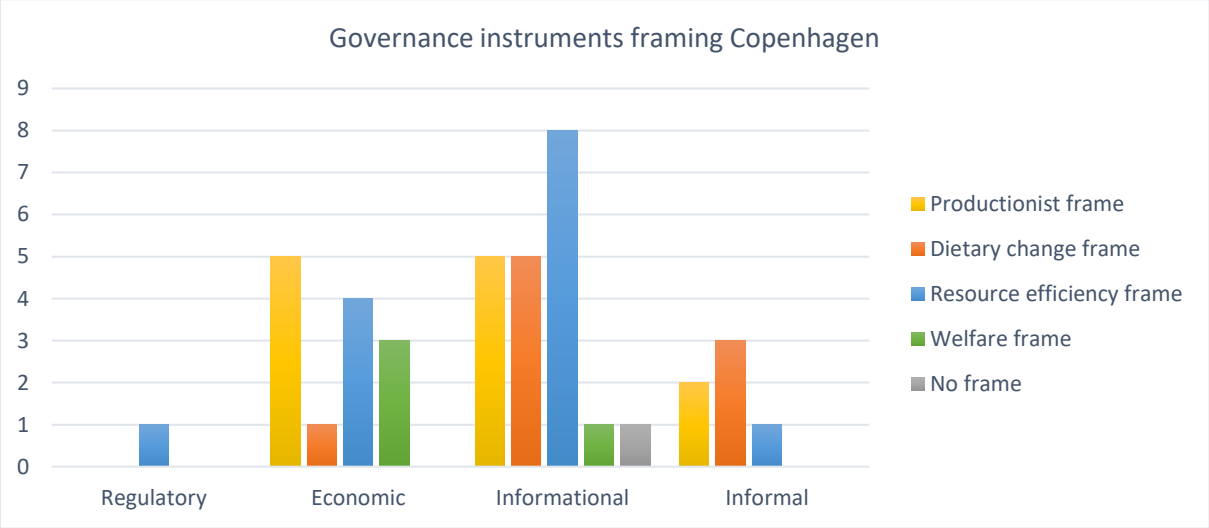

Figure 7: Occurrence of problem frames per instrument type in Copenhagen

5.3.3 London

The governance instrument mix present in London is focused on improving the diet-related health of Londoners, the reduction and recycling of food waste, and the uptake of urban agriculture in the city. Table 7 presents the governance instruments, and indicates the type of instrument, as well as the frames that they belong to.

In London, many governance instruments have the objective to help citizens eat healthier diets and to reduce obesity, particularly amongst children. The *School Food Standards* set mandatory requirements for healthier school meals for schools that belong under this scheme (School Food Plan, 2016). With *Healthy Schools London* and *Healthy Early Years London,* both receiving financial support from the Mayor of London, and *Food For Life Served Here*, several instruments provide accreditations to schools and kindergartens for adhering to certain health standards in school meals (Food For Life, 2021a, 2021b; GLA, 2021a, 2021b). The latter includes the objective to increase the consumption of local, organic and seasonal foods in schools. With the *Healthier Catering Commitment (n.d.),* there is also an accreditation system in place for private food businesses to show that they comply with health standards required by the commitment. The scheme is run by the London Boroughs with support of the Mayor. The Mayor further supports campaigns like *Veg City,* with the aim to increase vegetable

Table 7: Governance instruments applied in London's food governance landscape

Document/Resource	Governance instrument	Governance instrument type	F1	F2	F3	F4
New London Plan	• Restriction on new hot food takeaways within 400m of schools	Regulatory				
	• Target no biodegradable waste on landfills in 2026*	Informal				
	• Encourage development plans to include biogasification of organic waste	Informal				
	• Identification and protection of allotment sites in development plans for urban agriculture	Economic				
London Food strategy	• Ban on advertisement of unhealthy food across London public transport system	Regulatory				
	• Make community growing schemes part of social prescribing	Informal				
	• Collaborations to make London more breastfeeding friendly	Informal				
	• Information for citizens about how to foster change themselves	Informational				
	• Installation of drinking water fountains and funding of a water refill scheme	Economic				
	• Investments in the emerging nature-friendly farming sector	Economic				
	• Collaboration to increase number of water-only primary schools	Informal				
London Environmental Strategy	• Food waste reduction goal of 20% in 2025 and 50% in 2030	Informal				
	• Target no biodegradable waste on landfills in 2026*	Informal				
	• Introduction of separate food waste collection bins	Regulatory				
	• Greater community involvement in the management of green spaces	Economic				
Courtauld Commitment 2025	• Voluntary agreement with food waste reduction goal 20% in 2025 and 50% in 2030	Informal				
	• Voluntary agreement with 20% reduction goal for food and drink related GHG emissions per person by 2025 and 50% in 2030	Informal				
London Waste and Recycling Board	• Circular economy guide for the food service industry	Informational				
	• Deliver Love Food Hate Waste and TRiFOCAL behaviour change campaigns	Informational				
Healthy Schools London	• Accreditation for meeting specific requirements to improve health in school environment	Informational				
Healthy Early Years London	• Accreditation for meeting specific requirements to improve health in school environment	Informational				
FoodSave Scheme	• Funding for programme to help businesses reduce food waste	Economic				
Urban Food Awards	• Awards for sustainable food businesses	Informal				
Healthier Catering Commitment	• Accreditation for food businesses that adhere to certain health standards	Informational				
Sugar Smart campaign	• Project campaigning to reduce sugar intake	Informational				
Veg City	• Project campaigning to increase vegetable consumption	Informational				
School Food Standards	• Requirements to make school meals healthier	Regulatory				
Child Obesity Taskforce	• Taskforce committed to addressing child obesity	Informal				
Capital Growth	• Provision of economic resources for food growing in the city	Economic				
	• Provision of skills and knowledge resources for food growing in the city	Informational				
Food For Live Served Here	• Accreditation programme requiring health, ecological, and participation standards for the food culture in schools	Informational				
Peas Please	• Supply chain network to increase vegetable consumption	Informal				
Procurement Across London	• Framework agreement to improve the ethical and environmental standards in food procurement	Informal				
Local Government Declaration on Sugar Reduction and Healthier Food	• Framework for local authority actions to improve food environment in terms of health	Informal				

*These governance instruments were found in several documents and only included once in figure 8 and 9.

consumption in the city, and the *Sugar Smart Campaign,* with the aim to reduce sugar intake (GLA, 2018b; Sugar Smart, 2021; Veg Cities, 2021). Furthermore, *Peas Please*, a network for food suppliers, has the goal to increase vegetable consumption in the city (The Food Foundation, n.d.), and the *Local Government Declaration on Sugar Reduction and Healthier Food*, a framework for local authorities, proposes different kinds of actions to create a healthier food environment in the signatory boroughs (Sustain, n.d.). The Mayor initiated the *Child Obesity Taskforce*, which aims to significantly reduce child obesity and health inequalities (GLA, 2021d). He also wants to support collaborations to make London more breastfeeding friendly and increase the number of water-only primary schools as is mentioned in the food strategy (GLA, 2018b). To create a healthier food environment for children, the Mayor implements restrictions on new hot food takeaways within 400m of schools and bans advertisement of unhealthy food across the London public transport system (GLA, 2018b, 2021c). The food strategy also mentions the funding of a water refill scheme and the installation of drinking water fountains across the city (GLA, 2018b).

Like Copenhagen, the city employs several governance instruments that tackle food waste reduction and recycling. The *London Food and Recycling Board* is a signatory partner of the *Courtould Commitment 2025* and *2030,* a voluntary agreement setting food waste reduction goals of 20% in 2025 and 50% in 2030 per person (WRAP, 2021). This strategic goal can also be found in London's environmental strategy (GLA, 2018a). Furthermore, the environmental strategy and the London Plan have introduced the strategic target 'zero biodegradable waste on landfills in 2026'. Accordingly, the city administration implemented mandatory food waste collection bins and new development plans should pay attention to biogasification of organic waste (GLA, 2018a, 2021c). The *London Waste and Recycling Board* offers a circular economy guide for the food service industry to reduce food waste and improve the recycling of food surpluses (ReLondon, 2020). For London's businesses, *FoodSave* used to provide financial support funded to deliver food waste action funded by different public authorities (Sustainable Restaurant Association, 2021). The *London Waste and Recycling Board* is responsible for delivering behaviour change campaigns (GLA, 2018b; TriFOCAL, n.d.; WRAP, 2018).

Few governance instruments address the emissions caused by the food sector. With the *Courtould Commitment 2025* and *2030*, the municipal government committed to a general aim of cutting food and drink related GHG emissions by 20% per person by 2025 and 50% by 2030. The voluntary agreement provides relevant resources for its signing parties (WRAP, 2021).

In the GLA's (2021e) *Responsible Procurement Policy,* food is mentioned with regard to London's transition to a low carbon and circular economy. The *Procurement Across London Catering Group*, a public procurement service, offers a framework agreement that pays attention to ethical and environmental standards of food in catering contracts and can be used by local councils (Sustain, 2021b).

The GLA encourages food growing. Governance instruments include the identification and protection of allotment sites for urban agriculture, making community growing schemes part of social prescribing, and involving citizens in the management of urban green spaces (GLA, 2018a, 2018b, 2021c). The *Urban Food Awards* include, next to a climate champion and an ocean friendly category, a growing wild category to honour urban agriculture projects in the city (GLA, 2021f). With *Community Growth,* there is an organisation in place that provides economic resources as well as training for food growing in the city (Sustain, 2021a). The *Food For Life Served Here* accreditation also includes criteria for education about food growing, in theoretical and practical terms, i.e. incentivising the development of

school gardens for food growing (Food For Life, 2021b). Finally, the food strategy sets out investment intentions in the emerging nature-friendly farming sector in the peri-urban area around London (GLA, 2018b).

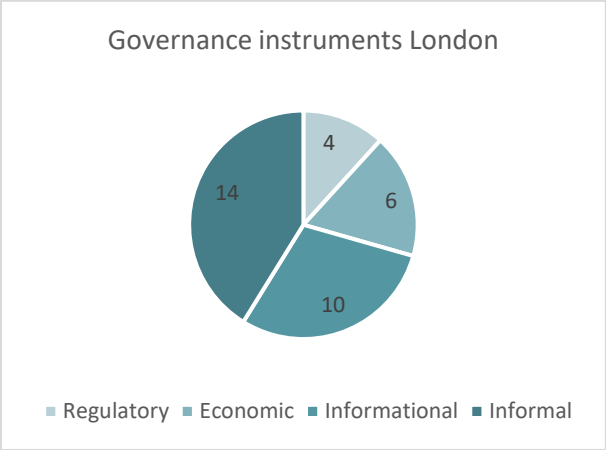

Figure 8: Frequency of governance instrument types used in London

As in Cologne and Copenhagen, informational instruments are frequently used in urban food governance in London. However, in contrast to the other two cities, the analysis also included many informal instruments (see figure 8). A possible explanation for this could be that the search for governance instruments in all three cities started with the references to other policy documents or initiatives made in the food strategy and in the case of London, it mentions a multitude of initiatives present in the city that receive support from the Mayor. Informational and informal instruments are followed in frequency by economic instruments and finally by regulatory instruments. The most popular framing used amongst the governance instruments in London is the dietary change frame (see figure 9). Again, the welfare frame is only present in governance instruments that at least partly include the topic of urban agriculture. While the dietary change frame is present in most of the accreditation schemes that are available in London, the productionist frame is only referred to in the *Food For Life Served Here* scheme. In contrast to Cologne but similarly to Copenhagen, the resource efficiency frame is relatively often used in London's governance instrument mix and both cities employ partly the same governance instruments. These are the mandatory collection of biowaste, or the aim to reduce the amount of organic waste that ends up incineration but instead aim for biogasification.

The dominant stance of the dietary change frame is unsurprising; healthy diets are a core theme of London's food strategy, which the governance instruments analysed were taken from. Governance instruments targeting the diet of citizens directly are mostly of informational nature, in the form of the various accreditation systems mentioned before and campaigns to raise awareness and inform the

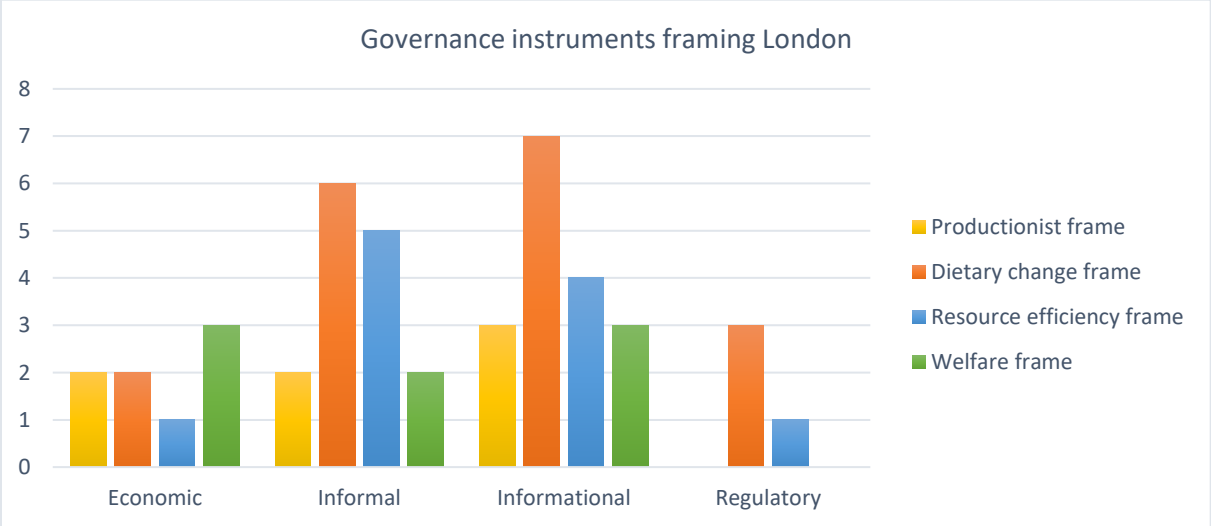

Figure 9: Occurrence of problem frames per instrument type in London

citizens about healthy diets. Remarkably, also two regulatory instruments are applied to achieve an improvement of dietary habits: The ban concerning advertising of unhealthy food products across the Transport for London system, and the ban on permits for new hot food takeaways near schools.

5.4 Urban food governance and biodiversity conservation, restoration, and thriving with nature

The analysis thus far has shown the different ways that cities frame the problem of food and sustainability. The majority of the governance instruments can be tied to one or more of the four frames that emerged from the eleven UFSs. The frames are therefore not only representative of the discourse institutionalisation in the form of the UFSs but also of the practices in the different cities. Thus, the frames prove useful to understand the political meaning of a sustainable urban food system in European cities. As Mendes and Sonnino (2018) argue, food strategies narratives are devices "that discursively reflect and reinforce a city's priorities" (p. 551). By choosing three cities with very different storylines – regionalisation, climate, and health – in the second part of the analysis, I found a diverse mix of governance instruments, though four clusters of similar instruments do emerge. As I selected the governance instruments based on their potential direct or indirect effect on biodiversity, the following four clusters describe ways how cities can address food sustainability that consider the global biodiversity challenge, even though biodiversity is usually not explicitly part of the instruments' goals. In most cases, the instruments belong to one or more of the four problem frames which means they can be tailored according to a city's narrative on food sustainability. The first cluster of instruments focuses on consumer education about sustainable food, for instance by providing shopping guides, by means of certification, or by running awareness campaigns. Second, several instruments focus on public procurement, improving the sustainability of the meals in municipal kitchens. A third cluster of instruments focuses on the issue of food waste, mostly by raising awareness amongst citizens or by improving organic waste management systems. Finally, a fourth cluster of instruments targets urban agriculture and the increase thereof. These clusters are not exhaustive and sometimes overlap. For instance, consumer education is important in instruments on food waste and food waste is also tackled in public procurement. Still, these clusters represent the majority of the instruments part of this analysis and provide a classification to discuss implications and draw some conclusions in light of the research objective.

Accordingly, in this section I focus on the question of what my findings imply for the potential of urban food governance to address biodiversity in and outside of the city. This is done based on the clusters of governance instruments, the frames, and the storylines from the UFSs. I contextualise my findings with the help of relevant literature as well as further insights I received from representatives from the cities Copenhagen and Cologne.

5.4.1 Cluster 1: Consumer education and raising awareness on healthy diets

Many instruments try to change consumer behaviour by informing citizens about the impacts of the food they consume. Many of them can be found in London, where improving the health of citizens via their diet is an important goal. This is linked to the dietary change frame and is consistent with the storyline of London's food strategy. As section 5.1.2 elaborated, the dietary change frame includes two main consumption interventions: fostering a healthier diet and accelerating the protein transition. While both can be achieved by providing relevant information or by adjusting the food offer for eating out of home, accelerating the protein transition can be difficult. In the interviews with Copenhagen,

the interviewees mentioned that the protein transition is a necessary change, but also that "this change in food culture will not happen overnight; but it is on its way, and we need to work step by step to implement this change" (Interview 1 Copenhagen) and that "hopefully being exposed to tasty and healthy plant-based food can inspire people to make that change at home to a higher degree" (Interview 2, Copenhagen). At the same time, cities usually have a strong public mandate to ensure public health. Urban food governance is a relatively recent phenomenon, which Wiskerke (2015) tries to explain with the fact that "food is often seen as part of the realm of agriculture and hence as belonging to rural policy" (p. 4). Also, Santo and Moragues-Faus (2019) criticise that for a long time, there was no mandate for food in the city. This changed because of increasing concerns about the ecological footprint of the food system, but especially because of increasing concerns about public health (Moragues-Faus & Morgan, 2015; Morgan, 2015). Singh and Beagley (2017) state that "urban citizens are increasingly likely to adopt unhealthy diets, fuelled by increasing access to and promotion of processed foods laden with salt, sugar, and fat at the expense of fruit and vegetable consumption" (p. 802). In this sense, the mandate for ensuring the health of citizens "extends well beyond the provision of health services" by the city but also includes, amongst others, agriculture and food (Singh & Beagley, 2017, p. 802). London's food strategy was originally developed to address public health concerns (Morgan & Sonnino, 2010). As the previous analysis shows, this origin is still visible in the current food strategy of London and many governance instruments in the city tackle the overconsumption of processed foods or foods high in sugar, salt, and fat, and the limited vegetable consumption.

As I explained in section 4.3.1, healthy diets are often more environmentally friendly. In western societies, diets usually consist of too many animal products, too little fruit and vegetable consumption, and too much consumption of processed foods (e.g. Cocking et al., 2020; Godfray et al., 2018; Willett et al., 2019). This is often accompanied by an energy intake that is higher than recommended – all these factors can cause health problems (Edwards & Roberts, 2009). Adjusting diets appropriately can reduce the related GHG emissions and reduce meat consumption, two of the main drivers of biodiversity loss. This helps to conserve biodiversity, as it mitigates climate change and reduces the pressures that intensive agriculture puts on our ecosystems. Depending on where the food is sourced, fostering a healthier diet amongst citizens can therefore have a positive effect on biodiversity regionally and/or globally. Therefore, governance instruments that promote healthier diets indirectly offer opportunities to harness co-benefits for biodiversity. Thus far, these co-benefits seem to be unrecognised in many of these governance instruments. They often do not seize this synergetic potential between healthy and green diets and interpret the dietary change frame solely from a health perspective. One counterexample is the *Peas Please Initiative*. The network fosters increased vegetable consumption amongst citizens accompanied by a reduction of meat consumption.

As "in many cities, diet-related ill-health is increasingly becoming a driver of change in urban food systems" (Wiskerke, 2015, p. 14), urban actors have the opportunity to contribute to biodiversity conservation regionally and globally, by deliberately paying attention to the synergies between healthy diets and biodiversity and by including these co-benefits into the governance instruments. This approach can be particularly interesting for cities where the food problem is strongly linked to the city's public health mandate, framing the sustainability of the urban food system in terms of dietary change and emphasising the need for healthier diets.

5.4.2 Cluster 2: Public procurement

Public procurement instruments represent the second cluster. Also, current literature sees public procurement as an important tool in urban food governance (e.g. Doernberg et al., 2019; Morgan, 2015; Morgan & Sonnino, 2010). At the same time, literature on urban biodiversity governance also refers to public procurement as a tool for cities to address biodiversity (e.g. Bulkeley et al., 2021; Puppim de Oliveira et al., 2011; Wilkinson et al., 2013). Puppim de Oliveira et al. (2011) state, "tools like green procurement can help mainstream [the sustainable use of materials] as cities have large purchasing power through their municipal budgets." (p. 1307). Indeed, the ways that cities contribute to the biodiversity problem are often framed in terms of unsustainable consumption and production patters. For instance, the UNCED (1992) states, "in industrialized countries, the consumption patterns of cities are severely stressing the global ecosystem" (p. 45) and in its New Urban Agenda, the UN (2017) address biodiversity and overall environmental sustainability "by promoting sustainable consumption and production patterns" (p. 8). While it is difficult for a city to directly interfere with the consumption of its citizens, the city itself is a big player on the market. Using public procurement, it has the potential to foster more sustainable food production and consumption. This was also reflected in the interviews:

> "One of the most powerful tools we have as a city is public procurement. If we are able to include biodiversity considerations into our food demand, we can have a positive effect on biodiversity." (City representative 1, Copenhagen)

> "Since agriculture is one of the biggest contributors to loss of biodiversity globally, the food we as a city source is a key point to look at because through our demand, we can indirectly affect biodiversity (…)." (City representative 2, Copenhagen)

> "The adjustment of the municipal food procurement system represents the central transformation lever in [the context of biodiversity action], which will have a [positive biodiversity] impact both inside and outside the city boundaries due to the size of Cologne." (City representative, Cologne)

Literature on urban biodiversity governance suggests that addressing biodiversity loss in distant places is challenging for cities. Wilkinson et al. (2013) argues that "a particular challenge related to spatial mismatch concerns how urban areas link to their regional to global sources of [ecosystem services]" (p. 558). Puppim de Oliveira et al. (2011) further state that "many policy makers limit the relationship between their city and biodiversity to the promotion of green areas, which (…) falls short of addressing the impacts of cities on biodiversity beyond their boundaries" (p. 1310). The literature further argues that governance instruments accounting for regional or global biodiversity need to be based on coordination and cooperation between several jurisdictional actors rather than one city alone (e.g. Puppim de Oliveira et al., 2011; Wilkinson et al., 2013). Public procurement instruments have the advantage that they can circumvent the described problem and thus are able to contribute to biodiversity conservation in areas beyond their jurisdiction and control. As many of the instruments applied in public procurement are economic instruments, they use market forces and can be carried out by a city on its own.[10]

[10] The analysis shows however that in public procurement, municipal governments use existing tendering frameworks in cooperation with different actors that are interested in sustainable procurement.

Public procurement can require specific production characteristics or target dietary compositions. The latter relates back to co-benefits between healthy diets, the protein transition, and biodiversity. The former falls into the productionist frame. These instruments place a strong emphasis on organic produce, but particularly Cologne's municipal government also aims to source more food locally and regionally. This is conveyed in Cologne's storyline on regionalisation and can also be found in the food strategies of Lyon, Paris, and Zurich. Mendes and Sonnino (2018) have identified a similar narrative in urban food governance and refer to it as *new localism*. As they explain, "recently, (…) the notion of 'local' is being reconceived beyond municipal boundaries" when before local stood for a focus on urban agriculture and community growing schemes (p. 552). Yet, "although food system localization is a necessary part of a sustainable food strategy, localization and sustainability are not synonymous terms" (Morgan & Sonnino, 2010, p. 212). Because of an assumption that lower food miles are equivalent with a lower carbon footprint of food, local and regional food is perceived as advantageous in terms of climate impact (Morgan & Sonnino, 2010) and consequently, benefits for biodiversity are expected – though this is not necessarily true (see section 4.3.1). However, Puppim de Oliveira et al. (2011) argue that, considering biodiversity, urban agroecological management has the potential to "create spaces for *in situ* conservation by using traditional varieties" and to provide local access to food, also reducing a city's ecological footprint (p. 1308). Beginnings of this are visible in Cologne, where the food council wants to support the growth and marketing of old food varieties and support participatory agricultural growing schemes. The municipal government together with the initiative *Essbare Stadt Köln* further adopted a holistic action plan on how to make Cologne an edible city. These instruments, however, focus on individual food provision rather than food procurement. With regard to public procurement, one interviewee mentioned:

> "During the last years, more and more urban farming initiatives have popped up in Copenhagen, which is great! However, the municipality itself doesn't source from these directly (…) and they are often directed to restaurants or directly B2C." (Interview 2, Copenhagen)

Mendes and Sonnino (2018) make clear that there is a difference between urban agriculture and community growing schemes on one side and regional agriculture on the other side. Nonetheless, the storyline of regionalisation presents both as superior in terms of climate impact compared to food imported from places farther away. Accordingly, many public procurement instruments target an increase of local and regional food. The regionalisation storyline also relates to the creation of regional welfare in economic terms by offering job opportunities and securing turn-over for regional farmers and in societal terms by strengthening the connection between the city and peri-urban areas, as well as its rural hinterland. As several UFSs convey this storyline and the resultantly claim for more local and regional food, it is important to consider how to create synergies between regional food sourcing and biodiversity.

Generally, there is no convincing scientific evidence for environmental benefits of regional production. Basing the demand for more regional food on solely environmental reasons can thus be misleading. The requirement 'regional produce' should therefore not stand alone. By coupling regional food with seasonal produce, the anticipated climate benefit becomes more likely (see section 4.3.1). Also a combination of regional demand with aspects like organic farming or other environmental requirements that can help to conserve biodiversity on and around agricultural land. In these ways, governance instruments can account for the existing doubts concerning the ecological benefits of regional food.

Taking Cologne as an example, this is already happening as several governance instruments not only support regional agriculture but specifically organic regional agriculture.[11] This was also mentioned in the interview with Cologne:

> "In the last few years, there has been a growing number of entrepreneurial initiatives which at local and regional level - also in the Rhineland - actively contribute to the production and processing of high-quality (organic) food in harmony with nature.
>
> (…)
>
> Another aspect of sustainable food policy in the implementation process in Cologne is the increased provision of organic, seasonal and regional food in the city-organised food procurement." (Interview Cologne)

However, the interviewee also explained that the potential of the city to benefit biodiversity outside of the city lies in the "gradual increase of the sustainability of the food system in and around Cologne, which first needs to realise the stronger regionalisation and then the organic transition of the food and agricultural sector" (Interview Cologne). This neglects the lack of evidence concerning a relationship between more regionalisation and environmental benefits.

One interviewee from Copenhagen mentioned that often there is a silo focus on a specific aspect of sustainability:

> "We also need to distance ourselves from this silo focus centring on climate and emissions reduction in food. The tools that we have now to analyse the climate impacts of food do not take into account other important factors like biodiversity needs and conservation. What we need is a more holistic method to be able to take the multifactorial nature of environmental impacts of food into consideration." (Interview 1, Copenhagen)

This suggests that in order to contribute to food sustainability generally and to biodiversity conservation specifically, there is a need for a holistic indicator set for public food procurement that helps cities evaluate food in different dimensions, rather than only focusing on one aspect. This pre-empts the pitfalls of the 'local trap' – as Born and Purcell (2006, p. 195) call the misleading idea that a regional food system is necessarily more sustainable.

5.4.3 Cluster 3: Urban agriculture

The third cluster consists of governance instruments on urban agriculture. Puppim de Oliveira et al. (2011) argue that "urban green areas, such as parks, lawns and urban forests, are the major sources of biodiversity in and around cities" (p. 1308). In this respect, to restore and preserve biodiversity, green spaces in cities need suitable design and management. For instance, fragmented urban green limits positive effects on biodiversity, and instead, it needs more connectivity or larger green corridors (Puppim de Oliveira et al., 2011). This means, that – while transforming sealed area into land for urban agriculture has potential to restore biodiversity in the city – this needs careful planning not only in terms of species composition but also with respect to other green areas in the city. Yet, at the same time, urban agriculture lets people thrive with nature. This positive biodiversity effect can be more

[11] This is the case also for instruments outside of public procurement like the *Biostädte Netzwerk* or the call for more synergies between regional brands and organic certification

easily reached, as interventions, such as community gardens or small patches on streets where food is grown for all citizens, let people experience benefits through nature.

Particularly Cologne offers various examples and even has an action plan on how to increase the availability of edible plants in the city. The latter is considered as one of the most promising governance instruments in the city concerning a sustainable urban food system:

> "The 'Edible City of Cologne' is a successful project in which steps have already been taken towards a more sustainable urban diet. The 'Edible City of Cologne Action Plan' shows possibilities for the preservation and redevelopment of areas in the inner-city and near-urban areas." (Interview Cologne)

In Copenhagen, even though more and more urban farming initiatives developed over the last years (Interview 2, Copenhagen), urban farming currently is not a big focus in the city's work on the food strategy (Interview 1, Copenhagen). The interviewees mentioned two reasons for this, both of which are related to Copenhagen's emphasis on public procurement to deliver a sustainable food system. For one, "the municipality itself doesn't source from [urban farming initiatives] directly as our demand exceeds their production" (interview 2, Copenhagen). Second, there are some EU limitations with regard to tender setting explicit requirements for local food due to the principle of free movement of goods (interview 1, Copenhagen). This shows an understanding of urban agriculture that is rooted in a productionist framing, focusing on the location of where food is produced. This also means that co-benefits for people thriving with nature might go unrecognised.

The welfare frame however is usually present in urban agriculture governance instruments applied in all three cities. This indicates that instruments consider the benefits for well-being and quality of life in the city or for local value creation, all aspects that relate to thriving with nature. Yet, in some instruments the frame is not present, such as the provision of information of the municipality of Cologne on urban agriculture and school gardens. Similarly, the school farm visits organised by Copenhagen's Children and Youth Administration do not use the welfare frame in its online presentation. Even though the latter does not necessarily belong to urban agriculture, these are missed opportunities to emphasise the positive effects that nature can have for people: to learn about food production, to experience where food comes from, or to reconnect with nature. Nevertheless, the list of governance instruments also includes some innovative ways to use urban agriculture to let people thrive with nature, for instance strengthening participatory agriculture in close-to-the-city farms via the edible city in Cologne, or as London's food strategy mentions, the mayor's goal to make urban agriculture part of social prescribing to achieve positive health outcomes.

5.4.4 Cluster 4: Food waste

The last cluster of instruments targets food waste and belongs to the resource efficiency frame. Two different approaches are visible in this cluster of instruments. On the one hand, some instruments aim to avoid food waste in the first place, for instance by using consumer education or training of kitchen staff. On the other hand, some instruments target the proper management and processing of food waste that has already occurred. By reducing the amount of food needed, those instruments can directly and indirectly help to conserve global biodiversity by lessening the adverse biodiversity impacts of industrial food production, and by collecting food waste for renewable energy production or the retrieval of primary resources, avoiding incineration and reducing the carbon footprint of food. In all three cities, governance instruments are in place to educate citizens about food waste. The food waste initiative *Schad dröm* in Cologne, where more than 600 pupils participated, was mentioned as

one of the most successful initiatives for a more sustainable food system in Cologne (Interview Cologne).

Food waste can occur at all stages of the food supply chain. Secondi et al. (2015) found that in the EU, "at individual level (…) people living in towns and large cities tend to produce more [food] waste thus emphasizing the need of diversifying policy interventions at local level according to the extent of urbanization" (p. 25). As urban dwellers tend to be more wasteful, this suggests that interventions concerning food waste on the city level offer potential for addressing biodiversity loss. There are some restrictions concerning the redistribution and use of discarded food items in EU regulations. Governance instruments that raise awareness amongst citizens on food waste can avoid these pitfalls created by hygiene regulations. London's UFS gives another reason to preference avoidance of food waste over redistribution: "We need to avoid surplus food being diverted to people in need being seen as a permanent solution to food poverty. We want to eliminate food poverty, not institutionalise it" (GLA, 2018b, p. 18). Nonetheless, barely any of the instruments concern the redistribution of food waste. Thus, the interpretation of the resource efficiency in the food strategies from a food waste perspective only includes the avoidance and the recycling of food, rather than including all steps of the waste hierarchy. One way to diversify governance instruments in this regard could be a closer alignment with the circular economy. In Copenhagen and London, instruments concerning circular waste management are already part of municipal strategies (see GLA, 2018a; Københavns Kommune, 2019b). Yet, food could be more strongly tied to the circular economy by including more steps of the waste hierarchy into the circular economy strategies for food.

Singh and Beagley (2017) state, that "it is undeniable that urban environments will be the context in which priorities for sustainable development are to be realised" (p. 802). Yet, there is only a limited understanding on how cities can be included in tackling the problem of biodiversity loss (Bulkeley et al., 2021). The four clusters of governance instruments present four opportunities of how cities can intervene in urban food governance that will also have benefits for urban, regional, or global biodiversity.

According to Bulkeley et al. (2021) "given that biodiversity-related actions are likely to be driven primarily by other pressing challenges facing cities (…) ensuring alignment with other Sustainable Development Goals is critical" (P. 7). Similarly, Oke et al. (2021) argue that "biodiversity conservation is often an ad hoc co-benefit of other actions, rather than an explicit strategic priority that is systematically planned across the whole city" (p. 2). A better understanding of these synergies and co-benefits can positively influence cities' interest in biodiversity issues (Puppim de Oliveira et al., 2011). Wiskerke (2015) argues that food can be used as a medium to create such synergies, which "link different urban policy objectives" (p. 18). The four clusters support this. Urban food governance can raise awareness of citizens and educate them about sustainable diets and the environmental impacts of their food choices. The two main points of intervention here – the protein transition and adopting healthier diets – show a great amount of overlap. Because cities usually have strong mandates in the area of public health, a focus on healthy diets seems advantageous as it provides a stronger ground for cities to act. All eleven UFSs consider the aspect of health important often interpret the dietary change frame from a health perspective, especially London and Glasgow. Thus, governance instruments targeting health provide a lot of opportunities for co-benefits for biodiversity conservation. Similarly, instruments targeting urban agriculture not only increase local food supply but

also offer co-benefits for the people involved related to thriving with nature. Cities, in which the food strategy dominantly employs the productionist framing, these co-benefits might be forgotten, even though the governance instruments applied in practice often relate to the welfare frame. Thus, a disconnection between how urban agriculture is interpreted in the dominant discourse compared to how it is applied in practice is visible. Public procurement instruments are an important tool for intervening in food production outside of the city, as particularly Copenhagen's and Berlin's UFSs acknowledge. One misconception in public procurement instruments but also in other governance instruments is the assumption of the 'local trap', which is strong in cities that follow a storyline of regionalisation, i.e. Cologne, Lyon, Paris, and Zurich. This 'local trap' however, can be circumvented by coupling other requirements like seasonality, organic farming, or environmental certifications with the requirement of regionality. This is already done to some extent. Lastly, governance instruments on food waste rarely target the whole waste hierarchy but focus on avoidance and recycling. Even though all food strategies recognised food waste as an important problem, not only from an environmental but also from an economic and moral point of view, the resource efficiency frame has also overall been rather weak across the sample of UFSs. Amsterdam is the major exception in this respect, as its food strategy is partly included in its circular economy strategy. To strengthen a city's work on food waste prevention, redistribution, reuse, and recycling and thus bridging it with the principles of a circular economy, seems promising.

6 Limitations and recommendations for future research

This research is subject to several limitations.

First, a comparison of the eleven food is only to a certain extent possible. While some of the strategies like Paris, Glasgow, Zurich or London are very comprehensive, extending all over 50 pages, Berlin, but particularly Milan's food strategies only gave limited information. This does not necessarily mean that in those cities, food is less important in the urban governance landscape. On the contrary, in the case of Milan, the city is well known for its work on a sustainable urban food system, and it was the main actor of the MUFPP: "In 2014, the Mayor of Milan decided to launch an international protocol aimed at tackling food-related issues at the urban level, to be adopted by as many world cities as possible" (MUFPP, 2020b). Based on the discourse coalition approach, this research assumed that the food strategies institutionalise the storylines of the dominant discourse coalition, however the case of Milan shows that this is not universally true. Moreover, different actors were responsible for the food strategies even though all food strategies were supported by the municipal government. In the three cities analysed, Cologne's strategy was authored by the food council of the city (*Ernährungsrat)*, but the translation into a municipal strategy is still on its way (Stadt Köln, 2020a). In Copenhagen and London, the strategies were authored by appointed food councils as well. In Copenhagen, the strategy however, was signed by the different administrations of the city government, while in London, the Mayor of London is the responsible for implementing the strategy. While also related to time constraints, only analysing the introduction, the conclusion and possible chapter introductions in the food strategies accounted for the differences in length to some extent. In the analysis of the second step, I did not discriminate between already implemented and suggested ideas for governance instruments, which helped to circumvent some of the limitations related to the differences of authority amongst the food strategies.

Second, the governance instrument analysis only looked at the food strategies and the cities' websites as well as instruments mentioned in policy documents, which led to a focus on instruments that the municipal government is involved in, either directly, or by providing some form of support. This however neglected governance instruments that are solely led by civil society or businesses. These instruments are however part of urban food governance. Due to the multiple cases looked at, an exhaustive analysis of the urban food governance landscape of the cities was beyond the scope of this research. The findings in the food waste instrument cluster connected to the resource efficiency frame show why an in-depth analysis of the governance landscape of one city would be interesting for the future. In the governance instruments analysed, food waste prevention and food waste management were dominant but other aspects of the waste hierarchy were missing concerning food waste. Looking at business and society initiatives might show a broader range of stages where food waste is addressed.

Third, the effects on biodiversity of the individual instruments are only of theoretical nature, based on the scientific literature consulted under section 4.3.1. While the literature suggests benefits for biodiversity, I cannot claim this to be true in practice. The governance instruments analysed thus, if used for biodiversity action, need to be evaluated for effectiveness by the cities. For this, biodiversity needs to become a more prominent issue in urban food governance. As one interviewee mentioned:

> "At the moment, the biodiversity challenge is not very present in my work, but it does get so more and more. Now, everyone is talking about climate, the same way that everyone was talking about organic ten years ago. This is what I meant with the silo focus; we often centre on one aspect. I hope that in five years we are talking about biodiversity." (Interview 1, Copenhagen)

This supports that a holistic indicator set, that accounts for different environmental challenges rather than only focusing on one, is a useful tool for cities to evaluate urban food governance instruments. For this, more research similar to the work Jungbluth et al. (2012) conducted is needed.

Fourth, the analysis only included western European cities. The challenges concerning the urban food system here are different compared to other parts of the world. Particularly the question of food security in western societies is usually interpreted differently than in the low-income countries (Morgan, 2015). In the food strategies analysed, food insecurity was interpreted as a lack of access to healthy and high-quality food rather than an insufficient supply of food. Therefore, while the governance instruments did not target food insecurity directly, increasing knowledge about and access to healthy diets or higher quality food like certified or organic products relates to this interpretation of food insecurity. In other socio-economic contexts, this challenge has a different nature (Morgan, 2015). This research explored how biodiversity can be addressed in urban food governance in western European cities, however, the biodiversity challenge is global and transformative potential of cities needs to be harnessed all over the world. Therefore, future research should cover other parts of the world and in particular, looking at the connection between urban food security and biodiversity is important to understand how cities can become active in the biodiversity challenge. To quote Sunderland (2011) again: "biodiversity conservation and food security are two sides of the same coin" (p. 266).

Finally, while food is one of the major resources needed in a city, Singh and Kennedy (2018) identify four other variables as inflows into the city that affect biodiversity loss. Next to food, these are energy, material, and water. Additionally to the need of looking at different geographical contexts, also

research on these other sectors is important. The work of McManamay et al. (2017) is an example for this.

7 Conclusion

Cities are important contributors to global biodiversity loss. Not only the growing urbanisation negatively impacts biodiversity due to the associated land use change, but as centres of resource consumption, cities accelerate biodiversity loss in places far away. This research explored the role that cities can play in addressing the biodiversity problem.

The guiding question therefore was 'how and with what consequences are cities considering biodiversity in urban food governance'? The two-step analysis showed that that there are four different frames concerning the problem definition in urban food strategies in a European context – the productionist frame, the dietary change frame, the resource efficiency frame and the welfare frame. Some of these have been mentioned in similar ways in previous studies on food governance. A consequent analysis of governance instruments that either directly or indirectly show benefits for biodiversity of three European cities with very different storylines in their food strategies, showed the applicability of the frames also in actions that take place in cities to make their food system more sustainable. While biodiversity loss was usually mentioned as one result of an unsustainable food system, the governance instruments barely addressed biodiversity directly. Nonetheless, based on the four frames, different clusters of governance instruments emerged that allow to give some recommendations on how to consider biodiversity action in urban food governance.

The four clusters of governance instruments hereby present four opportunities of how interventions in the urban food system can benefit urban, regional, and global biodiversity. A city can raise awareness of citizens and educate them about sustainable diets and the environmental impacts of their food choices. Here, two main points of intervention are the adoption of more plant-based diets and of healthier diets, which show a great amount of overlap. Because cities usually have strong mandates in the area of public health, a focus on healthy diets seems to be advantageous as it provides a stronger ground for cities to act and also includes a reduction of animal products in our diets. Furthermore, all UFSs analysed consider the aspect of health important and often interpret the dietary change frame accordingly. Thus, governance instruments targeting health offer opportunities for co-benefits for biodiversity conservation. Similarly, instruments targeting urban agriculture not only increase local food supply but have potential for social benefits for the people involved to thrive with nature. In cities that dominantly frame urban food governance using the productionist framing, these co-benefits might be forgotten, even though the look at the governance instruments actually applied, showed a high presence of the welfare frame. Thus, a disconnection between how urban agriculture is interpreted in the dominant discourse compared to how it is applied in practice is possible. Public procurement instruments are an important tool to intervene in food production outside of the city. One fallacy that can be observed in public procurement instruments is the assumption of the 'local trap', which seems to be strong in cities that follow a storyline of regionalisation. This 'local trap' however, can be circumvented by coupling other requirements like seasonality, organic farming, or environmental certifications, with the requirement of regionality. Lastly, governance instruments on food waste rarely target the whole waste hierarchy but focus on avoidance and recycling. The resource efficiency frame has overall been comparatively week across the analysed food strategies. Yet, all strategies recognised food waste as a major problem, not only from an environmental point of view,

but also in economic and particularly moral terms. To strengthen a city's work on food waste avoidance, redistribution, reuse, and recycling thus, bridging it with the principles of a circular economy seems promising.

Literature suggests that it is challenging for cities to address biodiversity loss that takes place beyond their jurisdictional boundaries. However, the analysis here resulted in four governance instruments, three out of which relate to regional and global biodiversity instead of urban biodiversity. The findings therefore support the need for a better recognition of the potential of cities as actors tackling the global biodiversity problem.

8 References

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Annex

The following tables show examples of the coding that I did in the framing analysis in the first step of my research. For each theme, I include examples for the subcodes that I used to code text items. Not every city addressed all of the 28 themes equally.

Table of contents

Code 'Agriculture'

Agriculture	
Amsterdam	• Circular agriculture benefits climate • Nature-inclusive land use benefits climate
Berlin	• n.a.
Brussels	• n.a.
Cologne	• Agricultural intensification led to a loss of species variety and biodiversity • Agriculture needs to compete for land
Copenhagen	• n.a.
Glasgow	• n.a.
London	• n.a.
Lyon	• Foster agro-ecological transition of agricultural production • Industrial agricultural system has environmental, economic, health and social limitations
Milan	• Agricultural land is decreasing • Preserve agricultural land as a component of the city
Paris	• Increase amount of organic agriculture in the region • Need for more diverse regional agriculture
Zurich	• n.a.

Code 'Certified Food'

Certified food	
Amsterdam	• n.a.
Berlin	• Focus on fair trade food
Brussels	• n.a.
Cologne	• Choose certified products for social and ecological benefits • Choose Fairtrade certified food
Copenhagen	• n.a.
Glasgow	• n.a.
London	• n.a.
Lyon	• n.a.
Milan	• n.a.
Paris	• Focus on certified food • Focus on Label Rouge
Zurich	• Focus on fair food • Focus on food with label

Code 'Circular economy'

Circular economy	
Amsterdam	• A circular economy for a better and more beautiful Amsterdam • A circular economy is good for the economy, for the envionment, and for the citizens
Berlin	• n.a.
Brussels	• Circular economy to reduce food waste
Cologne	• n.a.
Copenhagen	• n.a.
Glasgow	• n.a.
London	• n.a.

Lyon	• n.a.
Milan	• n.a.
Paris	• n.a.
Zurich	• n.a.

Code 'Climate'

Climate	
Amsterdam	• Chemical fertiliser, import of feed products and fertiliser has negative climate impact • City wants to become climate neutral
Berlin	• n.a.
Brussels	• Sustainable food system practical response to the challenges of climate change
Cologne	• Our diet impacts our climate
Copenhagen	• Evident link between food systems and climate • Introduction of significant climate focus in food strategy
Glasgow	• Climate emergency needs a change how we think about food
London	• n.a.
Lyon	• n.a.
Milan	• n.a.
Paris	• Mitigate effects of climate change
Zurich	• Impact of food consumption on climate

Code 'Community'

Community	
Amsterdam	• Eating together is a social activity
Berlin	• Neighbourhood and food offer opportunities for social interaction, exchange, and integration
Brussels	• n.a.
Cologne	• n.a.
Copenhagen	• n.a.
Glasgow	• More opportunities for communities to enjoy cooking and growing together
London	• Engaging citizens in community food preparation • Food brings people together
Lyon	• n.a.
Milan	• n.a.
Paris	• n.a.
Zurich	• n.a.

Code 'Culture and food'

Culture and food	
Amsterdam	• The content of someone's plate belongs into his private sphere
Berlin	• n.a.
Brussels	• Food action needs to take cultural aspects of city into consideration • The aim is to introduce a new good food culture
Cologne	• n.a.

Copenhagen	• A more sustainable food system includes a change in dietary habits but must be considerate of cultural context • City encourages new inspiring food initiatives
Glasgow	• Focus on culturally appropriate food
London	• Food is a central part of our cultural life
Lyon	• Develop a local and responsible food culture
Milan	• n.a.
Paris	• n.a.
Zurich	• n.a.

Code 'Economy'

Economy	
Amsterdam	• Food has economic significance • Innovation and good food entrepreneurship constitute revenues that are healthy, social, sustainable and circular
Berlin	• Entrepreneural innovation for food distribution is growing • Entrepreneural innovation for more regionality and sustainablility has social and ecological benefits
Brussels	• Current consumption model has negative economic effects on a local and global level • Development of a more sustainable local food system offers potential for economy and job creation
Cologne	• Alternative distribution models can support regional farmers • Demand for regional, seasonal, and organic products can be increased by local HORECA
Copenhagen	• City must support a sustainable food industry in and around the city
Glasgow	• A thriving local food economy which promotes fair work and principles of sustainability • Local food businesses support local people through employment
London	• A local food economy that is skilled and profitable • Focus on food that promotes decent working conditions
Lyon	• Connect local economy and sustainable diets • Need for a change in production model
Milan	• New forms of production, distribution and consumption to stimulate access to healthy food for everybody • Support innovation in the agri-food sector
Paris	• Innovation in food business • Local food economy
Zurich	• Good working conditions for people emplyoed in the food sector • New innovative production and distribution models

Code 'Education'

Education	
Amsterdam	• City stimulates nature education • Education on sustainable nutrition important
Berlin	• Focus on food literacy • Food and health education for responsible consumers
Brussels	• Focus on food literacy • Raise awareness about sustainable food
Cologne	• Edible city for food literacy • Food literacy to be able to eat independently, healthily, and responsibly
Copenhagen	• Cooking contributes to food literacy

	• Focus on promoting food literacy
Glasgow	• Increase understanding of the food system with regard to nutrition and sustainability
London	• Food education important to help citizens eat better at home
Lyon	• Education about healthy and sustainable food
Milan	• Education for preventin obesity and other health risks related to diet • Education important to support and promote food culture
Paris	• Focus on food education
Zurich	• Citizens know how they can contribute to a sustainable food system • Further education for individuals working with food or education on sustainable food

Code 'Emissions'

Emissions	
Amsterdam	• Circular economy contributes to emission reduction of global CO2 • Focus on reducing CO2 emissions
Berlin	• n.a.
Brussels	• n.a.
Cologne	• n.a.
Copenhagen	• Cool Food Pledge • Food consumption represents 25% of overall carbon footprint
Glasgow	• Food system produces large amount of GHG emissions • Reduce GHG emissions from food system
London	• Food sector emits GHG emissions • GHG emissions from food production contribute to city's poor air quality
Lyon	• Importation of food products biggest contribution to GHG emissions • Large amount of GHG emissions due to food consumption in city
Milan	• Food has large carbon footprint
Paris	• Become carbon-neutral • Food produces large carbon footprint
Zurich	• High emissions caused by food sector

Code 'Environment'

Environment	
Amsterdam	• A good life for everyone needs to be in the Earth's natural boundaries • Become a modern, thriving, inclusive city within planetary boundaries
Berlin	• n.a.
Brussels	• Current consumption model has negative environmental effects on a local and global level • Focus on effective food system from an environmental perspective
Cologne	• Good for the world - food consumption in city preserves resources of the world
Copenhagen	• Health inequalities between more and less prosperous citizens • Reduce health inequalities
Glasgow	• City aims for an environmentally sustainable food system • Mutual influence of food system and environment
London	• Food affects the environment • Food has impact on soils, biodiversity, and water quality
Lyon	• Food system affects environment in form of climate, soils, water, and biodiversity • Natural ressource preservation through food transition
Milan	• n.a.
Paris	• Food choice has environmental impact

	• High economic costs of environmental impacts
Zurich	• Impact of food consumption on environment • Priority of efficient ressource use

Code 'Fairness'

Fairness	
Amsterdam	• Circular economy provide opportunity for social justice • Consumption here influences prosperity elsewhere
Berlin	• Focus on fairness
Brussels	• n.a.
Cologne	• Higher socio-economic status associated with presence of sustainable consumption decisions • Lower socio-economic status associated with absence of sustainable consumption decisions
Copenhagen	• n.a.
Glasgow	• City aims for a fair food system • Health inequalities for children
London	• Link between deprivation and the number of takeaways in an area • Poverty and inequality limit people to eat well at home
Lyon	• Fair renumeration of professionals in the food business
Milan	• n.a.
Paris	• Reduce food inequalities for quartiers prioritaires • Vision of a juster food system
Zurich	• Focus on ethically responsible produced food

Code 'Food and waste'

Food and waste	
Amsterdam	• Fight food waste in households, hotels, restaurants • Focus on high-quality processing of organic waste
Berlin	• Focus on reducing food waste
Brussels	• Fight food waste • Focus on food waste reduction
Cologne	• Amount of food packaging is currently increasing • Choose packaging free food
Copenhagen	• Direct positive climate change outcome of limiting food waste • Focus on food waste reduction
Glasgow	• Food waste is an economic and environmental problem • Increase redistribution of surplus food
London	• Increase recycling rates of organic waste • Reduce food waste
Lyon	• Reduce food waste
Milan	• Food waste as environmental, social, and economic problem • Recycle food waste
Paris	• Food is wasted even though food insecurity exists • Recycling of food waste
Zurich	• Increase recycling • Reduce food packaging

Code 'food logistics'

Food logistics	
Amsterdam	• Focus on short food chains

	• High import and export rates of food
Berlin	• n.a.
Brussels	• Short supply chains for environmental and social improvements
Cologne	• climate-neutral transport of food • Feed and meat products are often imported from outside Europe
Copenhagen	• n.a.
Glasgow	• Climate emergency has pushed the need to reduce food miles up the agenda • Imported food continues to be an important component of our diet and should include consideration of sustainability and fair trade principles
London	• Need for a more efficient and consolidated transport network
Lyon	• Cities dependent on places for away for food production • Develop new capacities for production with short food chains
Milan	• n.a.
Paris	• Develop food logistics of proximity and short supply chains • Develop food logistics that benefit small regional producers
Zurich	• Food distribution via short food miles • Food logistics affect environment

Code 'Food quality

Food quality	
Amsterdam	• n.a.
Berlin	• n.a.
Brussels	• Focus on good quality food • Food associated with pleasure and well-being
Cologne	• n.a.
Copenhagen	• Cooking from scratch results in higher culinary quality and is greener and more climate-friendly • Focus on taste, quality, and food appreciation
Glasgow	• Focus on tasty food
London	• n.a.
Lyon	• Focus on high quality food
Milan	• n.a.
Paris	• n.a.
Zurich	• n.a.

Code 'Food safety'

Food safety	
Amsterdam	• n.a.
Berlin	• n.a.
Brussels	• n.a.
Cologne	• n.a.
Copenhagen	• n.a.
Glasgow	• n.a.
London	• Focus on food safety
Lyon	• n.a.
Milan	• n.a.
Paris	• n.a.
Zurich	• Focus on safe food

Code 'Food security'

Food security	
Amsterdam	• City needs to ensure access to healthy and affordable food
Berlin	• n.a.
Brussels	• Access to good quality, healthy, balanced, and sufficient food limited by poverty • Every citizen has access to good food
Cologne	• Lack of access to healthy and fresh food can have negative health effects
Copenhagen	• Fewer undernourished and malnourished residents in the city
Glasgow	• Focus on affordable food • Improve access to healthy affordable food
London	• Access to healthy, affordable, sustainable food for all citizens • Focus on food that is fair, inclusive and accessible for everyone
Lyon	• Access to healthy and sustainable food • Access to high quality food
Milan	• Access to healthy food and sufficient drinking water for all • Access to quantitatively and qualitatively adequate food
Paris	• Access to a high quality diet • Access to sustainable, healthy, local, environmentally sound, and affordable food for all
Zurich	• Everyone should be able to afford healthy food • Focus on access to food

Code 'Health'

Health	
Amsterdam	• Current food system has negative health effect • Encourage healthy food consumption by citizens
Berlin	• Focus on healthy food • Transparency of ingredients in convenience products important
Brussels	• Current consumption model has negative health effects on a local and global level • Focus on healthy food
Cologne	• Healthy food for all • Our diet impacts our health
Copenhagen	• A greener diet will have a positive effect on health • Climate action in food must take nutritional requirements into account
Glasgow	• Better health through improved food environment • Breastfeeding best for long-term health for children and mother
London	• Focus on healthy food • Focus on healthy, nutritious food for all cultures and needs
Lyon	• Focus on healthy food
Milan	• Inadequate diet can lead to obesity and related diseases • Obesity as a health risk factor and economic problem
Paris	• Food choice has health impacts • Reduce obesity
Zurich	• Focus on healthy food • Food is an important factor for health

Code 'Locality Regionality'

Locality Regionality	
Amsterdam	• Focus on increasing consumption of regional products • Focus on regional food production and distribution
Berlin	• Demand for conventional and organic food from the region is growing

	• Demand for regional produce exceeds supply, particularly for organic food
Brussels	• Connecting the city with its hinterland • Focus on locally-sourced food
Cologne	• Choose regionally produced food • Decreasing number of regional food processing businesses limits supply of regional products
Copenhagen	• City wants to be closely interlinked with its regional food system • Focus on local food system
Glasgow	• City needs to grow and source more food locally • Demand for local food economy driven by personal food choices and public procurement
London	• Focus on regional food that meets higher ethical and environmental standards • Increase demand for local food producers through public procurement
Lyon	• A stronger focus on a local food system has economic benefits and is transparent • Focus on local food
Milan	• Connect city and the rural region around • Local, sustainable food system creates benefits for local economy, the environment, and the overall resilience of the city
Paris	• Focus on regional food products • Link urban and rural spheres
Zurich	• Better direct marketing of regional products • Better regional cooperation in the food system

Code 'Organic food'

Organic food	
Amsterdam	• n.a.
Berlin	• Focus on organic food • Organic agriculture benefits environmental and climate protection
Brussels	• n.a.
Cologne	• Choose organic food • Organic markets offer organic (regional) food supply for citizens
Copenhagen	• Objective of 90% organic food in public meals • Organic food products provide a broad perspective on sustainability (helps to preserve biodiversity, protect groundwater, increase animal welfare)
Glasgow	• Increase local organic food production • Organic food can be too expensive
London	• n.a.
Lyon	• n.a.
Milan	• n.a.
Paris	• Focus on organic food
Zurich	• n.a.

Code 'Plant-based diet'

Plant-based diet	
Amsterdam	• Choice for vegetable proteins good for animal welfare, less CO2 emissions, and better health • Encourage plant-based food consumption by citizens
Berlin	• n.a.
Brussels	• n.a.
Cologne	• Choose vegetarian or vegan food • Reduce meat consumption to reduce imports from outside Europe
Copenhagen	• Increase plant-based food in public meals

	• Substitute meat with other protein sources, particularly plant-based ones
Glasgow	• n.a.
London	• Focus on plant-based foods as planet-friendly
Lyon	• Focus on less meet and milk products, more plant-based food • Focus on plant-based food good for resilience of the region
Milan	• n.a.
Paris	• More flexitarian diets due to their favourable impact on the environment • More vegetarian meals
Zurich	• Plant-based diet can involve health risks or lower food enjoyment • Reduce meat consumption

Code 'Public procurement'

Public procurement	
Amsterdam	• n.a.
Berlin	• Legal restrictions and lack of knowledge limit opportunities for public procurement • Public procurement acknowledges dietary needs for different age groups
Brussels	• n.a.
Cologne	• Adjust public food procurement • Lack of healthy, regional, and organic food in kindergartens
Copenhagen	• Almost 90% of the food served in public meals is organic • City works on improving nutritional value, quality, and taste in public procurement
Glasgow	• Procurement policy provides opportunities for local and organic suppliers
London	• Food procurement can boost the local economy, provide healthy meals, and support environmentally-sound food production • Improve food procurement for communities
Lyon	• Transition of public food procurement towards sustainable diets
Milan	• n.a.
Paris	• Public food procurement to increase demand for sustainable food
Zurich	• Provide balanced diet with regards to food pyramide in public procurement • Public procurement important lever for sustainable food transition

Code 'Resilience'

Resilience	
Amsterdam	• n.a.
Berlin	• n.a.
Brussels	• n.a.
Cologne	• n.a.
Copenhagen	• City aims for a resilient food system
Glasgow	• n.a.
London	• Increasing the amount of local, sustainable food can play a key role in reducing vulnerability to future shocks • Need for a more resilient food system
Lyon	• n.a.
Milan	• n.a.
Paris	• Urban food system fragile due to dependency on territories far away and fossil fuels • Vision of resilient food system
Zurich	• n.a.

Code 'Responsibility'

Responsibility	
Amsterdam	• Citizens and businesses have to make more sustainable choices and the city can help • Citizens need to break old habits and change the way they think and act
Berlin	• Public authorities function as role models • Responsibility of consumers to reflect about their consumption behaviour
Brussels	• Local authorities act as role model in the deployment of a more sustainable food system
Cologne	• Adjust food system along the whole supply chain, from farm til fork • Educational institutions responsible to teach food literacy
Copenhagen	• City must lead the way and change how food products are produced today • Food important in a climate-responsible city
Glasgow	• Together we can create a better, fairer, healthier, more resilient and more sustainable food system
London	• Citizens can reduce the impact of their food consumption by making changes to what they eat • Community centres play an important role for food security, social integration, healthy food habits
Lyon	• n.a.
Milan	• n.a.
Paris	• n.a.
Zurich	• Responsibility of the city to foster environmentally friendly diet and to inform about dietary impact on the climate • The city acts consequently and transparently as a role model

Code 'Seasonality'

Seasonality	
Amsterdam	• n.a.
Berlin	• Focus on seasonal food
Brussels	• n.a.
Cologne	• n.a.
Copenhagen	• Focus on more seasonal food
Glasgow	• n.a.
London	• Focus on seasonal food
Lyon	• n.a.
Milan	• n.a.
Paris	• n.a.
Zurich	• Focus on seasonal food

Code 'Societal aspects'

Societal aspects	
Amsterdam	• Desire of broad prosperity where good life measures go beyond material wealth • Focus on animal welfare
Berlin	• Food is a cross-cutting issue • Foster social contribution of food to neighbourhoods
Brussels	• Current consumption model has negative social effects on a local and global level
Cologne	• Dietary transition for a sustainable fair, resilient, effective, and ecologic regional food system • Lack of transparency in supermarkets about origin of food products
Copenhagen	• Focus on strengthening social communities

	• Importance of participation of citizens in public food supply
Glasgow	• Focus on food that is good for animal welfare • Focus on food that is good for those involved in growing, making and selling it
London	• Focus on food that considers animal welfare • Food connects everything we do as a society
Lyon	• n.a.
Milan	• n.a.
Paris	• Food choices have societal impacts
Zurich	• Animal welfare requirements often increase the climate impact of meat • High relevance of food for society

Code 'Sustainability'

Sustainability	
Amsterdam	• Encourage sustainable food consumption by citizens • Focus on sustainable food consumption
Berlin	• Focus on sustainability
Brussels	• A more sustainable food system produces better and eats well • Focus on environmentally friendly products
Cologne	• Sustainable food can be certified, non-consumption, vegetarian, vegan, regional, organic, fair trade certified or packaging free products
Copenhagen	• Focus on climate-friendly food • Focus on food that is good for the environment
Glasgow	• Demand of sustainable food should help drive an increase in supply • Focus on food that is food for the planet
London	• Focus on good food for the environment • Promote more sustainable food choices and eating behaviours
Lyon	• Focus on sustainable food • Towards a more sustainable, inclusive and resilient food system
Milan	• Promote the sustainability of the food system including local production, and fresh and seasonal quality food
Paris	• Organic, local and seasonal food are considered sustainable • Sustainable food - from global to local
Zurich	• Avoiding questionable production models, heated greenhouses, and flight transports reduces envrionmental impact of food • City environment supportive of a transition towards a more sustinable food system

Code 'Urban agriculture'

Urban agriculture	
Amsterdam	• City adds edible green spaces • City stimulates citizens to take up urban agriculture
Berlin	• Land competition in the city for green spaces • Urban productive green has important educational functions
Brussels	• City provides access to land for local food production • Urban agriculture encourages the development of natural areas
Cologne	• Edible city to produce food • Focus on urban agriculture
Copenhagen	• Urban agriculture will contribute to status as a food city
Glasgow	• City has enough vacant land for urban growing spaces • Food growing in the city benefits personal wellbeing, the local economy, reduces carbon emissions, and increases biodiversity
London	• Good food growing, community gardens and urban farming

	• Promote the multiple benefits of food growing for individuals and communities
Lyon	• n.a.
Milan	• n.a.
Paris	• Increase urban agriculture
Zurich	• Better use of green areas for urban agriculture • Provision of room for urban food production

Code 'Water'

Water	
Amsterdam	• n.a.
Berlin	• n.a.
Brussels	• n.a.
Cologne	• n.a.
Copenhagen	• n.a.
Glasgow	• n.a.
London	• Free drinking water for budget and health
Lyon	• n.a.
Milan	• Sustainability of urban water system
Paris	• n.a.
Zurich	• n.a.