Alma Mater Studiorum – Università di Bologna

DOTTORATO DI RICERCA IN

SCIENZE E TECNOLOGIE AGRARIE, AMBIENTALI E ALIMENTARI.

Ciclo 33

Settore Concorsuale: 07/A1 – ECONOMIA AGRARIA ED ESTIMO RURALE

Settore Scientifico Disciplinare: AGR/01 – ECONOMIA ED ESTIMO RURALE

THE ROLE OF URBAN AGRICULTURE IN URBAN ORGANIC WASTE COMPOSTING AND HOUSEHOLD WASTE MANAGEMENT HABITS: THE CASE OF FLORIANÓPOLIS, BRAZIL

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Esame finale anno 2021

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List of abbreviations

UA Urban Agriculture

OW Organic Waste

FCL Florianópolis Composting Law

MSW Municipal Solid Waste

UAP Urban Agriculture Participants

UFSC Universidade Federal de Santa Catarina (Santa Catarina Federal University)

RDB Revolução dos Baldinhos (Revolution of Buckets)

PEV Ponto de Entrega Voluntaria (Voluntary Collecting Point)

LCA Latent Class Analysis

Thesis Abstract: The future of urban sustainability is affected by the consequences of the urban population growth. This growth is partially driven by migration from rural areas. The rural-to-urban migration is linked to a series of economic, cultural and environmental factors. The consequences are affecting mainly the most vulnerable parts of the new urban societies. The most perceived negative externalities of this migratory trend are affecting food security and Municipal Solid Waste (MSW) management thus affecting the social, environmental and economic dimensions of urban sustainability. To this end innovative approaches have been developed in the last decades in order to tackle the challenges related to food security and waste management. Local governments and international institutions are promoting new forms of food provision that support fragile communities' food security and their socio-cultural empowerment. One important strategy is represented by Urban Agriculture (UA). UA definition encompasses all those agrarian activities developed in an urban or peri-urban context. Beside supporting communities' food security, UA meets several Sustainable Development Goals related to: urban sustainable development, zero hunger, education, health, gender equity, economic development and biodiversity. Furthermore, literature shows that UA could support the management of Organic Wastes (OW) produced in household, food markets and along the food chain. OW represents the heaviest and generally represents 30% of Municipal Solid Waste in many contexts. Its valorization through UA has been considered both from local governments and scholars. The mutual relationship between UA and OW treatment through composting systems brings several benefits from the point of view of: i) safe and controlled waste management systems; ii) reduction of health and environmental issues related to uncontrolled OW management; iii) high quality fertilizers for UA; iv) proximity advantages due to the shorter distance between OW treatment sites and UA; v) production of fresh and accessible food; vi) reduction of potential contaminations due to the use of chemical fertilizers in densely populated areas. Even though literature reports the several benefits derived from the relation between UA and OW, little has been discussed on how these aspects are related from a socio-cultural perspective. Literature suggests that beside the waste valorization the OW/UA relation, is also reflected in citizens' waste management habits. Furthermore, municipalities like Florianópolis in Brazil, are trying to promote new strategies of OW valorization through UA. To this end the present thesis aims at addressing two main aspects related to: i) the urban stakeholders' acceptance of the new Florianópolis Composting Law (FCL) that support OW valorization through UA; ii) assessing the influence of UA participation on citizens' household waste management habits. The first aspect that needed to be addressed was the development of an analytical framework enabling to assess: UA stakeholders and UA participants' drivers. To this end a literature review was performed analyzing the main methodological approaches used to address these aspects of UA. Consequently, an empirical analysis of the urban stakeholders' acceptance of the new FCL was implemented through semi-structured interviews. Finally, an

analysis of the differences in waste management habits between UA Participants (UAP) and the other citizens was conducted through a survey. The results showed that the FCL can potentially satisfy several aspects related to the correct OW disposal and UA soil fertility issues. On the other hand, it needs a substantial mind-set change in many urban stakeholders and this aspect can potentially hinder the FCL successful implementation. The analysis of the survey data showed that UAP are more likely to separate their OW from other wastes and self-treat their OW in their household. From the results two main conclusion have been drawn up: i) a decentralized OW management model like the one proposed in the FCL, in addition to having several environmental and social benefits, can significantly contribute to fragile communities' empowerment; ii) The contribution of UA to OW management emerged both from a citizens' awareness perspective and a public MSW system workload reduction. Finally, the FCL model could be an example of good practices for other cities in the Latin American area where UA is becoming particularly relevant and recognized at the institutional level. Thus the affirmation of these MSW management models could lead to a rethinking of the current "food consumption/waste production scheme" towards a more circular and sustainable approach.

1) Introduction

Increasing urbanization represents one of the main challenges local government and international institutions will face in the near future. The effects of migration from rural to urban areas will be perceived particularly in vulnerable contexts (Gianquinto & Tei, 2010; Drescher, 2004). Urban overpopulation involves a series of negative consequences, such as the growth of food insecurity, urban poverty and an increased unemployment rate (Gianquinto et al., 2007; Orsini et al, 2013). The poorest strata of the urban population have limited access to food markets and can spend up to 75% of their income on food provision without achieving sufficient contributions in terms of food quality and quantity (Drescher, 2004). Food provision systems such as urban agriculture (UA) contribute to fostering independence from mainstream food markets through self-production, direct consumption and alternative markets, consequently increasing communities' resilience and food security (Mougeot, 2000; Deelstra & Girardet, 2000). UA has been defined as an activity that

> "grows or raises, processes and distributes a diversity of food and non-food products, re-using largely human and material resources […] found in and around that urban area, and in turn supplying human and material resources, products and services largely to that urban area" (Mougeot, 2000: 11).

UA has gained relevance in the recent years and its role has been recognized at the international level through several initiatives directly involving UA in the urban development (Azunre et al., 2019). Its contribution to urban sustainability has been recognized both in the literature and in the political agenda (De Bon et al., 2010, Azunre et al., 2019). Thanks to its multifunctional approach UA can be adapted to urban contexts in order to fulfil several sustainability goals (Pearson at al., 2010).

1.1 UA and urban sustainable development

Considering the role that urban settlements will play in the next decades, literature focused the attention on the UA impact on urban sustainability. The concept of urban sustainability is related to urban "stakeholders' actions, infrastructure, strategies and policies" and to "the integrated management of all these [aspects]" in order "to reach a certain level of self-sufficiency and long-term continuity." (Vásquez-Moreno & A Córdova, 2013: 204). A sustainable city should also aim at "improve and increase the required resources for the functioning of the environmental, economic and social subsystems" (Vásquez-Moreno & A Córdova, 2013: 205).

The urban environmental subsystem refers to the management of the urban natural resources without threatening their quality and quantity for the future generations (Goodland, 1995). This means that "waste emissions from an action…should be kept within the assimilative capacity of the local environment" (Goodland, 1995: 10). From this perspective UA is associated with a series of environmental benefits reported in the literature (Pearson et al., 2010). UA activities supports several Ecosystem Services like carbon sequestration, wastewater recycling and waste recycling (Vásquez-Moreno & A Córdova, 2013).

From an economic sustainability perspective UA contribution is associated to its capacity to generate income and employment (Vásquez-Moreno & A Córdova, 2013). Furthermore, UA can potentially reduce food costs thanks to its markets proximity (von Thünen, 1966). The markets' spatial proximity represents an opportunity for UA to reduce food transport and conservation costs of highly perishable

products (Vásquez-Moreno & A Córdova, 2013). This can potentially increase UA products competitiveness (von Thünen, 1966). The spatial economics approach also shows that proximity to an urban centre supports UA activities diversification (Alonso, 2017; Pölling et al., 2016). Urban and peri-urban agriculture activities often include other services such as leisure, education, tourism (Simon-Rojo et al., 2016). It is worth mentioning that the scarcity of urban land can generate a fierce competition for its access. UA activities on the ground competes with other commercial activities such as malls, housing and commercial uses (Specht et al., 2016b). Furthermore, UA activities on rooftops competes with other uses supposed to be more profitable such as energy production through solar panel (*ibidem*).

Social sustainability is described as "the factors that influence social relationships, from social norms to education, nourishment, employment, housing and security, all related to the satisfaction of basic human needs" (Vásquez-Moreno & A Córdova, 2013: 205). UA contributes to social sustainability through several benefits such as food security, psychological and physical health, gender equity, community building, environmental education, awareness on food production and personal skills (Pearson et al., 2010).

1.2 Theoretical Background

1.2.1 The concept of Metabolic Rift

Further UA aspects supporting urban sustainability are related to the distances reduction between urban society and food production. This aspect is encompassed in the concept of metabolic rift (McClintock, 2010). Metabolic rift is a concept belonging to environmental sociology inherited from Karl Marx's work; it can be described as the "disruption of traditional forms of exchange between humans and nature (e.g., through agriculture and other forms of resource extraction and use) through which people secured their social reproduction." (Dehane et al, 2016: 174).

The industrialization process separated food production and consumption, affecting its ecological cycles and the society awareness on its eating habits (Dehane et al, 2016; McClintock, 2010). The consequences of this process are affecting the urban metabolism and increase an unbalanced food access in terms of quality and quantity among different society groups (Dehane et al, 2016). Different functions of UA emerge when adopting the metabolic rift approach. McClintock (2010) contributes to this analysis by focusing on three interdependent dimensions of metabolic rift: *individual rift, social rift* and *ecological rift* (McClintock, 2010).

i) Individual rift

The concept of individual rift can be described as the process of "alienation" from labor and nature. In this perspective UA attempts to overcome individual rift by engaging individuals in the food production and its natural cycle. According to McClintock "By physically laboring the soil, sowing seeds, cultivating, harvesting, and preparing food, UA mends individual rift by reengaging individuals with their own metabolism of the natural environment." (McClintock, 2010: 201).

ii) Social rift

The social rift is referred to the relationship between the agri-food system and society (McClintock, 2010). It is mainly the result of a commodification process that affected land cultivation and food

production. The commodification of land can be summarized by the concept of "land grabbing" through which rural land is taken from communal or individual property forcing farmers to move in urban areas thus disrupting the link between the farmers' labor and food production (McClintock, 2010). UA development in developing countries is often a farmers' resilient response to land grabbing. Rural migrants have to protect themselves from the "socio-economic upheaval of dispossession from their land and from the lack of formal employment opportunities" (McClintock, 2010: 196). From this perspective, small-scale farms, often located in informal abandoned urban spaces, represent the only opportunity to access food and generate income through the surplus production. While in vulnerable contexts UA represents a resilient and adaptive strategy to living in an urban environment, in other contexts UA contributes to the de-commodification of food production (McClintock, 2010; Camps-Calvet et al., 2015).

iii) Ecological rift

It refers to the interdependence between human subsistence and natural resource exploitation. The capitalistic production led to an over-exploitation of the agricultural lands causing ecological and soil fertility crisis (McClintock, 2010). With reference to the work of Clark & York (Clark & York, 2008) McClintock affirms that, as a consequence, the capitalistic expansion led to a displacement of the food production resources' (fertilizers, fuel, seeds). From this perspective UA can mend the ecological rift by promoting the use of local fertilizers produced from urban OW. Urban farmers could use organic fertilizer to tackle their limited access to synthetic fertilizers. Cuba regained food sovereignty, after the collapse of the Soviet Union, thanks to the development of the Urban Agriculture Programme and "organoponico" systems, consisting in cultivations on a bed of organic material derived from OW (FAO, 2014). Urban agriculture can thus be a way to repair the ecological rift by rescaling the production system towards a local level (McClintock, 2010).

1.2.2 UA and Waste management

Following McClintock, the rift in the urban metabolism nutrient cycle could be filled through a closer relation between food production and waste valorization. Literature suggests that moving the food production towards the cities through urban and peri-urban agriculture could lead to a circular management of the urban Organic Waste (OW) (Deelstra & Girardet, 2000).

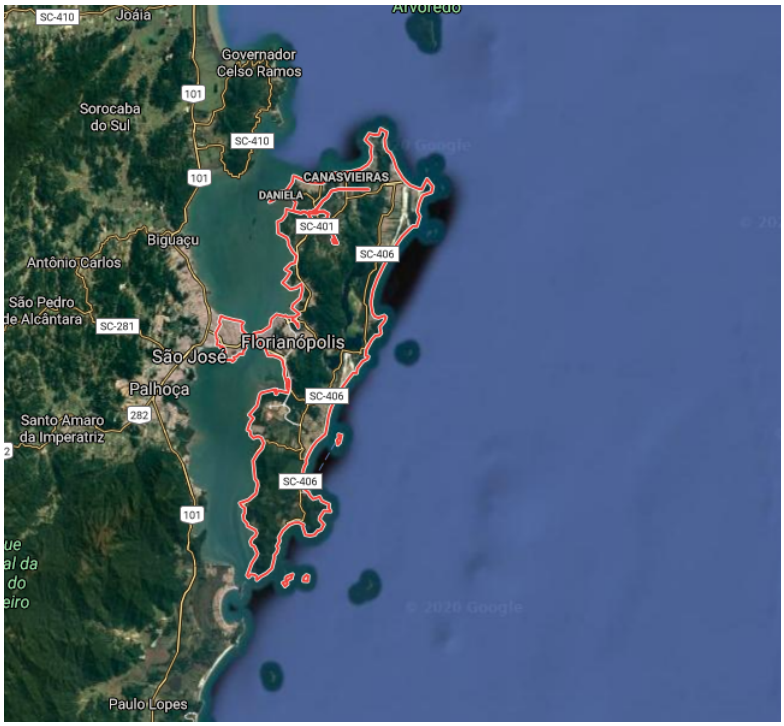
The Municipal Organic Waste represents the larger waste fraction in terms of weight in many contexts (Cofie et al., 2006). Inadequate waste disposal is responsible for uncontrolled Green House Gases emissions and water contamination risks (Struk, 2017; Ulm at al., 2019). On the other hand, one of the main UA limitation relies on the limited access to fertilizers and on the risks related to the use of chemical fertilizers in densely populated areas (Bougnom et al., 2014; Van Veenhuizen, 2014). A possible solution to OW management and urban soil fertility issues lies in composting urban OW (Ulm et al., 2019, Shrestha et al., 2020). Literature shows that OW composting could produce high quality fertilizers from nearby sources (*ibidem*). Furthermore, case studies show that transforming OW in fertilizers through composting procedures and the use of the derived fertilizer in UA, is an aspect that is being considered by the municipalities (Danso et al., 2002; Bahers & Giacché, 2019; Weidner & Yang, 2020). Literature reports that OW compost valorization through UA provides a series of benefits linked to food security and waste management in terms of: access to fresh food, carbon emission, reduced risks of water and soil contamination, food security, savings on municipal budgets and citizens' health (Weidner & Yang, 2020; Mohareb et al., 2017, Bahers & Giacché, 2019).

Even though literature addresses the role of UA in valorizing the urban OW, little has been discussed on how UA can also affect citizens' household waste management habits (Bahers & Giacché, 2019; Weidner & Yang, 2020). Literature suggests that UA/OW relationship goes beyond the simple waste valorization and it reflects on citizens' habits and beliefs (Bahers & Giacché, 2019). On the other hand this relation has not been adequately explored in literature and further research should focus on how these two activities are affecting urban society (*ibidem*). Thus, the need of assessing how UA is influencing and supporting OW management systems both in terms of waste valorization and citizens' habits, emerged.

1.3 The UA/OW relation in the context of Florianópolis, Brazil.

The Brazilian city of Florianópolis is the Santa Catarina's State Capital. The total population of 508.826 citizens is widespread on a 674,844 km² area distributed in a continental area (3% of the territory) and less densely populated insular area characterized by hills and rural areas (97% of the territory) (IBGE, 2020; Yigitcanlar, 2018).

Figure 1.1: Florianópolis territory.
Source: Google ©2020



The city of Florianópolis is one of the first Brazilian capitals to recognize the role of UA through the approval in 2018 of a Municipal Program of Urban Agriculture. The program provides technical support, ensure a role in local markets and recognizes the role of the UA in organic waste management and environmental education (Law, 17688/17).

Furthermore, the link between Urban Agriculture and Organic Waste (OW) management emerged in the city's policy agenda. This relation has been carried out in the latest 30 years through several experiences developed both from bottom-up initiatives and government initiatives. The first OW management initiative started in 1986 and is named "Programa Beija-Flor"; its objective is to support the composting services including those implemented in Community gardens (Bagnati & de Abreu, 2015). The most known project of OW valorization through UA is called the Revolução dos Baldinhos (RDB). This project started in a marginal neighborhood and focused on the community composting of OW in order to reuse the compost as fertilizer for local UA initiatives. The project was conceived in 2009 in collaboration with the University of Santa Catarina to deal with an emergency linked to the transmission of diseases (Abreu & Rover, 2013).

The great challenge of the RDB is to develop this project also in other areas of the city and in other urban contexts of Brazil. For this purpose, the UA, thanks to its ability to support environmental education and community building, could be an effective tool for raising awareness among citizens towards a more responsible household OW management (Abreu & Rover, 2013). The RDB had a huge impact on both the community well-being and its method has been introduced in other Brazilian cities (Abreu & Rover, 2013). The implication of this type of projects are important in Latin American context where there is still a lack of correct Municipal Solid Waste disposal (Struk, 2017). Furthermore, the recent survey on the Florianópolis vegetable gardens reveal the existence of more than 100 vegetable garden in the territory all with an OW composting yard used by the garden's users as well as other residents (Floripamanha, 2019). It is also worth mentioning that together with the more institutionalized and recognizable OW management initiatives, thousands of citizens are independently treating their OW in their household often supported by initiatives like "*Minhoca na Cabeça*" (Earthworm in your head). This program provided 500 composting kits that could easily fit in a household environment (Prefeitura de Florianópolis, 2018).

This cultural and historical background has been institutionalized in the recent years through two main initiatives:

1) The development of the composting method called "UFSC method" through the university. This method was developed in 1994 by the professor Riki Miller. It is the method used for composting OW in the city of Florianópolis and guidelines for its use have been developed in order to guarantee the users' safety as well as good quality compost for UA (FAPESC, 2017).

2) The 2019 Florianópolis Composting Law (FCL) on OW management that is the first policy on OW mandatory composting ever approved in a Brazilian capital. The law enforces the mandatory collection and compost of OW by supporting institutionalized collection through public and private companies and gives empowerment to community and domestic composting activities in order to provide high quality compost for UA (Law 10501/19)

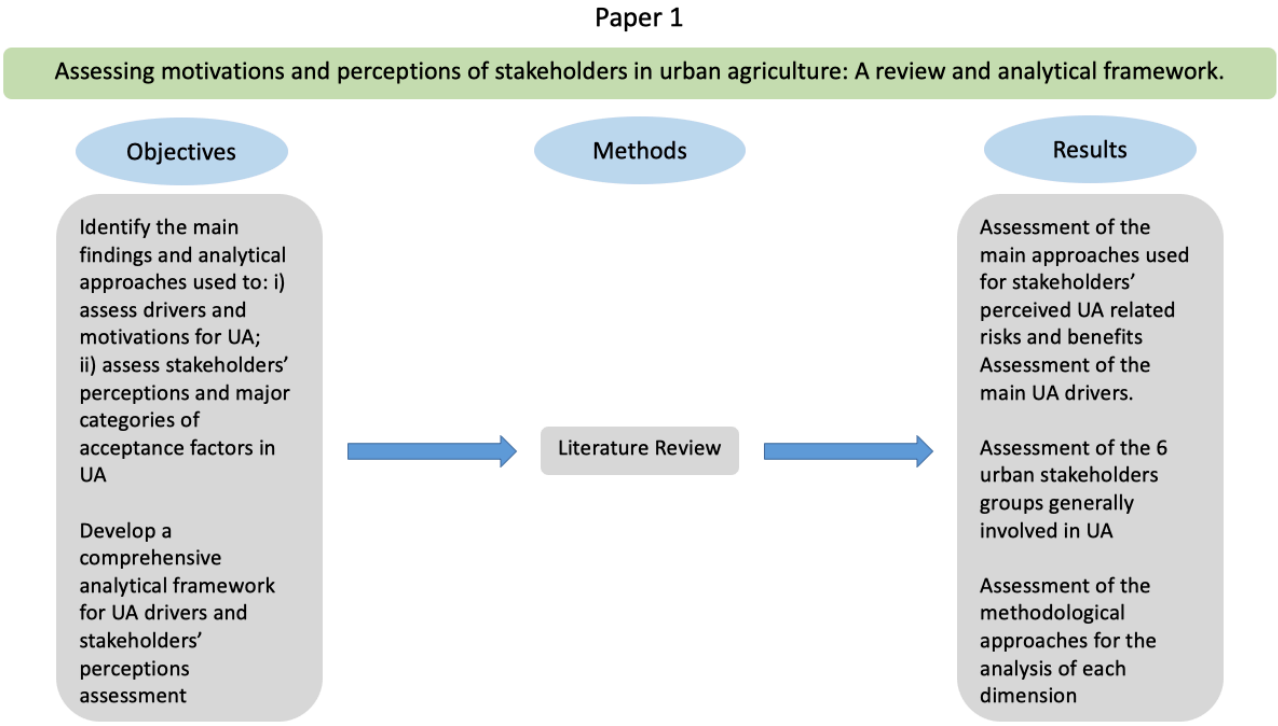
Nevertheless, the effectiveness of the law requires a high level of engagement from the individual citizens as well as from al the stakeholders involved in the Florianópolis UA and waste management system. To this end, three main research goals were defined: assessment of relevant stakeholders involved in UA and composting activities; evaluate the FCL social acceptance according to local stakeholders; evaluate the role of UA in supporting Ecosystem Services such as OW management through citizens' sensitization.

1.4 Thesis objectives and structure

The research goals where addressed through three articles respectively analyzing: i) the stakeholders involved in UA; ii) the FCL acceptance; iii) UA influence on citizens' household OW management habits. These aspects will be addressed and examined in the following articles:

PAPER 1: Assessing motivations and perceptions of stakeholders in urban agriculture: A review and analytical framework.
Paper type: Literature Review
Objectives: The first paper is focused on the development of an analytical framework for the assessment of the stakeholders' perception of UA, and the driving factors influencing the participation in UA.
Method: A literature review was performed in order to develop an analytical framework in order to address Urban Agriculture Participants' drivers (UAP) and urban stakeholders' perceptions of UA.
Main outcomes: The literature review showed that UA interacts with urban stakeholders through several dimensions. These dimensions were assessed in: Policy Framework, Legal Framework, Urban Planning, Market, Community and UA activists. For each of the assessed dimension the paper proposed an overall applicable methodological approach. The proposed analytical framework result to be suitable for research applications in multiple geographical contexts and in UA related activities like OW management.

Figure 1.2: First paper structure



PAPER 2: Urban stakeholders' acceptance of organic waste treatment regulation. The case of Florianópolis, Brazil.

Paper type: Empirical/Qualitative analysis

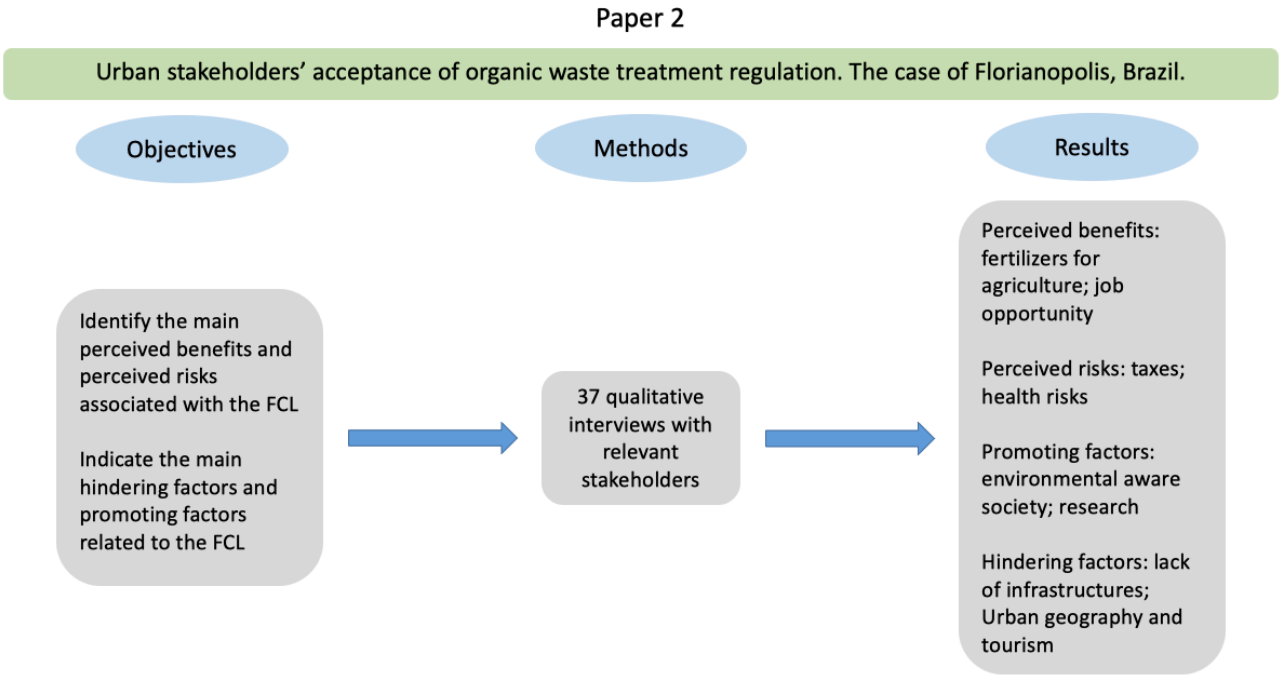
Geographical context: Florianópolis (Brazil)

Objectives: the second paper describes the stakeholders' perceptions towards the FCL that support the OW valorization through UA.

Methods: the analysis of the stakeholders' perceptions was performed through semi-structured interviews with 37 relevant stakeholders. The stakeholders' groups and the research focuses for each of the stakeholders group were assessed through the analytical framework developed in the first paper. The interview guideline was focused on assessing the benefits and risks associated to the FCL and the main promoting and hindering factors. The interviews were recorded, transcribed and then analyzed through the MAXQDA software. The coding process was performed following the coding principles from Saldaña (2015). Codes were assigned to fragments of text according to their topic (environment, socio-economic). These topics were assessed through Grounded theory according to what emerged from the interviews. These codes were then included into a category (benefits, risks, hindering, promoting).

Main outcomes: the results showed that the main FCL perceived benefits are environmental (fertilizers for UA) and social (job opportunities). The risks are mainly economic (taxes increase) and social (potential health issues). The results showed that despite a supporting society and historical background, the lack of infrastructures in Florianópolis could hinder the successful implementation of the FCL and cause contrasts within the several OW management stakeholders. Nonetheless, the results suggest that the successful implementation of the FCL could significantly reduce the public waste management company workload. Furthermore, the FCL model beside supporting the correct OW valorization, could potentially empower marginal communities', promote environmental education and could represent an example of good practices to be followed by other cities with limited investment capacity in OW treatment strategies.

Figure 1.3: Second paper structure



PAPER 3: Influence of participation in urban agriculture activities on household Organic Waste Management habits.

Paper type: Empirical/ Quantitative Analysis

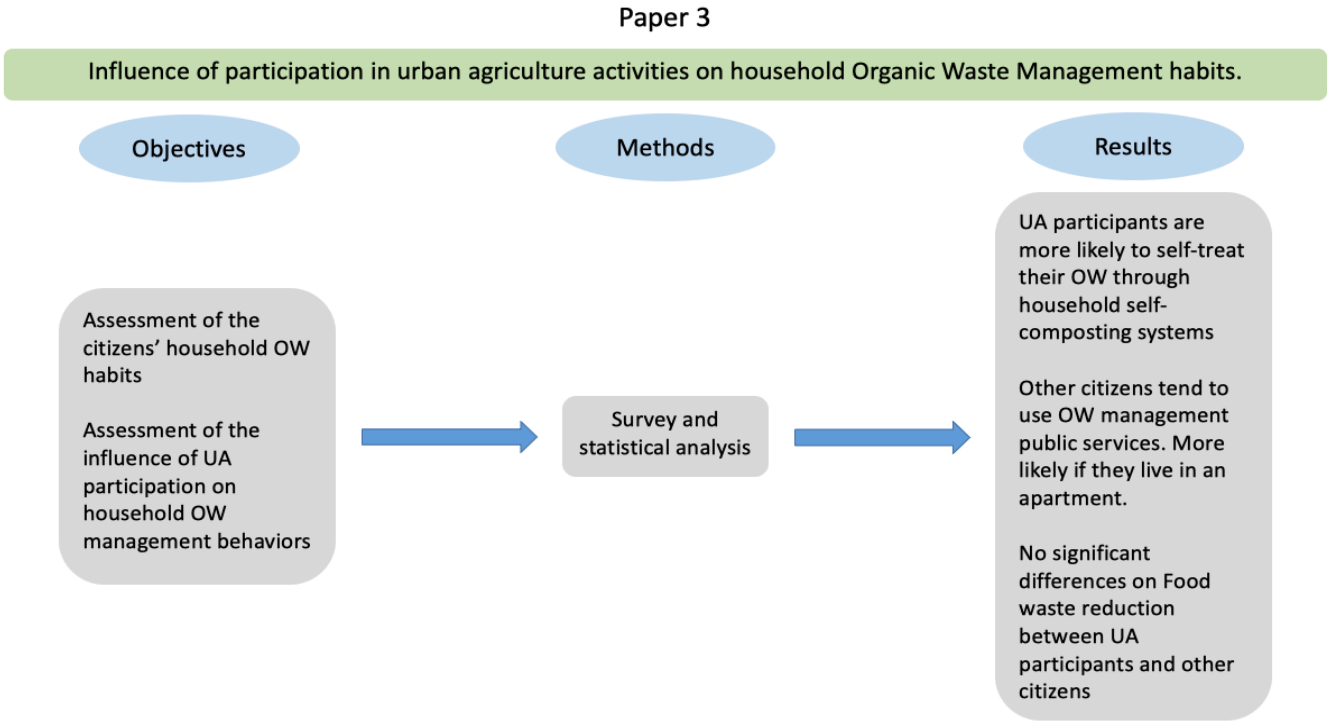
Geographical context: Florianópolis (Brazil)

Objectives: The third paper assess the household OW management habits and compares differences between UA participants (UAP) and other citizens.

Methods: The analysis of the OW management behaviors was performed through a questionnaire involving 206 individuals, out of which 102 were UAP. The questionnaire aimed at assessing the subjects' household OW management habits. These habits were divided into three OW management habits according to the literature: i) Reduce OW production through the food waste reduction; ii) Recycle the OW through public or private services; iii) Reuse the OW in agriculture or gardening through self-composing. The questionnaire considers the influence on this three behaviors of demographic variables (age, income, education); household typology (independent house or apartment); and participation in UA.

Main outcomes: The results showed that UA participants are more likely to self-treat their organic waste whether they live in an apartment or an open house. Even if UAP have no access to an open space for practicing OW composting they prefer to install composting systems in their households. On the other hand, the rest of the citizens prefer to let the public service treat their OW. UA participation has no influence on the OW production which is negatively influenced by age. Finally, the results are particularly relevant since they show that UA, beside supporting food security, influences citizens' environmental awareness on correct waste management.

Figure 1.4: Third paper structure



2) Assessing motivations and perceptions of stakeholders in urban agriculture: Literature review and analytical framework development.

Abstract: Interest in the adoption of urban agriculture (UA) has grown in recent years. The compatibility of UA with the urban social context, in particular with urban stake-holders' attitudes, is crucial for its successful implementation and represents one of the key factors influencing its development. To this end, a literature review on different approaches to analysing stakeholders' and farmers' perceptions of UA is performed. The paper identifies the main approaches assessing these aspects and designs an integrated framework to support the development of context-tailored analytical approaches for UA drivers' and stakeholder perceptions. The study aims to address and solve potential conflicts between UA practitioners and urban stake- holders and adapt the implementation of UA to contextual factors. This increases the possibility of developing successful UA strategies that meet the challenges currently facing urban food systems..

Keywords: stakeholder analysis; social acceptance; urban food systems; analytical approaches; literature review

2.1 Introduction

Despite the positive effects of UA reported in the introduction, some critical points should be considered by policy makers and stakeholders in order to improve the positive impact of UA on urban development. For instance, allowing access to UA only for a specific area or part of the population can contribute to "reinforc[ing] and deepen[ing] societal inequities by benefitting better resourced organizations and the propertied class", thus encouraging disadvantaged group marginalization (Horst et al, 2017: 277). Other critical situations deriving from a lack of awareness, political guidelines and collective organization can lead to undesirable results such as "green gentrification", conflicts between local authorities and UA organizations for the management of abandoned spaces, and UA initiative displacement (Anguelovski, 2015; Calvet-Mir et al, 2016).
UA faces different challenges due to its complex interactions with environmental, social and economic contexts; as a consequence, diverse stakeholders are involved in UA development. Understanding of how UA stakeholders interact and influence UA development is therefore needed. The literature suggests that UA activities are managed mainly through the interaction of stakeholders from three major groups (Prové et al., 2016):

- Government: this category includes local, national and international levels as well as government-led organizations and institutions.
- Civil society: in this category, stakeholders often correspond to those directly involved in UA and can be individuals, volunteers, NGOs and educational institutions.
- Market: this category of stakeholders is relevant for profit-oriented UA activities and includes distributors, entrepreneurs and consumers.

2.1.1 UA governance models

The stakeholders involved in urban agriculture act on three levels of governance, as reported in Figure 2.1 (Prové et al., 2016). The first level is defined by the specific internal governance model. Horizontal governance (shared responsibility) is typical for community gardens and bottom-up initiatives, whereas hierarchical governance (centralized responsibility) can be observed in entrepreneurial initiatives (Prové et al., 2016). The main factors influencing internal governance are usually UA practitioners' motivations and objectives. However, in most cases, urban gardeners' activities depend on resources (knowledge, funds, land access, tools, seed) that are often owned or managed by external stakeholders such as policy makers and urban planners. This implies the necessity of better understanding and managing the relation between policy makers and all the other stakeholders in order to better harmonize their relationship (*ibidem*).
The second level concerns external partnerships between UA activities and representatives of government, civil society and the market. According to the type of relations among UA, government, society and market, a range of UA types can be identified from full top-down UA, where the only stakeholder related to the activity is the local government, to full bottom-up UA, where civil society is the main influencing actor (Prové et al, 2016b).

The third level regards the urban context characteristics influencing the diffusion of UA, such as political and economic situations. The urban context also includes all the drivers not directly related to UA that define various UA types and influence the partnerships between UA practitioners and other stakeholders. It also includes the political context and legal and spatial issues (Prové et al, 2016). Since UA is a context-related and multisectorial activity, its effective management requires a multistakeholder approach in order to achieve good levels of engagement and participation among all the stakeholders involved (Cabannes & Marocchino, 2018). The effectiveness of UA policies is in fact guaranteed by adopting strategies to "address the needs and priorities" of the different actors (Dubbeling & Merzthal, 2006). The more frequently adopted analytical approaches that address these needs and priorities focus on motivations for participating in UA (Dubbeling & Merzthal, 2006). Different case studies show that participation in UA is motivated by several factors, such as food security, environmental protection, or political fulfillment (Mougeot, 2000; Calvet-Mir et al., 2016). Several theoretical frameworks and analytical approaches have been developed to study these motivations. Some authors consider the existence of a geographical continuum along which different types of motivations can be located, from more individual motivations such as food provision to more general motivations linking UA to the "global environment and economies" (Calvet-Mir et al., 2016: 338, Zoll et al. 2017).

2.1.2 Research gap and objectives

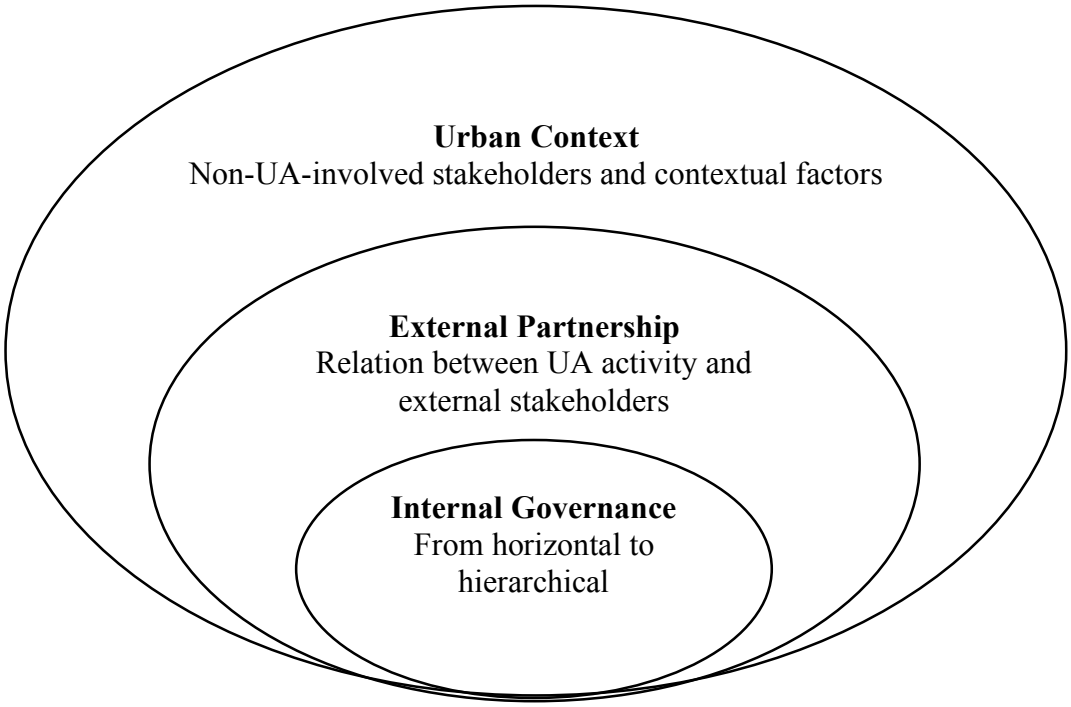
The literature analyzing the motivations for and perceived benefits from participating in UA focuses mainly on UA participants' perceptions (Calvet-Mir et al., 2016; Camps-Calvet et al., 2016). Studies on the "multistakeholder" approach and its role in increasing engagement in UA policies are still lacking (Dubbeling & Merzthal, 2006; Cabannes & Marocchino, 2018), as is an analytical framework considering the roles and perceptions of different actors involved in UA. Therefore, an integration of analyses of drivers and motivations and of stakeholders' perception of UA activities is needed.

To this end, the aim of this paper is to perform a literature review on UA aiming to

- Identify the main findings and analytical approaches used to assess drivers and motivations for UA
- Identify the main findings and analytical approaches used to assess stakeholders' perceptions and major categories of acceptance factors in UA

- Develop a comprehensive analytical framework that represents a toolkit enabling policy makers and researchers to assess UA drivers and stakeholders' perceptions

Figure 2.1: UA governance levels.
According to Prové et al., 2016

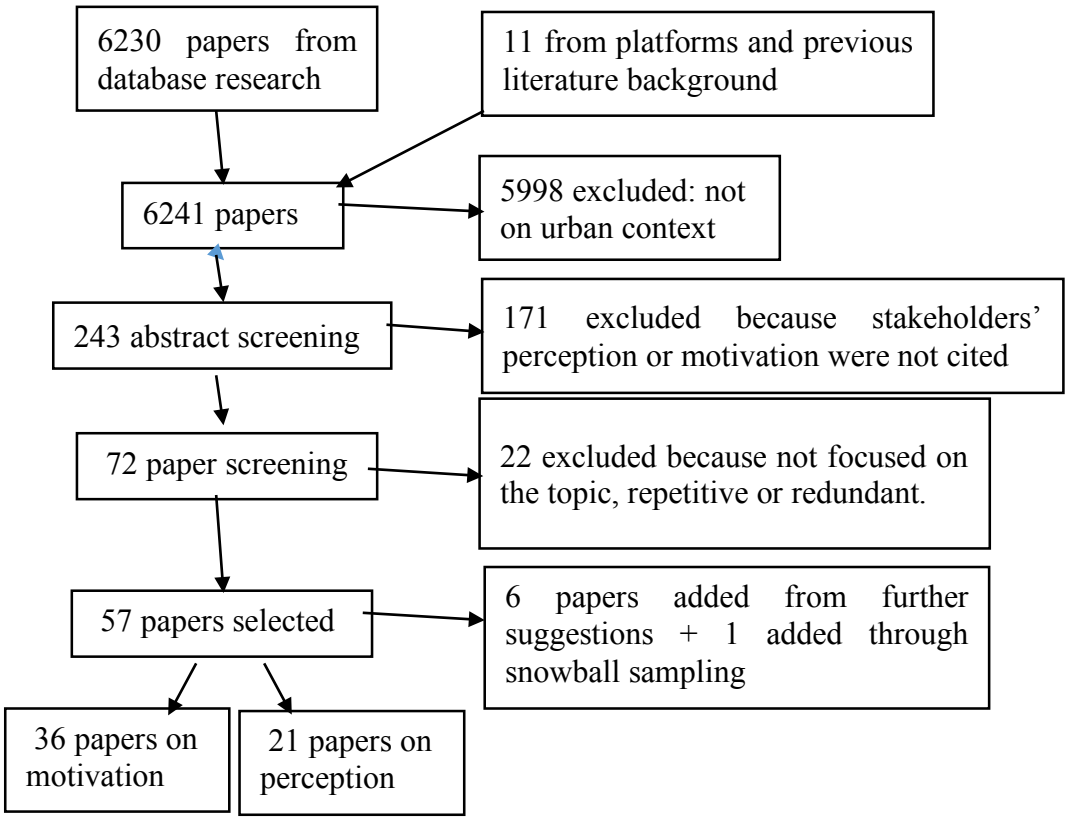


2.2 Methods

A literature review on the main motivations associated with UA participation and perceptions of UA among different stakeholders was performed. The method used for the literature review was based on the PRISMA statement and followed a four-step research path (Liberati et al., 2009, Warren et al., 2015). The literature research was performed on the following web platforms, and databases: Academia, Google Scholar, ResearchGate, Scopus and Web of Science. The research included bachelor, master and PhD thesis. Papers were searched for the entire timeline without exclusion of any dates. The keywords used in the database search were "urban agriculture" combined with the words "motivations" or "drivers" and "stakeholders' perception" or "stakeholders' acceptance". Keyword filters were then applied in order to focus on urban areas and the exact keyword "urban agriculture". Further articles were added following suggestions from platforms such as Academia and ResearchGate.
Based on these selection criteria, 6241 articles were found, as reported in Figure 2.2. Focusing on articles effectively mentioning UA led to the exclusion of 5998 articles. Among the remaining 243 abstracts screened, 72 cited UA motivations and stakeholders' perceptions. The screening of the 72 articles led to 18 being excluded since they did not focus on motivation or perception or were repetitive or redundant. The final 54 selected articles were divided as follows: 36 articles specifically focused on participants' motivations, while the remaining 18 focused on UA perceptions of stakeholders not directly involved in UA. Of the 54 articles, three were added on the basis of web platform suggestions (Kingsley et al., 2019; Mourão et al., 2019; Ramalingam et al., 2019), and one was added through the snowball sampling technique (da Silva et al., 2016). The publication dates of the selected articles range from 2002 to 2019.
The selected articles were then analyzed through a content analysis via the web application "LidyaText", which helped in the extraction of key concepts regarding motivation and stakeholders'

perception. These articles were analyzed in-depth according to their country of provenance, type of UA analyzed and analytical research methods adopted.

Figure 2.2: Description of the literature selection process



2.3 Results

2.3.1 Literature on Motivation

Thirty-three of the 36 articles focusing on motivation refer to case studies and the remaining three (Poulsen et al., 2015; Trendov, 2018; Draper & Freedman, 2010) to literature reviews. Fifteen studies are located in European cities, eight in North America, six in Sub-Saharan Africa, 4 in Australia and 2 in Malaysia.

The articles collecting data from 5 different types of UA according to the types defined by Simon-Rojo et al, 2016. The categorization by Simon-Rojo has been selected due to its proven applicability and its suitability for our reference framework. The typologies of UA found in the literature review were: i) Backyard/family gardens: vegetable gardens managed by a household and generally used for self-consumption. Backyard gardens were considered in 10 articles. ii) Community gardens: This category includes vegetable gardens from bottom-up initiatives that are generally community managed. This category was assessed in 20 of the 36 articles. iii) Allotment gardens: these usually originate from top-down initiatives involving specific population categories and were analyzed in 10 articles. iv) Business activities: UA entrepreneurial activities started for for-profit reasons were considered in 4 case studies. v) The last category, institutional vegetable gardens, involves UA activities implemented by institutions such as schools, hospitals and universities. These were found in 4 case studies. With the exception of the 3 literature review articles, different methodological approaches characterized the selected studies. Qualitative methods based on participants observations

and semi-structured and in- depth interviews were used in 15 papers. Other articles (14) used quantitative statistical analysis and structural equation models. Finally, a few articles (4) used mixed method approaches.

2.3.2 Motivation categories

Several categories of motivation emerged from the literature, some of which partially overlap. The Synthesis of the categories observed mainly in the analyzed literature can be observed in Figure 2.4. The most frequently assessed motivation is "psychological and physical health", mentioned in 23 of 36 papers. This category includes all motivations referring to physical and psychological benefits; UA is often considered a good opportunity for physical exercise and a healthy lifestyle, including access to healthier food. Physical exercise is often related to psychological benefits. Psychological benefits are referred to in the studies mainly as stress relief and mental relaxation.

The second most mentioned category of motivation is food security (22 papers). It refers to participation in UA as a way to access food and/or satisfy local food demand. Education is the third most mentioned category (21 papers). Education refers to the willingness to participate in UA in order to learn (or teach) how to produce food. Economic reasons, including savings and income generation, were mentioned in 17 articles. This category included both business models related to UA and informal selling of home-grown products. UA as an activity supporting socialization is mentioned in 16 of 36 studies. In this sense, socialization refers to an activity supporting social interaction in a "twofold process that must be viewed from the vantage of the group as well as the individual" (Mortimer & Simmons, 1978: 422). Food quality, referred to the willingness to participate in UA not for food demand satisfaction but as a way to obtain fresh and high-quality food, was mentioned in 15 studies. The same number of articles considered ecology and environment as a category that includes motivations related to environmental issues and ecosystem preservation. Community building was mentioned in 14 papers. In contrast to socialization, community building expresses the need to create "a functional spatial unit meeting sustenance needs, made of patterned social interaction, developed as a cultural-symbolic unit of collective identity", and it is less linked to individuals' need to socialize and more linked to the need to create a community (Hunter, 1975: 538). Other motivations found in the literature analysis were willingness to spend leisure time on UA without any further specific objective (14); family background or farming lifestyle and attitude (12); political commitment (10); community improvements (8), referring to participation in UA in response to community challenges such as crime and waste management; biophilia (8), defined as the willingness of humans to be in contact with nature (Wilson, 2017); aesthetic improvements (7) in both the household and the urban context; lack of formal employment (5); and limited access to agricultural land (4).

Differences emerged according the geographical contexts. Food security is the main driver in 6 of the 8 papers analyzed in lower income contexts. In 4 of the 6 papers analyzed, participants mentioned unemployment, economic reasons, limited access to land, socialization and community improvements as driving factors for UA participation. Political motivations, aesthetics and need for contact with nature were reported in 25 studies in Europe and North America.

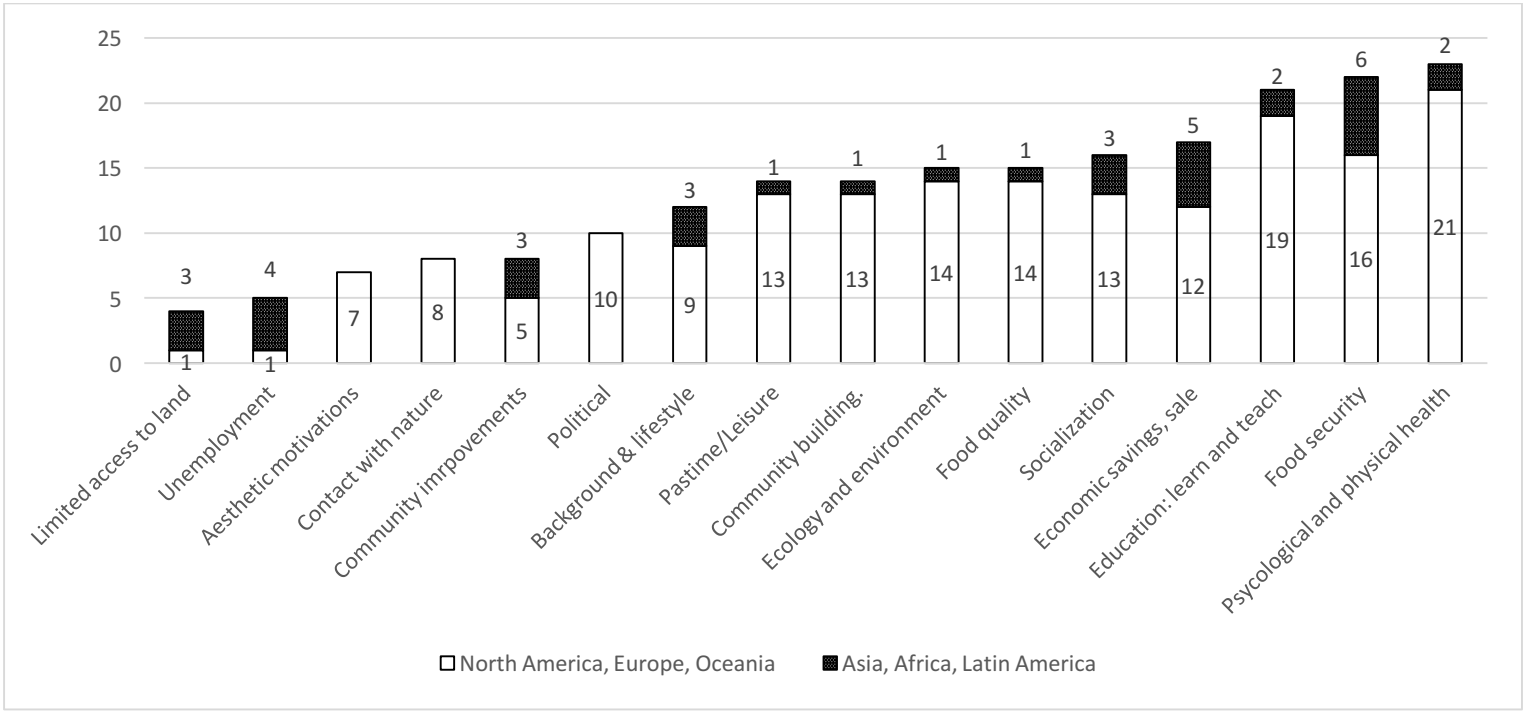
The literature also shows the existence of different urban farmer profiles based on different motivations (Kettle 2014, Ruggeri et al., 2016). Gardener profiles are defined by their attitudes towards gardening activities and their social status. For example, Kettle, 2014 defines practical gardeners as those who are participating for reasons related to "self-provision, food production and inter-generational connections to UA. Older men and women, from working-class backgrounds, who possess an agrarian habitus" (Kettle, 2014: 39). The same author defines another type of urban farmer as "the Idealist Eco-Warrior", who belongs to the "new middle class investing in allotments in Dublin today. Their motivations are part of wider concerns for the environment and ecological sustainability" (Kettle, 2014: 43). Some of the analyzed studies show that motivation reported by urban farmers is also determined by latent factors, such as cultural background and lifestyle, as well as exogenous factors, such as economic condition (Roberts & Schakleton, 2018; Poulsen, 2017; Trendov, 2018).

Table 2.1: Types of UA and methods used in the analyzed literature on motivation

	Community Garden	Backyard Garden	Allotment Garden	Business Garden	Institutional	Qualitative	Quantitative	Mixed Methods	Literature Review
North America	Draper & Freedman, 2010; McClintock & Simpson 2018; Poulsen et al., 2014; Poulsen et al., 2017; Poulsen, 2017; Dobernig & Stalg, 2015; McClintock et al., 2016	Conway 2016		McClintock & Simpson 2018; Poulsen et al., 2017; Poulsen, 2017; McClintock et al., 2016	Trendov, 2018; McClintock & Simpson 2018	Poulsen et al., 2014; Poulsen et al., 2017; Poulsen, 2017; Dobernig & Stalg, 2015	McClintock & Simpson 2018; McClintock et al., 2016	Conway, 2016	Draper & Freedman, 2010;
Oceania	Kingsley et al., 2019	Kirkpatrick & Davison, 2018			Guitart et al., 2014	Guitart et al., 2014; Zainuddin & Mercer, 2014; Kingsley et al., 2019	Kirkpatrick & Davison, 2018		
Asia	Ramalingam et al., 2019				Tiraieyari & Krauss, 2018		Ramalingam et al., 2019; Tiraieyari & Krauss, 2018		
Europe	McVey et al., 2018; Trendov, 2018; Calvet-Mir et al., 2016; Camps-Calvet et al. 2016; Langemeyer et al., 2018; Calvet-Mir & March, 2019; Scheromm 2015; Gauder et al., 2018; Pourias et al., 2016; ; Yap, 2019	Trendov, 2018; Calvet-Mir et al., 2016; Calvet-Mir et al., 2012; Reyes-Garcia et al. 2012;	Trendov, 2018; Calvet-Mir et al., 2016; Camps-Calvet et al. 2016; Langemeyer et al., 2018; Kettle, 2014; Ruggeri et al., 2016; Calvet-Mir & March, 2019; Pourias et al., 2016; Mourão et al., 2019; da Silva et al., 2016		Trendov, 2018	McVey et al., 2018; Calvet-Mir et al., 2016; Kettle, 2014; Calvet-Mir & March, 2019; Scheromm 2015; Yap, 2019	Reyes-Garcia et al. 2012; Ruggeri et al., 2016; Gauder et al., 2018; Mourão et al., 2019; da Silva et al., 2016	Calvet-Mir et al., 2012; Camps-Calvet et al., 2016; Langemeyer et al., 2018: Pourias et al., 2016	Trendov, 2018

Central & Latin America									
Africa	Roberts & Schakleton, 2018	Battersby & Marshak, 2013; Simatele & Bins, 2008; Smart et al., 2015				Battersby & Marshak, 2013; Simatele & Bins, 2008	Adebis & Monisola, 2012; Roberts & Schakleton, 2018; Smart et al., 2015		Poulsen et al., 2015

Figure 2.3: Number of articles citing each category of motivation.
Number of articles 36. Each article could mention more than one motivational category.



2.3.3 Literature on stakeholders' perception.

The literature on stakeholders' perception includes 21 papers that focused on different topics related to UA perception, such as social acceptance and the compatibility of UA with the social context. The majority of the reviewed articles use qualitative methods except for one (Islam & Siwar, 2012) that is a literature review, two that are policy analyses (Rogerson, 2011 and Napawan, 2016) and one (Cohen & Reynolds, 2014) that uses both policy analysis and in-depth interviews. Other papers (Grebitus et al., 2017; Sanyé-Mengual et al., 2018; Sanyé-Mengual et al., 2018b; Ercilla-Montserrat et al., 2019; Jürkenbeck et al., 2019) adopt mixed methods, quantitative analysis and structural equation models to predict consumers' behavior and willingness to purchase UA products. These case studies assess UA perceptions of several types of stakeholders. The first stakeholder category is the urban farmers themselves. This category of stakeholders is represented by effective food producers who can be either professional or amateur farmers (Hara et al. 2013; Cook et al. 2015; Sanyé-Mengual et al. 2016; Specht et al. 2016b; Delgado 2018; Nadal et al. 2018; Diehl 2020). Other stakeholders involved in UA are food supply chain actors involved in urban food provision, such as restaurants interested in buying UA products or NGOs promoting local markets for urban and peri- urban agriculture products. These stakeholders are relevant in guaranteeing the access of UA products to urban markets (Sanyé-Mengual et al. 2016; Specht et al. 2016b; Pollard et al. 2017). Another stakeholder category is the potential consumers, in particular citizens who may be (potential or actual) UA product consumers. This is relevant mostly for business-oriented activities (Jürkenbeck et al. 2019; Grebitus et al. 2017; Sanyé-Mengual et al. 2018, 2018bb; Ercilla-Montserrat et al. 2019). Local and national governments are also emerging as a relevant stakeholder group in the analysed papers. The actors involved in policymaking can influence the effectiveness of UA initiatives. More specifically, restrictions on UA activities or their promotion through government-led UA pro- grammes such as allotment gardens can be intro- duced (Vásquez et al. 2002; Rogerson 2011; Cohen and Reynolds 2014; Sanyé-Mengual et al. 2016; Specht et al. 2016b; Paddeu 2017; Specht and Sanyé-Mengual 2017; Delgado 2018; Nadal et al. 2018). Local administrators and technicians repre- sent another important stakeholder category. Even though they are not directly involved in UA, some of their decision-making can influence relevant aspects of UA development, such as urban plan- ning, infrastructures, technical aspects and new technologies (Sanyé-Mengual et al. 2016; Napawan 2016; Specht et al. 2016b; Pollard et al. 2017; Paddeu 2017; Specht and Sanyé-Mengual 2017; Nadal et al. 2018). Finally, the literature sug- gests that local residents can promote or hinder UA activity implementation. UA can evoke changes in urban patterns, and its implementation can therefore lead to conflicts (e.g. related to an increase in noise and smells). (Specht et al., 2016a; Sanyé-Mengual et al. 2018; Ramaloo et al. 2018; Nadal et al. 2018).

2.3.4 Perceived benefits associated with UA and promoting context factors

Different authors analyze stakeholders' perceptions by addressing the general attitudes and benefits associated with UA. There is a wide range of UA types, including more experimental types such as soilless gardening and aquaponics (Specht & Sanyé-Mengual, 2017; Specht et al., 2016b; Sanyé-Mengual et al., 2016; Pollard et al., 2017). The stakeholders' attitude towards UA is generally positive, and UA is associated with the environment, food production, leisure, alternative food networks and food quality (Delgado, 2018; Sanyé-Mengual et al., 2018; Grebitus et al., 2017). These concepts are often connected with the perceived benefits of UA and are similar to the motivations found in the motivation-centered literature. However, this part of the literature addresses categories of benefits that are not directly connected with individual wellbeing such as "physical and psychological health", but rather address potentially positive societal impacts. The main social benefits associated with stakeholders are similar to those assessed in the literature in relation to

elements such as environmental education, social inclusion and food security (Nadal et al., 2018; Delgado, 2018; Sanyé-Mengual et al., 2018b). Other benefits are often linked to environmental issues, such as rainwater management, organic waste recycling and pesticide use reduction (Sanyé-Mengual et al., 2018; Specht et al., 2016b; Napawan, 2016; Nadal et al., 2018; Vásquez et al., 2002; Delgado, 2018). Economic benefits are related mainly to general urban economic benefits, such as job creation and reuse of abandoned spaces (Specht et al., 2016b; Ramaloo et al., 2018; Napawan, 2016;). Other economic benefits assessed in the literature are related to cost reduction due to self-production and proximity (Nadal et al., 2018; Sanyé-Mengual et al., 2018b). Some stakeholders associate aesthetic benefits with UA, both in terms of single buildings and of the urban context as a whole (Pollard et al., 2017; Specht et al., 2016b).
Finally, the literature shows that several potentially promoting contextual factors need to be considered when analysing UA acceptance. These factors can be summarised as follows:

● Political context: the possibility of integrating UA with local policies so that it becomes part of the local government strategic vision (Cohen and Reynolds 2014; Specht et al. 2016b; Nadal et al. 2018).

● Legal framework: compatibility with local laws and the existence of a UA legal framework and recognition (Cohen and Reynolds 2014; Specht et al. 2016b; Paddeu 2017).

● Market: the existence of a market and need for market-oriented UA (Cook et al. 2015; Specht et al. 2016b; Ercilla-Montserrat et al. 2019; Jürkenbeck et al. 2019; Diehl 2020).

● Land and space availability: the existence of proper space that allows cultivation and limits the possibilities of contamination in an urban environment (Hara et al. 2013; Specht et al. 2016b; Nadal et al. 2018; Diehl 2020).

● Cultural background: UA needs to be part of a cultural process that allows its acceptance by.

2.3.5 Risks and challenges associated with UA

The analysis of UA stakeholders' perception points to hindering factors, negative aspects and challenges related to UA as well (see table 2.2). Stakeholders are concerned with potentially negative impacts of UA on their quality of life in terms of noise, smell, logistics, possible product contamination and aesthetics (Specht et al., 2018b; Sanyé-Mengual et al., 2018b). Some potential UA consumers consider soilless and hydroponic products to be "artificial", "low quality", "tasteless" and far from the conventional idea of "agriculture" (Jürkenbeck et al., 2019; Pollard et al., 2017; Specht et al., 2016). A correlation between low education levels and negative perceptions of soilless production has been observed (Ercilla-Montserrat et al., 2019). Furthermore, some UA stakeholders perceive soilless UA as too complex in terms of technical difficulties, consequently increasing the cost and environmental and health risks associated with bad management (Specht & Sanyé-Mengual, 2017; Pollard et al., 2017). Some other negative aspects of UA are linked to more practical daily-life problems, such as a higher probability of theft and vandalism, lack of time, lack of space and lacking community commitment (Kingsley et al., 2019; Conway, 2016; Gauder et al., 2018). Furthermore, characteristics of the urban spatial and political context and its management (such as urban planning, policies and interaction between urban and agricultural activities) can have a negative impact on UA development.

Table 2.2: Types of UA and methods used in the analyzed literature on stakeholder perceptions

	Qualitative	Quantitative	Mixed Methods	Literature Review	Policy Analysis
North America	Paddeu 2017; Cohen & Reynolds, 2014	Grebitus et al., 2017			Napawan, 2016
Oceania	Pollard et al., 2017				
Asia	Hara et al., 2013; Ramaloo et al., 2018			Islam & Siwar, 2012;	
Europe	Delgado, 2018; Sanyé-Mengual et al., 2016; Specht et al., 2016; Specht et al., 2016b; Specht & Sanyé-Mengual, 2017; Ercilla-Montserrat et al., 2019	Jürkenbeck et al., 2019	Sanyé-Mengual et al., 2018; Sanyé-Mengual et al., 2018b		
Central & Latin America		Nadal et al., 2018			
Africa	Vásquez et al., 2002;				Rogerson, 2011

Table 2.3: Perceived Benefits and Risks addressed in the literature.

Benefits	***Risks***
• *Social*: environmental education, social inclusion and food security • *Environmental*: as rainwater management, organic waste recycling and pesticide use reduction • *Economic*: job creation, cost reduction, • *Aesthetics*	• *Life quality*: noise, smell, logistics, possible product contamination and city aesthetics • *Cultural*: soil-less agriculture as artificial, and tasteless • Technical difficulties and high costs. • Environmental and health risks • *Social*: theft and vandalism, lack of time and management issues.

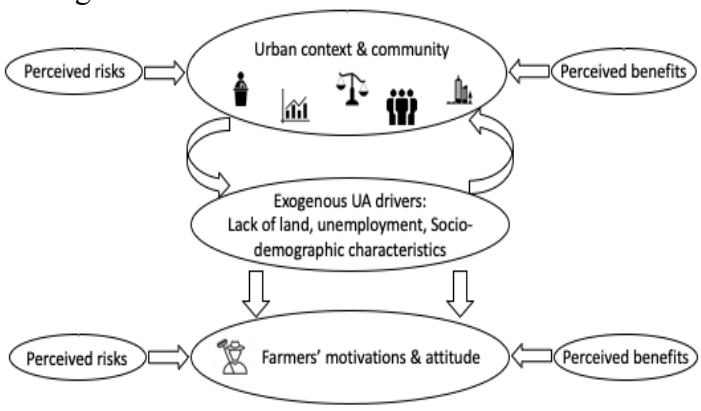
As suggested by Specht and Sanyé-Mengual (2017), the level of acceptance of UA also depends on how the city interacts with the rural environment. UA acceptance is higher in cities where agriculture has always been integrated into the cityscape. In the European context, the distinction between rural and urban areas is very clear, and 'urban stakeholders that have never dealt with agricultural production' might show an adverse attitude towards UA (Specht and Sanyé- Mengual 2017, p. 16). According to the literature, the constraints on UA development related to the general urban context are not exclusively related to citizens' perceptions but can be considered a consequence of hindering contextual factors (Specht et al. 2016b). The proximity to building areas and the phenomenon of urban sprawl often represent a threat to UA activities'
continuity in the absence of any legal recognition of UA (Hara et al. 2013; Cook et al. 2015; Diehl 2020).

2.3.6 Towards an analytical framework for analyzing UA stakeholder motivations and perceptions

The analysis of the literature shows that despite the wide range of articles produced on UA in developing countries, few studies focus on farmers' motivations in participating in UA in these contexts. In particular, little coverage was found in Latin American countries, where UA has a huge impact on food security and community development (Altieri et al., 1999; Thomas, 2014). This absence may derive from a different approach to the topic that focuses more on UA impact on food security than on motivation; furthermore, the relatively small number of studies in English from Latin American authors contributes to this biased outcome (Zezza & Tasciotti, 2010; Bryld, 2003). The results show a wide range of motivations for assessing the different needs of urban farmers, from individual needs, such as food security, to more altruistic needs, such as ecological and environmental motivations. Bearing in mind that these motivations are interconnected and sometimes overlap, there is a need to classify them to provide an organic and more manageable analytical framework. We can divide the motivations into three main categories.

- Basic need satisfaction and personal fulfillment: motivations related to satisfying physiological needs and the need for human relations.
- Community wellbeing and ideological issues: motivations related to relational aspects and societal improvements.
- Exogenous factors: latent drivers such as cultural background and lifestyle as well as contextual characteristics such as unemployment and limited access to land.

Figure 2.4: Interaction among the UA dimensions.



These exogenous factors directly affect the type of motivations influencing UA participation. This clearly emerges when comparing developed and developing countries. UA participation in developing countries is driven by basic needs satisfaction. This is motivated by structural exogenous drivers such as a lack of access to cultivable land and lack of formal employment. Another important factor influencing participation in UA in developing countries is agricultural background; most people participate in UA because they come from rural areas where they used to work in fields. This highlights the importance of developing an analytical framework that assesses exogenous drivers and personal background as a means of influencing individual motivations. A possible analytical approach should thus focus on assessing the exogenous factors collected through demographic information and analyzing how different cultural backgrounds and socioeconomic conditions influence the typology of motivations affecting individual participation in UA (see Figure 2.4).

2.4 A UA integrated analytical framework

As mentioned before, a multistakeholder approach could support UA harmonisation with the urban context. To this end, a UA analytical framework should consider how different stakeholders perceive and influence UA development. Several approaches describing different stakeholders' perceptions of UA emerged from the literature review. Integrating these approaches can be useful to: i) policymakers in developing tailored strategies aimed at preventing possible conflicts and inequitable access to UA;

ii) researchers and academics in order to define the methodological approach to address one of the UA dimensions; and finally to other UA stakeholders to better understand the dynamics and relations between the several urban dimensions involved by UA. Starting at the urban level, the stakeholders involved are actors not directly connected with UA but strongly influencing its development, such as policymakers, public administrators, urban planners and technicians (see table 2.4).

In particular, the development of different UA types is strongly influenced by compatibility with the vision and priorities of local government. To this end, the analysis of UA should start by considering the political context in which UA operates. This implies the need to assess governmental stakeholders' attitudes towards UA. Other aspects, such as the legal framework and urban planning, are also crucial factors influencing UA development. An analysis carried out by interviewing public administrators, urban planners and technicians can describe UA legal compatibility regarding food production in a certain urban area and its integration with the urban space. Another important contextual dimension is how the community perceives UA, particularly from the perspective of both the market and citizens. The food market attitude towards UA is explored in several of the studies reviewed. It can be assessed through a quantitative analysis of UA customers' behaviour and interviews with supply chain stakeholders and UA practitioners. In particular, the willingness of food chain actors to accept UA products as well as urban farmers' need to sell their products is analysed. The last dimension, cultural background, emerged as an important aspect influencing UA social acceptance, in particular the role of the related 'not in my back yard' (NIMBY) phenomenon. The influence of geographical location and specific UA type on the role of NIMBY in UA acceptance also emerged. Furthermore, understanding how citizens perceive sustainability in relation to UA activities could help in creating a more participatory way of determining priorities in the UA development agenda. Finally, the different UA dimensions are connected and shape UA development and urban farmers' attitudes, as displayed in table 2.4. In particular, urban context/community acceptance and exogenous UA drivers are interdependent and, in turn, influence individuals' involvement in UA. From this perspective, understanding stakeholders' perceptions, participants' motivations and the respective perceived risks and benefits will help the assessment of hindering factors, possible conflicts and UA management strategies.

This study was affected by two main limitations. The first is the limited access to non-English language studies, which did not allow a fair representation of the principal UA drivers and perceptions in these contexts. This was due to language limitations caused by the scarcity of articles in English language journals about the Latin American and Asian contexts. In general, unbalanced geographical representation could lead to an incorrect evaluation of drivers' and stakeholders' perceptions in these less represented contexts. Future studies on UA drivers' and UA stakeholders' perceptions in these least represented geographical regions, are thus needed. A second limitation is directly connected with the first. The analytical framework can thus be suitable only for contexts more similar to European and North American contexts. This will hinder the capacity of the developed framework to allow holistic UA analyses in less represented contexts.

To this end, the next research step should be focused on empirically testing the methods suggested in the framework. This will help to test the framework validity for North American and European contexts. Furthermore, the framework would probably need to be redefined and tailored for African, Latin American and Asian countries to improve its applicability.

Nonetheless, the framework provides a series of analytical strategies that could be implemented to develop a comprehensive understanding of the role and impact of public and private UA strategies in urban sustainability. First, the framework can be a tool of analysis to determine the impact of UA on social and environmental sustainability, focusing on conflicts with the policy agenda, the legal framework and acceptance among citizens through an analysis of the acceptance of UA. Furthermore, the framework could address economic sustainability through an analysis of UA acceptance in local markets and the drivers and barriers behind urban farmer participation. Finally, the analysis of the urban planning context could help to assess the overall sustainability contribution of UA according to contextual characteristics.

Table 2.4: A possible analytical framework to assess motivations and perceptions of UA stakeholders

	Urban level			Community		Urban Agriculture
Dimension to Be Analyzed	Policy Framework 	Legal Framework 	Urban Planning 	Market 	Cultural Background 	UA Initiatives 
Objective	Understand political views regarding UA activities. Which policies promote and hinder UA?	Are there any legal restrictions on or laws in support of food production in urban areas? Is the legal framework supporting irrigation supply?	How does the city relates to UA? Are there any restricted areas? Need for soilless technology (in case lack of land availability)? Which is the relation between Urban and Rural? Where is UA implemented?	Is there a possible market for UA products? Are sales important for urban farmers?	What are the risks and benefits associated with UA? How is sustainability perceived in relation to UA? What type is most acceptable? Is there any NIMBY phenomenon? City Historical Background?	Which are urban farmers drivers? Which is the Role of basic need satisfaction; personal fulfillment; community wellbeing and ideological motivations? Are there existing farmers networks?
Stakeholders	Governmental stakeholders	Public administrators	Urban planners, technicians	Consumers, food supply-chain stakeholders, UA activists	Residents	Urban farmers
Analytical Approach	Semi-structured interviews and content analysis	Interviews and secondary data analysis	Semi-structured interviews and secondary data analysis	Quantitative analysis of consumer attitudes and semi-structured interviews	Surveys based on acceptance models (Venkatesh et al.; 2003), mixed-method approaches	Qualitative interviews assessing possible drivers and confirmative surveys on motivation influence and demographic information
Reference Literature	Specht et al., 2016b; Nadal et al., 2018; Rogerson, 2011; Islam & Siwar, 2012; Napawan, 2016; Cohen & Reynolds, 2014	Specht et al., 2016b; Nadal et al., 2018; Rogerson, 2011; Hara et al., 2013; Islam & Siwar, 2012; Cohen & Reynolds, 2014, Paddeu 2017	Sanyé-mengual et al., 2016; Specht & Sanyé-Mengual, 2017; Specht et al., 2016b; Nadal et al., 2018; Rogerson, 2011; Hara et al., 2013; Islam & Siwar, 2012	Pollard et al., 2017; Sanyé-mengual et al., 2016; Jürkenbeck et al., 2019; Grebitus et al., 2017; Sanyé-Mengual et al., 2018	Sanyé-Mengual et al., 2018b; Ramaloo et al., 2018; Nadal et al., 2018	Conway, 2016; Calvet-Mir et al., 2012; Camps-Calvet et al., 2016; Langemeyer et al., 2018; Pourias et al., 2016

2.5 Discussion and Conclusion

The results of these thesis section, show how many different interactions are existing between the several dimensions involved in UA. The framework that has been developed from the literature review, is potentially meeting the needs and the public agenda regarding the urban food system that is emerging during the last decade. Documents and agreements such as the Milan Urban Food Policy Pact (MUFPP), are highlighting the importance of integrating the food in the municipalities agendas. As shown in literature and in case studies, the successfulness of the Urban Food Policies relies on how good the existing activities related to food production, transformation and consumption, are integrated under a legal framework and a political agenda (Filippini et al., 2019). This process needs to be realized through an analytical lens that shows how existing initiatives are acting on the territory. In this sense the developed analytical framework represents a tool for policy makers and urban food system stakeholder, to have a holistic view of the urban food system related dimensions and activities and how they interrelate.

This thesis section aimed to use a review of the existing literature to develop a holistic analytical framework to assess the motivations and perceptions of UA stakeholders. The results of the literature review on motivations showed that the main motivations are related to individuals' psychological and physical health, followed by food security. Differences emerged according to the geographical context, especially regarding the higher influence of contextual factors as drivers of UA implementation in African, Latin American and Asian countries, including local policies, land use, cultural aspects, and socioeconomic conditions. This led the literature review to focus on the perception of UA according to the local stakeholders potentially involved during the UA implementation process. This includes all relevant stakeholders influencing several aspects of UA, such as local policies, urban planning, the food market and residents' acceptance. The literature focusing on stakeholders' perception analysis revealed that several risks and hindering factors need to be addressed when developing UA, including lack of space, conflict with the market in accepting UA production, conflicts with residents and cultural resistance to soilless production. The literature review revealed six main categories that should be considered when assessing UA development strategies: policy framework, legal framework, urban planning, market, cultural background, and UA initiatives. These dimensions have been included in the proposed analytical framework, and methodological approaches to address these aspects have been suggested within the framework (see Table 2.4).

The overall objective of the analytical framework is to create a tool that could support the definition of strategies for UA implementation in several con- texts through an integrated analysis of the different aspects related to these activities. A holistic approach such as the one proposed in the paper is particularly relevant for the successful implementation of UA that involves multiple stakeholders and multidimensional activities. This will help us to understand the compatibility of UA activities in the several contexts in which they are implemented. Finally, empirical applications of the frame- work can be implemented in case studies in future research. This will help us to better address the potential limits associated with the dimensional complexity of the framework.

3) Urban stakeholders' acceptance of organic waste treatment regulation. The case of Florianópolis, Brazil.

Abstract: The effects of urban population growth are particularly perceived in densely populated countries and their impacts are reflected on several aspects including problems related to the increased production of Municipal Solid Waste (MSW). Literature reports that a significant part of the MSW is represented by Organic Wastes (OW). Several environmental and health issues derive from the lack of OW management strategies. Municipalities are adopting several strategies in order to reduce the amount of OW incorrectly disposed. Florianópolis in Brazil resulted to be the first Brazilian capital to ever approve a law on mandatory OW separation and composting. The Florianópolis Composting Law (FCL) is particularly innovating since it supports the OW composting in order to provide fertilizers for Urban Agriculture activities. Nevertheless, its implementation relies on the acceptance from urban stakeholders and civil society. To this end the following paper addresses which are the factors influencing the FCL acceptance by analyzing stakeholders' perception of risks, benefits, hindering and promoting factors. The results showed that the law could represent an important first step towards the sustainability of the MSW management system, on the other hand several risks could be determined in absence of adequate monitoring systems. Furthermore, even though the society seems culturally open the lack of infrastructure and investments could hinder the effectiveness of the law. To this end possible strategies improving the law effectiveness should be focused on supporting the existing formal and informal composting initiatives that have widespread in the latest decades. This could lead to an integrated OW management system empowering the local initiatives and reducing the initial costs of new composting systems implementation.

3.1 Introduction

Solid waste management strategies are relevant issues in the political agendas of the cities. The solid waste can be managed through different systems. Even though in several municipalities, municipal solid waste (MSW) are managed in controlled areas or incinerated, in more vulnerable contexts these systems are not properly diffused yet and solid waste are still disposed in dumps in the peri-urban areas (Struk, 2017). Unappropriated solid waste management has a series of negative impacts from an environmental and social perspective. Literature shows that inappropriate waste management could have negative impact in terms of greenhouse gas emission, water pollution and air contamination (Menikpura et al., 2013; Cruvinel et al., 2019). These impacts are also reflected in waste management operators' and citizens' health (Rego et al., 2005). The problems related to solid waste management are mostly perceived in contexts where both the population and per-capita waste production are increasing (Guerrero et al., 2013). In several cases the main fraction of the MSW is represented by the Organic part of the MSW (Stenmarck et al., 2016). Organic waste (OW) could represent up to 50% of the total municipal solid waste production and the problems related to its management are related with health and environmental issues (Stenmarck et al., 2016). This is particularly perceived in contexts where there are still problems related to inappropriate management of the OW (Struk, 2017). To this end, municipalities started to implement supporting strategies for a correct OW management (Bahers & Giacché, 2019). The effectiveness of OW management strategies relies on correct household separation and correct management by the stakeholders involved in the composting processes (Bernad-Beltrán et al., 2014; Wolsink & Devilee, 2009). This implies strong efforts in terms of investments, institutional commitment, technical requirements; citizens, education (Wolsink, 2010). Furthermore, different risks need to be considered when dealing with waste management (Wei et al., 2017). First there might be a series of risks linked to composting. Risks mainly described in literature are related to "volatile organic compound" potentially harmful for

human health (Nie et al 2018), fungi and bacteria proliferation, possible water and soil contamination (Mudruňka et al., 2017; Clark et al., 1984; Domingo & Nadal, 2009). This really depends on how the composting process is managed. Literature suggests that OW contaminated with chemical solvents and low compost aeration increase volatile organic compound as well as risks of water contamination (Nie et al 2018; Domingo & Nadal, 2009; Sykes et al., 2007).
Furthermore, just like every innovation the law introduction could be hindered by certain level of resistance. Literature suggests that innovations in waste management could be hindered by the way stakeholders perceive risks and benefits related to that innovation (Zeiss & Atwater, 1987). This can be observed in several examples in environmental and agricultural innovation from renewable energy production to urban agriculture (Specht et al., 2016; Wolsink, 2010). Literature shows that possible conflicts can derive from aspects linked to different views on correct waste disposal (incineration ve methanization vs recycling) determined by stakeholders' belief and perception (Achillas et al., 2011; Wolsink, 2010). Furthermore, lack of economical investments, problems related to spatial management, national and international policies and the resistance to change of habits of waste collectors' companies, has emerged as conflict generator (Wolsink, 2004; Wüstenhagen et al., 2007; Wolsink & Devilee, 2009).
Laws on the OW management represents a quite significant innovation in vulnerable contexts and their successful implementation could depend on how these measures are accepted among stakeholders and citizens. The Brazilian city of Florianópolis approved the first law on OW mandatory treatment ever approved in a Brazilian State capital (law n°10501/19). The present paper describes key waste management stakeholders' perception of the law in order to understand the level of acceptance of the new Florianópolis Composting Law (FCL). To this end this paper answers three research questions:

- Which are the benefits that waste management stakeholders associate to the FCL?
- Which are the risks that waste management stakeholders associate to the FCL?
- Which factors can influence the success or failure of FCL?

3.2 Materials and methods

3.2.1 Analytical framework

The analytical framework follows the social acceptance approach adapted from Specht et al., 2016 integrating it with the framework developed in the first article of the thesis. According to the literature, social acceptance is referred to the acceptance of technological and societal changes and "is not only referred to individuals' attitude, but more broadly to social relationships and organizations dynamically shaped in learning processes" (Wolsink, 2010: 303). "These processes depend on the subject of acceptance, the object of acceptance and the respective context" (Specht et al., 2016: 755). The subjects of acceptance in this case are all the stakeholders involved in the waste management, and characterized by the knowledge of the law and potentially impacting and or impacted by the law. The stakeholders were assessed trying to involve experts on each of the MSW dimensions addressed in the previous paper and explained in table 3.1. The object of acceptance is represented by the FCL, the aim is to address which are the benefits associated with the law and which are the risks that stakeholders associate with the composting law. The benefits and risks associated to composting law are partially derived from literature and other have been included after the data analysis (Strauss & Corbin, 1997). The contextual factors are factors related to several dimensions connected with the law that could hinder or support the FCL implementation. These dimensions in this case study are related to the several dimensions assessed in the theoretical framework addressed in the previous sections (see table 3.1). Following the framework in table 3.1, the aim of the study is to address the Composting Law acceptance within the following dimensions Policy making, legal framework, urban planning, market acceptance, cultural background and community OW management and UA. A further category has been added named Large OW production as part of the community acceptance.

Table 3.1: The analytical framework for assessing the acceptance of the new composting law.

Dimension to be analyzed	**Urban level**			**Community**			**Urban Agriculture**
Stakeholders Groups	Policy Making 	Legal Framework 	Urban Planning 	Large OW production 	Market 	Cultural Background 	Community OW management and UA 
Research focuses	Understand political views regarding the new FCL. Which policies promote or hinder the composting law?	Are there any legal supporting factors or restrictions with the FCL?	Where composting yards can be built? Are there any conflict areas? Need for urban planning renovation?	Are there any advantages or disadvantages for the activities producing big quantities of OW?	How are the Waste Management private companies reacting to the new Composting Law? Are there any disadvantage for certain private companies?	Which kind of perceptions do citizens have about composting? Which is the citizens' level of environmental education?	Which is the relationship between Urban Agriculture and Organic Waste management within the city neighborhoods?
Stakeholders involved	Members of the government promoting the law and Waste management public company decision makers	Technicians and public administrators	Public Administrators Experts on Urban Planning	Representatives of restaurants supermarkets and hotels	Private Waste Management companies	Environmental Education Associations.	UFSC method initiators, Community OW management associations.

3.2.2 Methods

Semi-structured interviews with 37 relevant stakeholders were conducted from April to August 2019. The interviews were conducted following a guideline that divided the interviews in section. The first section was more introductive and descriptive of the role of the subject. The second part was focused on the main benefits and risks associated with the FCL. The third part was on the assessment of potential conflicts and barriers and the last part tried to get other relevant stakeholders' indication. The interviews were conducted duration was approximately 50 minutes per interview. The data analysis was performed through the coding software MAXQDA; the coding process was performed according to the coding principles from Saldaña (2015). The process consisted in text fragments classification in data units assigned to a series of conceptual categories (codes). The codes were associated to the analytical framework in terms of perceived risks and benefits; hindering promoting factors. Further codes were added after the first data analysis. The codes were then analyzed and difference in weights have been assigned to each code according to their frequencies and to the weight interviewees were giving to specific topic.

3.2.3 Case Study description: state of MSW in Brazil

Solid wastes in Brazil are mainly treated through three systems:

- Garbage dump: consisting in uncontrolled open air garbage dumps with no draining systems or gas collection;
- Landfill: where the waste is covered but there are no draining or gas collection systems;
- Sanitary landfill: where the solid wastes are stocked, liquid is drained and gasses are collected (ABRELPE, 2019)

In 2018, 79 million tons of solid waste were generated representing an increase of 1% over the previous year in Brazil and 92% (72.7 millions) of this amount, was collected. Proper disposal in controlled environment has been received by 59.5% (43.3 million tons) of the collected solid urban waste representing a small improvement over the previous year scenario. Even though a national law prohibiting the adoption of open air garbage dump has been approved in 2010, the rest of the solid waste (40.5%) has been inappropriately dumped by 3,001 municipalities. This Municipal Solid Waste ends up going to garbage dumps or landfills, which do not have a set of systems and measures necessary to protect people's health and the environment from damage and degradation (ABRELPE, 2019; de Andrade & Ferreira 2011). Furthermore, in Brazil there are relevant differences in terms of solid waste management and treatment. Even though there is a little improvement in SW treatment. Huge differences emerge when comparing the SW treatment between the regions. In terms of recycling initiatives and proper treatment of MSW southern and southern-east states are the only regions managing to guarantee a correct treatment of the MSW (ABRELPE, 2019).

3.2.4 State of MSW management in Florianópolis

One of the Brazilian state that is particularly advanced on waste treatment is Santa Catarina. The Santa Catarina's capital Florianópolis approved the Florianópolis Composting Law (FCL). The aim is the obligation of appropriate disposal for OW through the process of composting and the prohibition of destination to sanitary land and to incineration (law 10.501/2019). This law, approved in June 2019 through the municipal decree 20645/2019, aims at reaching a 25% of the organic waste composting by 2020 and reach a completely ban of organic waste incineration and collection in the sanitary landfill by 2030. The law fosters the implementation of the obligation starting from big OW producers such as supermarkets, hotels and restaurants. The total investment for the implementation

of the FCL is 1 million R$ (160.000 euros) from the National Environmental Funds (FNMA). This support helped to achieve new equipment for the OW collection, in particular, 900 big tanks (70 liters) and 2 million small ones (30 liters). The municipality of Florianopolis invested further 10 million R$ (1,6 million euros) for new equipment for waste collection (4 new trucks) (Ciclovivo.com.br, 2019). It is worth mentioning that despite being programed to start in 2020 the law implementation was moved to 2021 because of the Covid-19 pandemic. Nonetheless, this municipal law approval is particularly relevant considering that organic waste represents on average 35% of the total household waste weight produced in Florianópolis (COMCAP, 2019). The rest of the waste are represented by recyclable waste like plastic, paper, metal and glass (42%) and non-recyclable material (22%) (see table 3.2).

Table 3.2: Composting and Recycle rates from 2018 (COMCAP, 2019).

	Total tons collected	**Goals Recycled/Composted**	**Actual Composted/Recycled amount amount**
Dry recyclable materials (paper, plastic, metal)	90.007 (42%)	21.602 (24%)	12.052 (13%)
Organic waste (household food waste, public gardens)	73.261 (35%)	18.315 (25%)	3,437 (5%)

The law promotes a OW management model that supports household composting and de-centralized waste management within the neighbourhoods in small OW treatment landfills. It also supports the production of high quality compost for the Urban Agriculture (UA) activities in Florianpólis. The composting method mainly used in Florianópolis and promoted by the FCL is the method from the Federal University of Santa Catarina called “UFSC method”. This method consists in composting windrows, made by vertical straw walls. The OW is placed inside the composting windrow and then covered with a straw layer. A decomposition process is carried out through passive aeration and thermophilic process (Neto & Miller, 2017; Trivella et al., 2016). These windrows can have several dimensions and applications from household to municipal scale. They can reach up to 3 meters of height and width, and 8 – 10 meters of length. Examples of the windrow are the ones in figure 3.1 and 3.1a from the municipal waste management company of Florianópolis “COMCAP” and from a household back yard garden. The OW is manually collected from 30 to 70 liters tanks and manually thrown in the composting yards. The main advantages related to this methodology lays in its ease of use and low investments required.

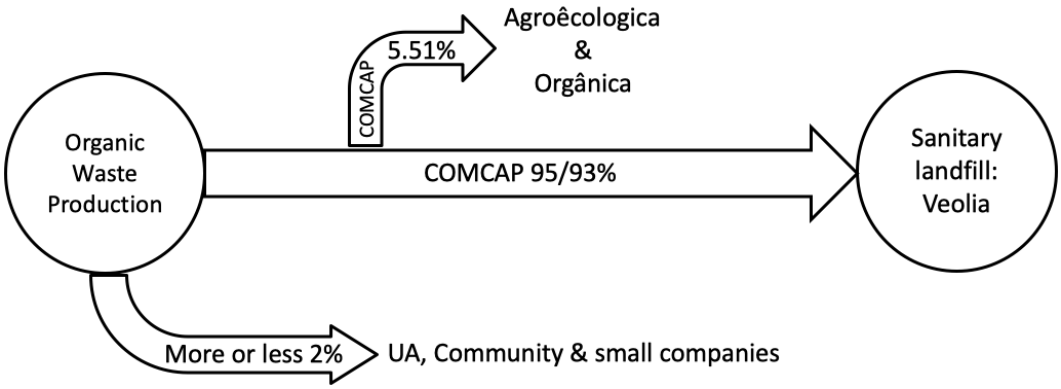
Figure 3.1: COMCAP composting landfill system.
Source: Author

Figure 3.1a: household composting.

Source: Author

Although the implementation of this technology started in 1994, the collection and treatment of organic waste has never been mandatory. Several attempts to support mandatory OW collection and treatment took place since the ’80 with several interruptions. The most successful and long-living OW management initiatives are those started by communities, like the Revolução dos Baldinhos literally meaning revolution of buckets (RDB). This project started in 2009, manages and compost the organic waste produced in the Chico Mendes community a peripheral community in the continental area of Florianópolis. This project, initiated by the Chico Mendes inhabitants, contributed to the creation of a community vegetable garden and successfully contained health issues related to lack of management of the OW (Abreu & Rover, 2013). Other small composting initiatives are promoted by local institutions working on Environmental and Waste management themes like those implemented in the Florianópolis Botanical Garden and in the *Córrego Grande* Park.
Still these community initiatives have little impact on the treatment of the municipal solid waste and the actual capacity of organic waste treatment in Florianópolis is very low. The total amount of organic waste composted by the municipal company COMCAP in 2019 was 4.019 tons of organic waste representing just the 5.51% of the total amount of organic waste produced in Florianópolis (COMCAP, 2019). The rest of the wastes produced in the city are treated in the Sanitary landfill managed by a private company (VEOLIA/PROATIVA) in Biguaçu 40 km far away from Florianópolis (see figure 3.2). The composting treatment will then represent a chance to reduce the environmental impact of the waste management, reduce the waste transportation cost, educational aspects and being an example of good practices for Brazilian and Latin America cities.

Figure 3.2: Florianópolis OW flow before the FCL.
The community and small companies’ treatment capacity is an esteem based on their average per day treatment capacity = 500kg/day.



3.3 Results

3.3.1 Subjects of acceptance

The interviews were conducted with 37 stakeholders considered to be relevant in several dimension of organic waste management. Following the framework, several groups representing the subject of acceptance, were assessed. A first group is represented by those members of the government involved in the law design. Furthermore, COMCAP technical experts and two former COMCAP presidents

were involved. A further group of stakeholders involved employees from COMCAP and public administrators with expertize on health and environmental regulations. In order to have some representative of the planning implications a public administration expert on urban geography, an urban planner and an expert on household projects have been involved.
Another group of stakeholders is represented by those potentially affected by the OW law and it includes large producers of OW like hotels restaurants and Food distribution centre. Private OW treatment companies were also involved including: 3 small companies with a treatment limit of 500 kg of OW per day; 2 representatives of the company that manages the COMCAP main composting yard; a semi-public OW treatment company treating OW produced in a hotel; the waste management company in charge of the Biguaçu sanitary landfill. Environmental education association were also involved including: 3 experts from CEPAGRO an NGO particularly focused on Composting education; the Brazilian president of the Zero Waste Movement; a project manager from the environmental education association *Instituto Çarakura*. Finally, stakeholders involved in the community waste management initiatives and UA were included. More specifically the initiator of the PACUCA a vegetable garden and OW valorisation initiative, the RDB project coordinator and the UFSC method initiator.
It is worth mentioning that the stakeholders' groups are often overlapping. Particularly regarding: i) the Environmental Education Associations, whose workers are often UA and community OW management activists; ii) the small OW management companies whose part of the workers are former UFSC students directly connected with the research activities of the "UFSC method" initiator.

Table 3.3: Interviewed stakeholders and stakeholders' groups.

Policy and decision makers	
Policy #1	COMCAP decision maker
Policy #2	COMCAP decision maker
Policy #3	FCL promoter
Policy #4	FCL promoter
Policy #5	COMCAP technical expert
Policy #6	COMCAP technical expert
Experts on Legal Framework	
Legal_Fr #7	Municipal expert on health and tropical diseases
Legal_Fr t #8	COMCAP expert on regulatory aspects
Legal_Fr #9	COMCAP expert on environmental education
Legal_Fr #10	Expert on Santa Catarina State Environmental Regulation
Legal_Fr #11	COMCAP expert on regulatory aspects
Legal_Fr #12	Expert on Florianópolis Environmental Regulation
Experts on Urban Planning	
Plann #13	Municipal expert on Urban Geography
Plann #14	Florianópolis Households Planner
Plann #15	Florianópolis Urban Planner
Large OW producers	
Prod #16	Representative of Santa Catarina's Supermarkets Association
Prod #17	Representatives of Santa Catarina's Hotels Association
Prod #18	Private Restaurant
Prod #19	Representative of the Florianópolis Food Distribution Centre
Prod #20	Representative of Florianópolis Private Businesses
Prod #21	Representative of Bars, Restaurants and Food companies association
Prod #22	Representative of Santa Catarina's Supermarkets Association
OW treatment companies	
Treat #23	Small treatment company
Treat #24	Company responsible for COMCAP treatment area
Treat #25	Small treatment company
Treat #26	Small treatment company
Treat #27	Company responsible for COMCAP treatment area
Treat #28	Semi-public treatment company

Treat #29	Sanitary Landfill company
Environmental education association	
Education #30	CEPAGRO (NGO active on composting practices)
Education #31	Instituto Çarakura - NGO focused on Environmental education
Education #32	CEPAGRO activist
Education #33	CEPAGRO activist
Education #34	Zero Waste movement president
Community OW treatment initiatives & UA activists	
Community #35	Community OW treatment and UA initiative PACUCA initiator
Community #36	UFSC method initiator
Community #37	Project Coordinator of Revolução dos Baldinhos

3.3.2 Object of acceptance: Benefits

The benefits mainly associated with the FCL are related with several environmental benefits. First it increases the possibility to reuse the compost as fertilizer for UA. A representative of a small OW treatment company reports how this material could be considered a resource:
"*Something that used to be […] waste is now transformed into a resource, into a raw material that can be used locally and transformed"* [Treat #26].
Another important benefit is related to avoid sending organic waste to the sanitary landfill. This will reduce the impact in terms of water contamination, air pollution and it is also related to a more ethical dimension on the correct treatment of this material. Finally, part of the environmental benefits is connected with reduction of carbon emission deriving from waste collection and transportation. Economic benefits are perceived in relation to public savings through aspects. A first aspect is related to supporting local and household treatment. Furthermore, as this FCL promoter suggests a large part of waste management cost is related with the transportation of this material to the sanitary landfill. He claims that *"by stop sending this waste to the sanitary landfill, we reduced a cost of 37 million R$ per year for the municipality."* [Policy #3].
Another aspect that needs to be considered is that there is a limit on the amount of waste that a garbage dump can treat. Usually this limit corresponds to a period of 20 years. OW represents on average 35% of the total waste produced in Florianópolis. The law could reduce the workload for the Sanitary Landfill as affirmed by a representative of the sanitary landfill management company
"The law effectiveness will reduce the amount of organic waste treated in the sanitary landfill consequently extending the sanitary landfill life." [Treat #29].
Other benefits associated to the FCL are social benefits. These social benefits include occupational opportunities deriving from new OW treatment companies that can be established as a FCL consequence. This is also confirmed by several interviewees including a representative of environmental education associations *"a lot of composting companies will start to come in Florianópolis"* [Education #34].
Furthermore, as the owner of a small OW treatment company reports the FCL can contribute to citizens' food security and promote a more sustainable food provision model since "*communities can produce food by themselves that can be easily accessible and that will generate income, will generate food security. "*. [Treat #26]
The law is also representing an opportunity to sensitize the citizens on waste separation and environmental education and "*can lead more people to raise awareness on the topic*" [Treat #26]. A last social benefits indicated by the interviewees is the possibility of enhancing the role of the community waste management initiatives and support their role as community builders. The RDB is an example of this "*The RDB is a solution to several problems. We are talking about garbage, but*

we are also talking about reducing violence, potentially generate income, interact with the community" [Community #37]
Finally, several stakeholders reported that the FCL ensures continuity to the several existing waste management initiatives and projects. This law establishes a formal commitment to use financial resources in order to reach the goal of a 100% of organic waste treatment. This is seen by the stakeholders as a positive aspect ensuring continuity to all those small waste management businesses and associations. "*for people working in this field is great to have this regulation*" [Treat #24]

3.3.3 Object of acceptance: Risks

The interviews showed a series perceived risks associated with the FCL. One of the most reported perceived risks is related with a possible increase in taxes. Citizens and private businesses are afraid that the FCL implies an increase on the annual taxes on waste management as this large OW producer suggests: "*the government can't create money. he will have to share this cost with society*" [Prod #20]
Stakeholders also reported that composting systems could facilitate tropical insects' proliferation and the diseases related with these insects. Technicians are afraid that organic matter in decomposition could potentially attract insects as well as rats. Although the UFSC composting method has been tested and used throughout a period of 25 years, if not well managed it can cause harmful insects' proliferation: "*We know that there are diseases […] transmitted by an insect […] This insect reproduces in decomposing organic matter […] Furthermore, in open air composting systems, the chance of attracting rodents is very high"* [Legal_Fr #7]
Part of the perceived risks are related to potential environmental impact due to water contamination. Even though the UFSC method is not a particularly complex technology, it requires technical knowledge, assistance, maintenance and materials. The composting yards' limits can be reached and there is not a clear strategy on how to deal with materials scarcity: "*I think this method has a certain operative limit...sometimes they [other OW treatment activities] had to came here to ask for materials*" Treat #28. The lack of these elements is then perceived as potentially increasing the chances of bad management of the composting yard and increase the environmental risks.

Table 3.4: FCL major perceived benefits and perceived risks

Benefits	***Risks***
Environmental Benefits	***Environmental Risks***
• *Use of the compost in UA (cited 47 times)*	• *Environmental and water contamination risks (cited 10 times)*
• *Environmental impact (cited 32 times)*	***Economic risks***
Economic Benefits	• *Tax increases for private companies (cited 38 times)*
• *Public costs reduction (cited 43 times)*	***Social Risks***
Social Benefits	• *Health issues related to its bad management (cited 28 times)*
• *Job creation (cited 23 times)*	
• *Citizens' awareness (cited 23 times)*	
• *Local OW management initiative valorization (cited 17 times)*	

3.3.4 Context: Promoting factors

The interviews revealed a series of aspects that can potentially promote the successful implementation of the law. Most of these aspects are related to some characteristics of the society of Florianópolis. The society has been described as particularly open to environmental innovations and past experiences affected citizens' awareness on OW themes as affirmed by a COMCAP employee: "*The composting program "Prográma Beija-Flor" […]started [...]in '86, […]until '95 / '96 […]we never abandoned the idea […] So I think that in a way this left a root"* [Legal_Fr #9]
Other promoting factors are linked to the role of the University in the field of OW treatment, particularly thorough the UFSC method. According to stakeholders from environmental education association the UFSC "*encourages many professionals who work in the composting area"* [Education #34]. Furthermore, the good level of experience with the method guarantee a certain level of safety: *"I really have no worries about handling…it is such an old knowledge"* [Education #31].
Finally, the existing legal framework seems to promote the law. There are several national laws from which local and regional OW management regulations derive. The legal framework thus promotes the adoption of local strategies for OW treatment and seems to reflect the Florianópolis public agenda. A treatment company owner refers particularly to the 12305/2010 law "*the 2010 law the 12305 [...]says that all types of waste must be returned to the production cycle itself. And organic waste has been included too*" [Treat #26]. Other supporting decree is represented by *"The "Zero Waste" decree that the city signed, saying that the city will be garbage free by 2030"* as suggested by a CEPAGRO member [Education #30]

3.3.5 Context: hindering factors

Stakeholders mentioned different factors that can hinder the successful implementation of the FCL.
Some hindering aspects are related to lack of technology and resources for the waste treatment. The UFSC method is very affordable and easy to use, but "*it is a very rough job, because you work with that 50 litres tanks"*. [Treat #25].
This aspect, together with the time demand of the UFSC method (depending on the quantity can require up to 6 months) hinders the effectiveness of the FCL as confirmed by a COMCAP technical expert: *"Treating huge waste amount through […] the UFSC thermophilic process won't be viable. We will need a more accelerated treatment so that we can treat more in a smaller area."*. [Policy #6]
A possible solution can be represented by the adoption of new technology like bio digesters but there is not *"any sort of technology like that…in Brazil I don't know about a bio digester for municipal organic waste*" as it has been described by a technician from COMCAP [Policy #5].
Another hindering factor is the rejection from part of the society in changing their household waste management habits. An expert on COMCAP regulation affirms that citizens could have difficulties in accepting both a change in their behaviour and a possible taxes increase: "*I'm sure that […] in 2030 […] we will still have people not doing it*" [Legal_Fr #11]. A decision maker from COMCAP describes the Florianópolis context as characterised by daily commuters and tourists coming to the city. These subjects are not so aware of the Florianópolis waste management regulations: *"Florianópolis […] is a city where those who study and work in the city do not actually live in the city but they produce waste [...] they throw their waste in the first place they find […] Florianópolis is [...] a touristic city, the people who come to the city do not have the same awareness or concern, because the city is not theirs"* [Policy #2]. These two aspects together can hinder the FCL implementation, particularly during the touristic season.
Another hindering factor is related to a lack of strict regulation. The interviewee stakeholders say that the law is not so strict for two main reason:

- there are no indications on fines and measures against those not complying the law. "*Unfortunately, due to lack of regulation, the ways we have today for inspecting the law compliance are not effective."* [Prod #20].
- There is not a clear definition of large OW producer "*the law says that will start from Large producers but does not specify who can be considered a Large OW producer*" [Treat #26].

Furthermore, as an urban planner suggests the FCL can be hindered by the complexity of the territory. "*well…if you think of an island that is 50 km long from north to south, with roads that end up all in the same place (here on the bridge) that is the only way to connect the island to the continental area […] where all the waste is"* [Plann #13]. Other geographical characteristics create several difficulties and cause communities' isolation *"in the central area there are hills that the garbage truck cannot reach, the streets are narrow or so steep … in "Costa da Lagoa" you can only get there by boat. […] So we have a very eclectic geography, which complicates our operation in the waste area."* [Plann #13].

As a law promoter suggests the political view can hinder the successful implementation of the waste management law. There is the fear of possible bad administration due to the perception that *"How politics works is still very bad."*, policies are not well applied and "*possible pressures coming from part of the society willing to build a bio digester […] and privatize the waste management system*" can collide with the FCL model [Policy #4].

Finally, a factor that has been addressed by a community OW practitioner and reported by other stakeholders is the contrasting view between COMCAP and community waste management initiatives. This leads to OW initiatives isolation in peripheral areas in terms of public services support in *"receiving material, or having street cleaning services"* [Community #37]. This consequently intensifies the contrast between the public institutions and peripheral communities.

Table 3.5: FCL promoting and hindering factors

Promoting context factors	***Hindering context factors***
• *Environmental aware society (cited 65 times)* • *History and Cultural Background in composting initiatives (cited 74 times)* • *Research and technology (cited 53 times)* • *Legal framework (cited 23 times)* • *Political framework and institutions' commitment (cited 25 times)*	• *Lack of infrastructures (cited 78 times)* • *Lack of citizens' acceptance (cited 59 times)* • *Spatial issues and tourism (cited 49 times)* • *Lack of regulation (cited 44 times)* • *Political view and Lobbying (cited 43 times)* • *Conflictual view between COMCAP and communities' OW initiatives (cited 24 times).*

3.4 Discussion

The aim of the paper is: i) to assess the level of acceptance of the FCL by evaluating how stakeholders perceive the risks and benefits related to the FCL; ii) to address contextual factors that could influence the successful implementation of the FCL.

The results show that the benefits assessed are mainly environmental and social. The perceived environmental benefits are related to the potential reduction of the ecological footprint caused by OW

transportation and treatment. Although these benefits are in line with what reported in literature (Sikora 1998; Larney at al., 2006; Zeiss & Atwater, 1987) Florianópolis stakeholders associate as the main environmental benefits the agronomic use of the compost for household and community vegetable gardens. This is particularly relevant in enhancing the relation between UA and OW management system (Cofie et al., 2006).
The economic benefits are related to avoiding of sanitary landfill disposure with a reduction of public expenditures. The cost reduction is an aspect that is being debated in the literature and it is context related. From the point of view of the waste treatment, composting does not always come with public costs reduction when compared to landfill disposal (Renkow & Rubin, 1998). On the other hand, when environmental and educational aspects are included in the cost analysis, composting could support public costs reduction (Mu et al., 2017; Farrell & Jones, 2009).
The social benefits assessed in the results are particularly linked to the Florianópolis characteristics these benefits are associated to new job opportunities and marginal communities' empowerment. This could be of particular importance since in the context of Florianópolis there are initiatives like the RDB that have positive impact on the community wellbeing. Furthermore, these kind of initiatives could be an example of good practices for similar context both in Brasil as well as in other countries. The kind of benefits revealed by the stakeholders seems to be very connected to the contextual tradition of urban farming and community waste management initiatives, which represent the main characteristic of the context of Florianópolis regarding waste management.
The major concern of the stakeholders is related to taxes increase. This is a common perceived risk when public policies on waste management are approved (Wolsink, 2010). Nevertheless, it is worth mentioning that the law itself does not give the certainty of a tax increase and the proponent discusses about possible tax discounts that could be applied for those who are composting their organic waste and payments for the small community initiatives of OW treatment. The main preoccupation on tax increases comes from private businesses and big waste producers. This can represent a problem for part of the citizens but can also discourage the successful implementation of the law itself due to possible rejection within the population. The second most mentioned perceived risk is health issue. Diseases vectors proliferation in composting methods similar to the UFSC has already been reported in the literature (Mudruňka et al., 2017; Haug, 2018). Bad management of the composting yard could also lead to issues related to environmental risks like ground water contamination. Organic wastes are more than 70% composed by water. Heavy rain or absence of any efficient draining system can increase the chances of groundwater contamination (Wei et al., 2017; Korboulewsky et al., 2002). On the other hand, these negative externalities appear when the composting yard management is inappropriate. The institutions involved in Florianópolis environmental management reported composting guidelines for composting yards' implementers (FAPESC, 2017) and no severe accidents have been reported in relation to the UFSC method.
Several promoting aspects emerged through the interviews. These aspects are connected with the Florianópolis cultural background. The city has a well-established network of institutions and associations working on the theme of OW management. This network is mainly represented by the university where the UFSC method was studied and developed. Environmental education associations acting on the territory since several years, have also played an important role in citizens' education. Furthermore, stakeholders describe Florianópolis civil society as particularly sensitive to environmental issue. This, together with a proactive political view and the absence of particular legal or urban planning boundaries, could support the successful implementation of the Municipal Law.
Hindering factors emerging from the analysis of the contextual aspects, emerged. The lack of a clear guideline regarding the operational implementation could delay the law initiation. Furthermore, the lack of technical requirement and economical resources could hinder the effective collection and treatment by the COMCAP. Other aspects that could potentially hinder the success of the composting law are related with the lack of cooperation between the several small composting initiatives in marginal areas and the COMCAP management. The lack of technical assistance in terms of waste

collection and treatment in peripheral areas could compromise the implementation of the law and increase social conflict.
Finally, the most critical aspect is represented by different vision of the waste management model. This represents the main point that needs to be addressed in the next years. On one hand, a centralized model of OW management that concentrates all the resources towards a bio-digester technology could surely represent a viable solution in terms of energetic efficiency, but it requires huge investment from the community or private sector. Furthermore, this solution would not stand with the principles of the FCL and would not valorize the existing small composting initiatives started through the latest decades.
A decentralized model through the UFSC method is the one supported by the law promoters, small composting initiatives such as Revolução dos Baldinhos and small private companies. Although it does not treat OW as efficiently as a bio digester the UFSC method is already widespread throughout the city and it does not require big investments for its implementation. Furthermore, case studies have already shown the potential positive impact on organic fertilizers production, that a widespread OW management treatment strategy can have (Barboza et al., 2011). The main critical aspects lay on the above mentioned safety issues related to health risks and water contamination. Nonetheless this model is already well known and implemented in households, vegetable gardens, University, municipal parks, small private companies, community initiatives of OW treatment. Furthermore, guidelines for its correct management have been drown by the university and developing a decentralized model will reduce the composting yards' dimensions sensitively reducing the composting yard risks (Oliveira et al., 2017; FAPESC, 2017). Furthermore, despite the lack of huge investment the small community initiatives and businesses already manage to compost almost half the OW tons treated by COMCAP (see figure 3.2). Apart from the low investment required the main advantages of this model derive from its participatory approach and ease of use. This model empowers local communities' capacity building and could support job creation, environmental education, community building and well-being in marginal areas. Finally, a decentralized model of OW management will represent an example of good practices that could be followed by other cities needing to solve the OW management issues with limited investment capacity.

3.5 Conclusion

The present section of the thesis describes the level of social acceptance of the 2019 FCL. The value added provided by the present study relates to the identification of critical aspects of the FCL constraining the implementation of an efficient OW management system. Another relevant contribution was provided by the analytical framework which was defined in the first part of the manuscript, allowing to address the social acceptance of the FCL, answering the main research question reported in this part of the manuscript. In particular, the analytical framework allowed the identification of the subjects involved; it also allowed to identify the main dimensions that needed to be addressed to assess the FCL social acceptance; this helped to identify the stakeholders involved in each specific dimension characterizing the municipal waste management of Florianopolis. The perceptions that the stakeholders associate to the FCL have been also assessed supporting the municipality of Florianopolis in the implementation of their Municipal Organic Waste management strategies within the framework of the FCL. Furthermore, through an integration with the social acceptance approach from Specht at al., 2016, a description of the risks and benefits, as well as the main hindering and promoting factors, was allowed. The main advantage that is derived from this section is the possibility to implement the analytical framework not only in the UA analysis but also in other urban research fields like waste management.
Further studies should address the assessment of the citizens' perception of OW and their waste management habits, which is lacking in the present section. To this end the investigation should focus on those who are participating in activities supporting OW treatment like Urban Agriculture which represents a key element in the FCL strategy.

4) Participation in urban agriculture activities positively influences household organic waste management habits - A quantitative study from Florianopolis, Brazil

Abstract: Correct household organic waste management practices are crucial in order to limit the negative environmental and health impacts caused by inappropriate treatment of municipal waste. The impacts of organic waste have been described in the literature and its main treatment strategy relies on technical facilities such as bio digesters. Nonetheless, such technologies require financial investments, which could hinder their application in contexts where it is not economically sustainable. Among the several organic waste treatment strategies, the role of Urban Agriculture (UA) is being increasingly considered. Even though the literature suggests that UA can contribute to organic waste management by providing a service for its treatment and compost exploitation, little has been investigated so far on how participation in UA can influence household waste management behaviors. To this end the present paper analyses the role of UA participation along with other demographic variables such as age, gender, education, income and housing conditions in influencing citizens' household organic waste management behaviors. The city of Florianopolis in Brazil has been selected as a case study since the municipality of Florianopolis recently approved a new organic waste regulation law that supports the use of organic compost for UA. We surveyed 206 individuals regarding their household organic waste management habits in the four behavioral areas: (i) separation, (ii) reduction, (iii) recycling and (iv) re-use of organic waste. The dataset comprises 102 individuals, who were actively engaged in UA activities and 104, who were not involved in UA, in order to allow a comparison of habits between the two groups. The results showed that the UA-participants are more likely to separating and self-treating their organic waste in order to use the derived compost for gardening activities. The use of public facilities for organic waste management is instead rather influenced by peoples housing conditions. Respondents, who live in an apartment with no access to a garden have a sensibly reduced willingness for self-treating the produced organic waste compared to respondents, who live in a house with garden access. On the other hand, results showed that UA-participants are composting their own organic waste independently from their housing conditions. The results showed a strong positive influence of the participation in UA on self-composting and thereby highlighted the role of UA participation in sensitization of urban dwellers and support to local organic waste management strategies. Even though there is still an open debate on the role of UA in organic waste management, this paper highlights that this relation could support a potential shifting towards a circular approach of organic waste treatment.

4.1 Introduction

The appropriate management of household waste is a challenging task affecting municipalities worldwide. Organic waste represents up to 50% of the total municipal solid waste production, and it is attached to several health and environmental threats (Stenmark et al., 2016). The potential negative impacts related to organic waste are particularly relevant since they represent the largest fraction of municipal solid waste and its inappropriate management could cause severe health issue related to "volatile organic compound" and possible water and soil contamination (Nie et al 2018; Clark et al., 1984; Domingo & Nadal, 2009). Previous studies revealed, that the per capita production of

household organic waste mainly comes from food waste and just as the municipal solid waste, household organic waste production is increasing (World Bank, 2020). Furthermore, the growth of per capita waste production could worsen these problems especially in developing contexts (Struk, 2017).

Organic waste management and treatment is part of the urban systems and it therefore impacts on several dimensions of the urban metabolism (Kibler at al., 2018). As described by Bahers & Giacché (2019), the concept of urban metabolism is related with the analysis of the energy and material flows. Even though organic waste is considered an output deriving from urban anthropic activities, its use as input for agriculture in urban environment has been assessed by McClintock in the "Metabolic Rift" approach (McClintock, 2010: 2). According to the author the actual food production system leads towards an unbalanced provision of inputs for food production (fertilizers) causing a series of environmental consequences related to the soil overexploitation (*ibidem*). The implementation of food production for the cities through Urban Agriculture (UA) could potentially lead to a circular use of organic waste by turning it into an input for UA through the composting process, thus buffering the soil overexploitation consequences (Grard et al., 2015; Deelstra & Girardet, 2000).
Case studies show that compost use through urban agriculture (UA) is an aspect that is being considered by the municipalities and that could be a cornerstone of more sustainable organic waste management systems in terms of: carbon emission, reduced risks of water and soil contamination, savings on municipal budgets and better citizens' habits (Weidner & Yang, 2020; Mohareb et al., 2017, Bahers & Giacché, 2019).

The general theme of organic waste reduction is considered one of the major global challenges and embraces part of the Sustainable Development Goals (SDG 11; SDG 12) and it is increasingly being discussed in public institutions' agendas and scientific literature (UN, 2015; Cicatiello & Giordano, 2018). Caputo et al. (2021) conceptualize how people shape the nexus of urban food, energy, waste and water flows and how these inputs and outputs are related to people's behaviors in the context of UA. Even though strategies for organic waste management and treatment, including mandatory separation of the household organic wastes, is globally growing, these initiatives still require significant changes in citizens' awareness and behaviors (Swani et al., 2011). Therefore, the relation between policies implementation and citizens' behaviors is relevant for policy makers. This will contribute to improve the effectiveness of the waste management processes in terms of resources availability and citizens' participation (Wan & Shen, 2013). While a few studies investigated the input flows for UA, with a focus on fertilizers derived from organic waste composting, (Bahers & Giacché, 2019; Weidner & Yang, 2020; Grard et al., 2018) the importance of assessing the role of UA in the organic waste management systems and its impact especially on citizens' waste management habits, emerged.

To this end, the aim of this paper is to analyze citizens' organic waste management behaviors, particularly focusing on whether participation in UA has an impact on citizens' awareness and if UA participation can foster the improvement of household organic waste management.
Thus, the present study analyses the influence of the participation in UA (along with further demographic variables) on household organic waste management behaviors. In particular, our analysis answers the following two research questions:

1) Which factors influence the household organic waste management?
2) Are there any differences in organic waste management behaviors between UA-participants and citizens, who are not involved in UA activities?

4.2 Analytical Framework

Assessing waste management behaviors implies a complex approach that addresses both social and psychological dimensions. Previous studies explored the factors influencing the household waste management behaviors (Swami et al., 2011; Tucker & Speirs, 2003). These behaviors are divided in four main types (Barr, 2007; Zheng et al., 2020). Each of the following can be applied to organic waste management behaviors assessment, in particular:

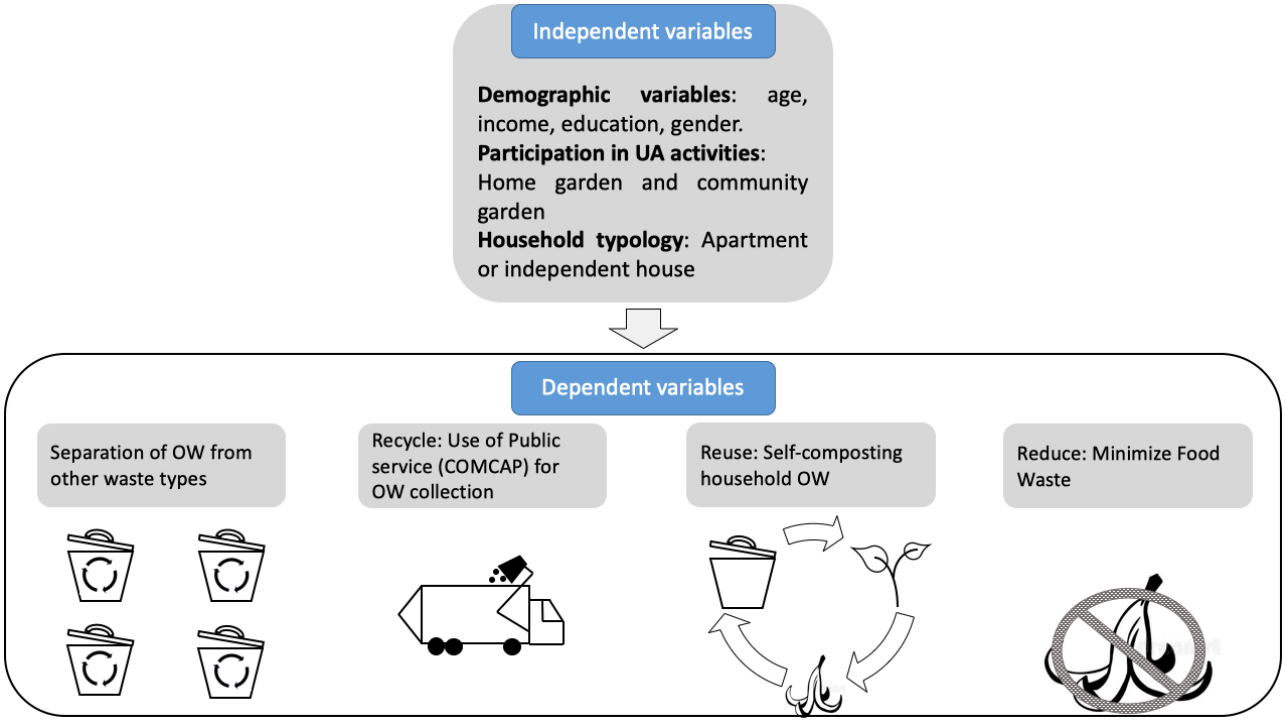
- *Separation*: The separation of different typologies of waste at the household level is the strategy municipalities are adopting (Zhang et al., 2017; Xu et al., 2017). The effectiveness of composting procedure is particularly related on how good the food and kitchen waste has been separated at the source (Bernstad, 2014; Boonrod et al., 2015).
- *Recycle:* The produced waste could be separated at the household level and recycled involving public or private services for its treatment (Barr, 2007). Organic waste could be separated and recycled through several composting systems like composting yards, biofuel and biogases production by public or private companies (Polprasert, 2007).
- *Reuse:* Household wastes can be reused. Just as plastic containers, glass jars and repaired items can be reused rather than thrown away (van Heek et al., 2017), household organic waste could be composted in a household space and reused for home gardening and UA (Bartelings & Sterner, 1999; Cofie et al., 2006).
- *Reduce:* Waste management is strictly related to its production and reducing the waste production has several benefits for the waste management. In the case of organic waste the reduction behavior could be directly related with the habit of reducing the household food wastes (Graham-Rowe et al., 2015).

Laws regulating waste separation and recycling could encounter possible rejection from the population since it requires changes in citizens' behaviors. The adoption of new behaviors is influenced by several factors related to socio-demographic characteristics (Bortoleto et al., 2012). The literature suggests that willingness to separate household waste separation is influenced by factors such as higher education and income (Bernad-Beltrán et al., 2014; Keramitsoglou & Tsagarakis, 2013). Other aspects that can influence waste separation are the access to waste management facilities within the household (Bartelings & Sterner, 1999). Finally, environmental friendly behaviors and attitude results to have a strong influence on the recycling adoption (Tonglet et al. 2004, Knussen et al., 2004).

Together with the demographic aspects influencing the household behaviors, the participation in UA in influencing the waste management is taken into consideration in our analytical framework (see figure 1). UA has been included since it represents one of the tools for organic waste treatment and it is also considered as an awareness raising activity, especially regarding environmental issues (Travaline & Hunold, 2010; Ferreira et al., 2018).

Therefore, a series of independent variables have been addressed in order to assess their influence on the previously assessed organic waste management behaviors: Separation, Recycle, Reuse and Reduce. These independent variables include the participation in UA and demographic aspects: age, gender, income, education, housing conditions (see Figure 1). The same framework was also applied to a sub-sample representing UA-participants only. The aim was to assess the organic waste management behaviors within the group of UA-participants in order to detect differences according to the type of UA they were participating in (home gardens versus community gardens).

Figure 4.1: Analytical framework for the analysis of organic waste management habits. (Based on Barr, 2007; Zheng et al., 2020)



4.3 Materials and methods

4.3.1 The case study of Florianópolis (Brazil)

The study was settled in Florianópolis the capital of Santa Catarina state in southern Brazil, where the relationship between UA and OW has been recently institutionalized through the 2019 Florianópolis Composting Law. The main characteristics of the Florianópolis OW management system is that part of the household OW are treated by community initiatives through PEV (Pontos de Entrega Voluntaria), consisting in composting yards where citizens can freely dispose their OW. These community initiatives are particularly important in prevent health and pollution issues related to OW in marginal communities, where the public service lacks in collecting the produced wastes.

Figure 4.2: Examples of Community waste management initiatives.
Visitors are observing the composting yards from "Revolução dos Baldinhos" (left). A community gardener is preparing the compost from the organic waste collected through Voluntary Collecting Points (PEV) (right). Source: Authors

4.3.2 Survey design and data collection

A questionnaire was designed aiming at collecting different aspect of organic waste management beahaviours and UA participation (Annex 1). The first section of the questionnaire was for UA-participants only and aimed at addressing the motivation for participating in UA activities. Respondents were asked whether or not a particular aspect (eg.: food security) influenced their participation in UA. Through the questionnaire, we collected further information on their participation in UA such as, the type of UA activity in which they were participating.
The second section was targeting at organic waste management habits in particular, questioning whether or not the respondents were separating their organic waste and about their motivations to start separating organic waste. In this case the respondents were asked to indicate how they started to separate their organic waste (eg.: thorough their family). In the second section the respondents were also asked to indicate the destiny of their organic waste (e.g. re-using through compost or use of a public service collecting system). The respondents could answer more than one destiny. Finally, the respondents were asked to indicate an esteem of the food waste after a meal.
The third section aimed at collecting demographic data. In particular: age, education, employment, whether they were living or not in an apartment and household income.
The survey has been conducted in bus stations in Florianópolis from June 2019 to August 2019 and in November 2019. The central bus station was chosen because it increased the possibility of having a wider range of citizens coming from different neighborhoods. The sample was a convenience sample more than 500 people were approached out of which 167 accepted to participate. From the sample in the bus station, 63 individuals were already engaged in some UA activities (either a home garden or a community garden), while 104 were not involved in UA activities. In order to reach an even balance within the sample of UA-participants and non-participants, the survey was distributed to 39 members of the Urban Agriculture Municipal Program, who were directly approached and asked to answer an on-line version of the questionnaire.

4.3.3 Data analysis

The first analytical step was to identify clusters of citizens according to their drivers to separate their organic waste, the participation in UA and the destiny of their organic waste. This was performed through a Latent Class Analysis. The Latent Class Analysis allows to address separated groups according to their characteristic. It is similar to the cluster analysis, but is a method more suitable for binomial variables. It has the limit that does not provide any information on the correlation between variables but it only shows the probability that the subjects of the cluster show a certain categorical value for a particular variable. The aim of the Latent Class Analysis was to assess the factors differentiating citizens' groups in order to analyze them with a logistic model.
In order to have a better description of the relationships between the variables four logistic models were performed for each of the waste management behaviors assessed in the literature. The dependent variables were represented in turn by: i) the separation of organic waste from other waste typologies; ii) the recycle variable reported through a binomial variable assessing the use of public services (COMCAP) for organic waste management; iii) the self-composting variable that was represented by a binomial variable reporting the self-composting habit; iv) the food waste variable was collected through a Likert scale estimating the frequencies of waste production after a meal. Since the food waste was a 5-item Likert scale an Ordered Logistic Model was performed. Each of the model stepwise process has been performed in order to reduce the independent variables number and increase the models' likelihood.

4.3.4 Empirical basis – Respondent's demographics

The sample consists of 206 respondents in total, composed of 102 UA-participants and 104 respondents, who are not involved in any UA activities. The average age of the respondents is 42 and the category that is mainly represented is the population between 18 and 30 years old. In order to have an even gender representativeness the sample was designed in order to have distribution of 103 males and 103 female respondents. The majority of the interviewed are employees in private companies, the remaining categories were evenly distributed. The education level was mainly high school and the income level on average is from 1 to 3 minimum wages considering one minimum wage equal to 998 Brazilian Reais (corresponding to more or less 250 euros in the period of the data collection) (see Tab 4.1).

Table 4.1: Respondents' demographics.

	Measure	**Percentage**
Gender	Male	50%
	Female	50%
Education	Primary School	4%
	Middle School	9%
	High School	42%
	University	38%
	Master/PhD	7%
Income level	< 1 minimum wage	11%
	1 < 3 minimum wage	45%
	3 < 5 minimum wage	20%
	5 < 7 Minimum Wage	13%
	7 minimum wage <	7%
	NA	4%
Age	18-30	28%
	30-40	21%
	40-50	16%
	50-60	17%
	60 <	16%
	NA	2%

4.4 Results

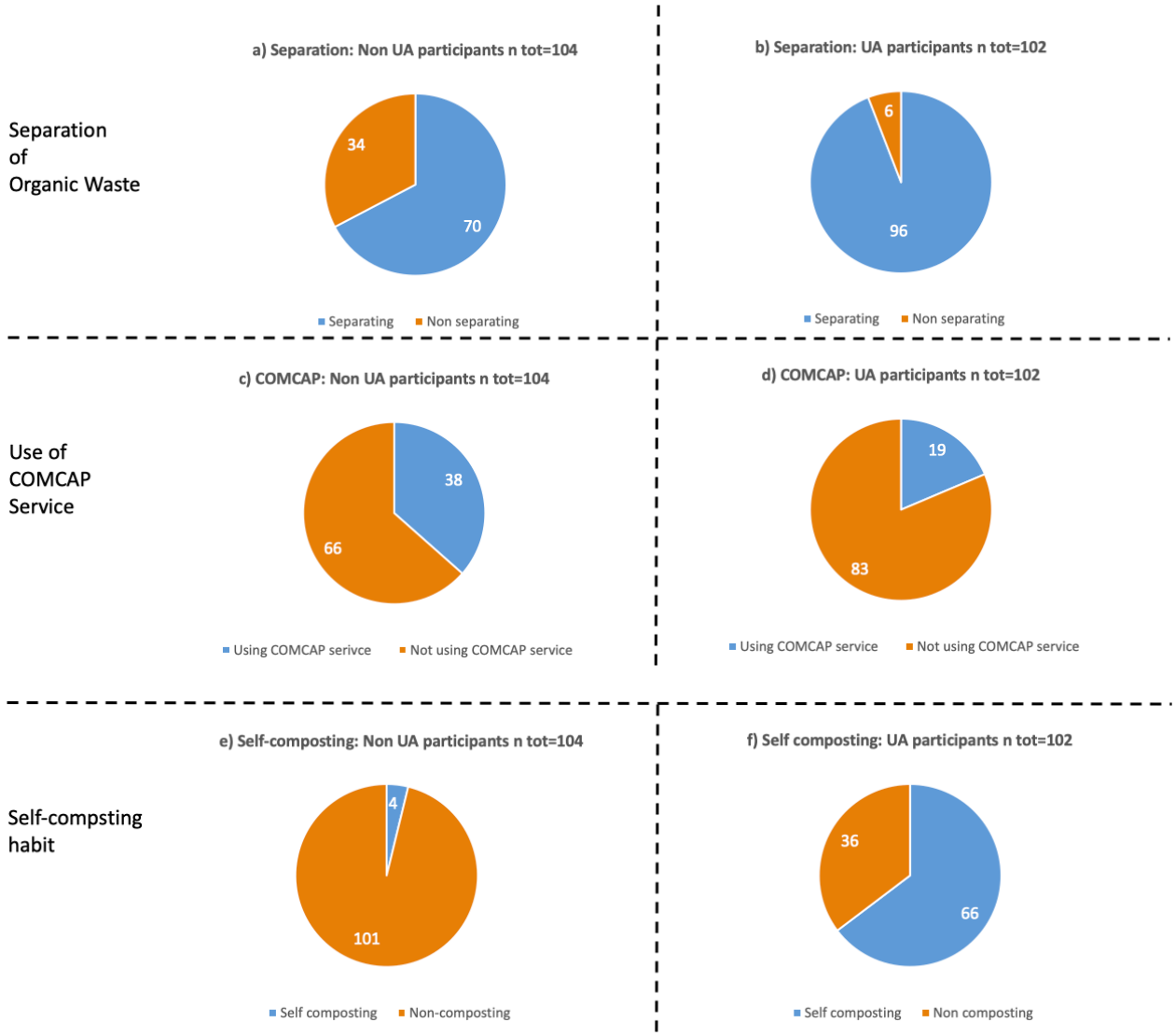
4.4.1 Separation habits and UA motivations

The majority of respondents (91,7 %) were aware of what organic waste is, the majority of the sample was also separating their household OW (80,6 %). The majority of the UAP are home gardeners (57,8%), the other category involves those participating in Shared forms of UA like community gardens, school gardens or vegetable gardens in workspaces (42,2%).

The organic waste separation was performed by 70 out of 104 subject that were non-UAP. While 96 out of 102 UAP were separating their organic waste. The destination mainly reported by the non-UA participants is use of public services from COMCAP (38 out of 70). While the organic waste

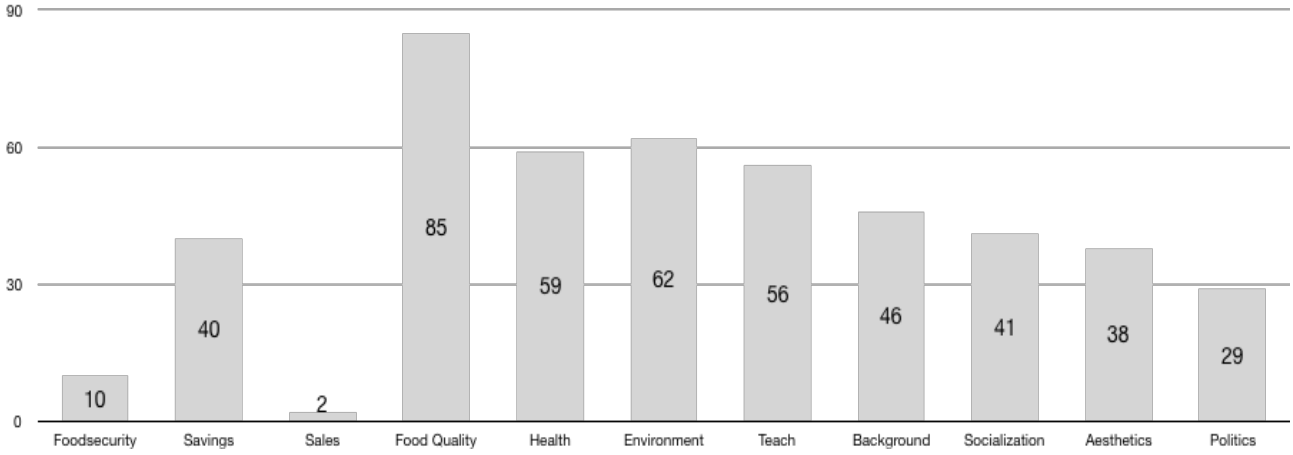
destination indicated by UA participants was self-composting (66 out of 102) (see Figure 4.3). It is worth noting that part of UA participants was indicating other destination rather than public service use or self-composting. In particular, 18 where directly adding part of their organic waste to their plants with no treatment; 17 were using PEV for organic waste treatment, and 10 were using part of their OW for animal feeding.

Figure 4.3: main organic waste management habits.
(n tot=206)



The motivations indicated by UAP as driving their participation in UA activities were the search of high quality food (85), the environmental education (62), their psychological and physical health (59) and the willingness to teach something to people they care off (56). Other motivations were related to agricultural background (46), economic savings (40), socialization (41), aesthetics (38) and political criticism (29). Food security (10) and products' sale (2) were rarely indicated by respondents (see figure 4.4).

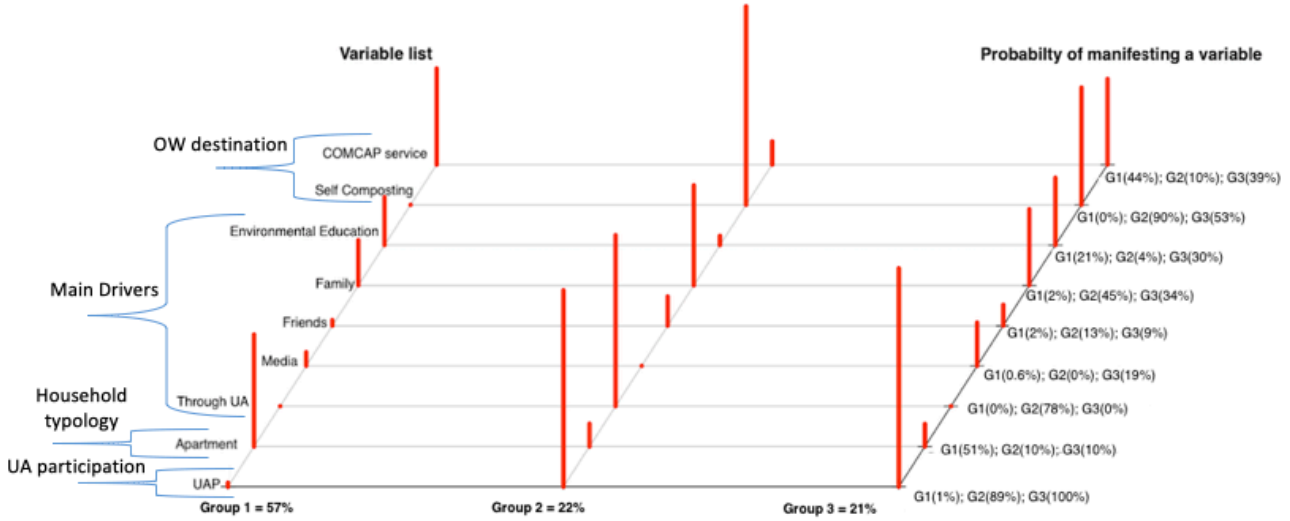
Figure 4.4: number of UAPs citation for each type of motivation



4.4.2 Citizens' groups definition

Differences between respondents emerged also through the Latent Class Analysis. In order to have a less fragmented result, the Latent Class Analysis was performed focusing only on the two main destinations assessed within the sample: the use of public composting services versus self-composting. The Latent Class Analysis addresses the groups of individuals according to four factors: their participation to UA, their drivers to separate organic waste, their household typology and the destination of their organic waste. A first exploratory Latent Class Analysis was performed with a simple two-groups assessment. Two separate groups clearly emerged, differentiated by a higher probability of participating in UA and a higher probability of self-treatment of their organic waste for one of the two groups. At second stage, a three groups Latent Class Analysis was performed and the results show a group (Group 1) with a low probability of participating in UA that clearly differentiate itself for a lower probability of self-composting the organic waste. The other groups (Group 2 & Group 3) are characterized by a higher probability of involving UA participants. The main differences between Group 2 and Group 3 are the lower probability of use the COMCAP service for Group2 and a lower probability of organic waste composting for Group 3 (see Figure 4.5).

Figure 4.5: Latent Class Analysis results.
The red columns represent the probability that a random subject from each group could manifest a certain variable. The exact percentages are reported on the right side of the graph. (e.g. a random member of group 1 has 1/100 probability of being involved in UA and 51/100 probability of living into an apartment)



The Latent Class Analysis provides a clear distinction of the groups according to their participation in UA and the drivers supporting their decision to separate the organic waste. The three groups observed can be summarized as follows: the first group (Group 1) are citizens living in an apartment and non UA participants, who are treating their organic waste through the public service; the second group (Group 2) are UA participants who started to separate their organic waste through their participation in UA and are rarely using the public service; the third group (Group 3) has similar characteristics with the second group except from the lower influence of participation in UA on organic waste separation and tend to use more often the public service (see Figure 4.5).

4.4.3 Household waste management habits

Separation

A first model was performed in order to assess the factors influencing the separation of the organic waste. The dependent variable was represented by the binominal variable organic waste separation while the independent variables are the binomial variables living into an apartment, participation in UA and the demographic variables age, income, gender and education level. The results show a positive influence of participation in UA and living into an apartment on organic waste separation. The validation through a stepwise process confirmed these results and excluded the demographic variables (see Table 4.2). The model after the stepwise process now includes two independent variables: household typology apartment and participation in UA. Both are positively influencing the organic waste separation behavior.

The assessment of the different organic waste management behavior patterns has been developed through three logistic models that aimed to assess the three waste management habits: recycle, reuse and reduce (Barr, 2007). The tables are reported as after the stepwise process. The stepwise process excluded variables with no influence on the dependent variable from the models.

Table 4.2: Logistic regression of organic waste separation after stepwise process

	Estimate	St.Error	Pr (>Chisq)	Model Nagelkerke Pseudo R square
Participation in UA	1.779	0.57	0.001**	0.67
Apartment	1.714	0.61	0.005**	-

Recycle.

Recycle habits was assessed through a question asking whether or not the individuals were using the public service of organic waste collection performed by COMCAP. The model dependent variable was represented by the use or not of COMCAP services while the independent variables were represented by the participation in UA and the demographic variables (age, education, gender, income, household typology).

The stepwise process excluded UA participation as influencing variable on the use of COMCAP services and the derived model included living into an apartment and income as independent

variables. Living into an apartment has a significant positive influence on the use of COMCAP services with a p value lower than 0.05 (see table 4.3). The likelihood of the model is high.

Table 4.3: Logistic regression of use of COMCAP services after stepwise process

	Estimate	Std.Error	Pr (>Chisq)	Model Nagelkerke Pseudo R square
1 < 3 minimum wage	0.43	0.80		0.72
3 < 5 minimum wage	1.28	0.85		-
5 < 7 Minimum wage	1.54	0.95		-
7 minimum wage <	2.29	1.22	0.06 .	-
Apartment	1.26	4.51	0.04 **	-

Reuse

The reuse habit was related to the habit of self-treatment of the household organic waste. The dependent variable in this case is represented by whether or not participants are self-composting their organic waste. The independent variables were participation in UA and demographic variables. The logistic model related to the composting habit shows a significant influence of participation in UA on the self-composting behaviors (table 4.4). The stepwise process excluded the household type, gender and education level variables from the model. Except from UA the other variables showed no significant influence on the dependent variable.

Table 4.4: Logistic regression of organic waste self-composting after step-wise process

	Estimate	Chisp	Pr (>Chisq	Model Nagelkerke Pseudo R square
Participation in UA	4.188	24.63	7.904e-11***	0.60
Age	0.007	0.014	0.612	-
Income	-	-	0.388	-

Reduce

The third model assessed the habit of reducing the organic waste production through an estimation of the frequency of food waste production after meals. The model implemented was an ordered logistic regression since the dependent variable (food waste) has been measured through a 5 items Likert scale. The independent variables were UA participation, household type and demographic variables. The stepwise process excluded the independent variables “participation in UA” and “income”. The results show a negative significant influence of male gender on food waste reduction and a U shaped-curve influence of education level in the food waste reduction (Table 4.5).

Table 4.5: Ordered Logistic Regression of Food waste after stepwise process

	Estimate	St. Error	Pr (>Chisq)
Age	-0.032	0.011	0.004**
Middle School	1.132	1.155	0.327
High School	-0.719	1.073	0.502
University	-0.047	1.130	0.966

Master/PhD	0.833	1.516	0.582
Apartment	0.628	0.375	0.094 .
Male	-1.090	0.464	0.018*

	Pr (>F)	Model Pseudo R Squared
Age	0.212	0.873
Education	2.912e05***	
Apartment	0.177	
Gender	0.802	

Furthermore, part of the UA participants sample uses other ways of organic waste treatment that have not been observed in the non-UA participants sample. Particularly: the use of Community collecting points (PEV); throwing part of the organic waste straight to the plants with no treatment; use part of the organic waste for animals feeding. To this end several logistic regressions were performed with including these three organic waste destinations as independent variable using the UAP sample only. No significant correlations have been observed in the models where these three ways of organic waste management occur, probably due to the smaller sample size. Only one simple logistic regression showed a significant influence of participation in shared forms of UA and the use of community services for organic waste treatment (see Table 4.6).

Table 4.6: Simple Logistic Regression on the influence of participating in shared forms of UA activities on the disposal of OW in PEV

	Estimate	Std. Error	Z value	Pr (>|z|)
(Intercept)	-2.48	0.48	-5.13	
Shared UA activity	1.55	0.57	2.69	0.006**

To summarize the results, several relevant information could be derived from the statistical analysis of the sample, which can be summarized as follows:

- The LCA clearly differentiate three main groups according to participation in UA and waste management behaviors.
- Participation in UA activities has a positive influence on organic waste management behaviors particularly the organic waste separation and the self-composting habits.
- Living into an apartment positively influence the use of Public Services of waste collection for non-UA participants.
- UA participants tend to self-treat their organic waste whether or not they: i) live into an apartment or a house with a garden; ii) participate or not in a shared UA activity.
- Lower and higher educational level correspond to more virtuous food waste behavior.
- Little influence of demographic variables on the waste management behaviors compared to the literature.

4.5 Discussion

4.5.1 Differences between UAP and other citizens

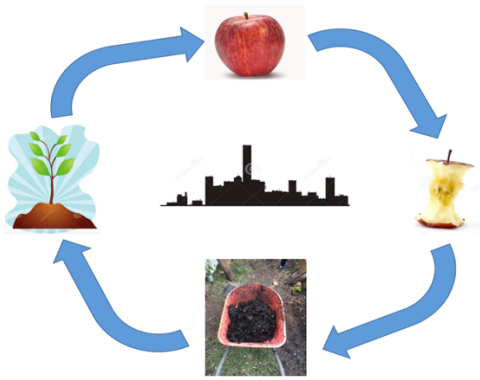
The aim of this paper was to assess the household organic waste management behaviors in terms of separation, reuse, recycle and organic waste reduction habits. In particular, this study is dedicated to identify possible differences between UA participants and non-UA participants. It emerged clearly from the LCA and from the logistic regressions, that there are differences between people engaged in UA and people, who are not engaged in UA in terms of their waste management habits. As a main outcome, the results could prove that the participation in UA activities supports the habit of self-compost the produced organic waste.
As described in "*citizens' group definition*" section, the Latent Class Analysis clearly distinct three groups according to their participation in UA and the drivers supporting their decision to separate the organic waste: (1) citizens living in an apartment and non-UA participants, who are treating their organic waste through the public service; (2) UA participants who started to separate their organic waste through their participation in UA and are rarely using the public service; (3) a third group that has similar characteristics with the second group except from the lower influence of participation in UA on organic waste separation and tend to use more often the public service (see Figure 4.7).
The strong positive influence of the participation in UA on self-composting was revealed through the logistic model. This confirms the hypothesis that the participation in UA can be both a tool for environmental education as well as a facilitating tool for organic waste treatment. The models showed an influence of some demographic variables on the three waste management behaviors. In particular, the factors higher income slightly influences the use of COMAP services while living in an apartment is a more determinant factor on choosing COMCAP services. Education has U-shaped influence on the food waste reduction behavior, meaning that less educated and higher educated respondents are less likely to waste their food. Surprisingly, when the Recycle/COMCAP model was run with the full set of independent variables, the participation in UA resulted as negatively influencing the use of public services. The model showed a better r square when the variable UA was excluded and reported a positive influence of living into an apartment. This shows that the use of public services is motivated by the lack of possibility to treat the organic waste in other ways at least for non-UA practitioners. Thus, living in a house with a backyard garden significantly increases the likelihood of self-compost household OW for non-UA practitioners. On the other hand, there are no significant differences in the composting and use of public service habits for UA participants living in an apartment or in an independent house. UA participants living in apartments tend to treat their organic waste with household facilities such as small composting boxes. In terms of food waste, the analysis revealed a U-shaped curve influence of education on food waste reduction. This means that people with low and high education level tend to produce less waste than individuals with an average education level. Finally, part of the UAP sample showed a positive influence of participation in shared forms of UA on the use of voluntary organic waste collecting points (PEV). This could be explained by the fact that the community organic waste treatment areas correspond often with the community vegetable garden. Further studies could focus the attention on assessing the characteristics of the citizens bringing their organic waste to community collecting points, by using a larger sample size of this particular group than what was covered in our study.

4.5.2 Implications for Florianópolis Urban Metabolism

Our results showed that UA participants have different approaches to the behaviors of recycling and reusing the household organic waste. If on one hand, the use of public services seems to be influenced by its more practicality when living into an apartment on the other hand, UA participants seems to prefer to treat their organic waste by their own whether they live or not into an apartment. This leads

us to reflecting about the role of UA in the sensitization of citizens and highlights the importance of UA as a supporting tool for: i) waste management; ii) citizens' environmental education; iii) adding value to organic waste through composting and fertilizers provision for UA. Our study besides confirming the findings of similar studies, suggests that the participation in UA directly influences the household waste management behaviors (Bahers & Giacché, 2019, Shrestha et al., 2020). Furthermore, the results support the existence of a circular in-put/out-put relationship between food production and organic waste (D'Odorico et al., 2018; Scanlon et al., 2017) (figure 4.6)

Figure 4.6: Urban metabolism circular flow



This is particularly relevant in the context of Florianópolis where the concept of circular urban metabolism has been implemented by both civil society and local government. Public administrators should keep following this trend and support the role of UA and community organic waste treatment in the reduction of the untreated organic waste. This will actively support the goals established by the Florianópolis Composting Law. Considering the actual absence of a Bio digester in Florianópolis, possible strategies aiming at supporting the waste management system should be linked to a valorization of the existing organic waste management initiatives. Community treatment areas and organic waste self-treatment should be supported by providing differentiated tax treatment for citizens using this type of services. On the other hand, the current COMCAP treatment area should be extended and new treatment areas implementation should be supported. Using the case of Florianopolis, the results finally show in a more generalizable way, how the support of organic waste treatment and food production in marginal communities could have an impact on the reduction of potential health issues related to inappropriate organic waste management and improve community access to fresh and healthy food.

4.5.3 Outlook for future studies.

The study has been affected by several limitations due to the sampling technique. The applied convenient sampling method was based on self-reporting and did not allow to acquire more detailed information. In particular, the data collection did not provide a real measurement of the food waste produced in a household. This information was collected through an estimation of the household food waste given by the respondents. This probably led to a social desirability bias and a probable under estimation of the produced food waste (Grimm, 2010). It would be very promising for future research to improve the sampling strategy allowing the implementation of more behavioral oriented analytical approaches (such as the Theory of Planned Behavior or the Technology Acceptance Model).

4.6 Conclusions

This paper presents a first exploratory study on the influence of UA participation on citizens' waste management behaviors in Florianopolis (Brazil) where reducing, re-using and recycling of organic waste policies are implemented. The results highlighted the positive contribution of UA on stimulating correct household organic waste management, due to an increased awareness and improved organic waste management practices. Consequently, the contribution of UA can significantly improve the management of municipal organic waste by reducing the amount of workload for the public or private companies involved in the management of the Municipal Solid Waste. This finding could potentially have several implications on the way the relation between urban food production, urban waste management and fertilizers provision is conceived. UA could become a cornerstone of an efficient system of Municipal Solid Waste and support the empowerment of local communities in implementing organic waste management initiatives.

Even though the debate on the role of UA in the organic waste management is still ongoing, the results of our study from Florianopolis (Brazil) showed that through a valorization of the relation between UA and organic waste, a potential shift towards a circular concept of urban metabolism can be supported.

5) Final remarks

The present study aimed at developing an innovative approach in order to address the role of Urban Agriculture in different urban contexts. In the first article an analytical framework was defined, enabling to address specific context-related challenges for UA and support the stakeholders' management of UA. To this end the focus of the study was on stakeholders' perception assessment and UA Participants (UAP) driving factors. The literature review allowed to address several dimensions through which UA activities relate with urban stakeholders. These dimensions are derived from the literature and their analysis allowed to understand the role of UA in the context of the case study.

The analytical framework developed through the literature review was applied to the analysis of the relation between waste management and UA in the municipality of Florianópolis, Brasil. It allowed to define which are the priorities related to the UA development in the municipality of Florianópolis. The literature on UA showed also a sound relationship between UA and OW management which turned out not to be adequately addressed by scholars. This aspect is particularly relevant since this relation has been institutionalized by the Florianópolis municipality. It enacted the Florianópolis Composting Law (FCL) a municipal law addressing the problems related to OW treatment through small composting initiatives with the aim of provide fertilizers for UA. To this end the second paper of the thesis aimed at addressing the social acceptance of the FCL. The social acceptance analysis was performed through the application of the analytical framework to the Florianópolis urban waste management stakeholders. This allowed to tailor the methods assessed through the literature review to the topic of Municipal Solid Waste management.

The results of the second article of the thesis showed that despite a supporting society and historical background, the lack of infrastructure and investments in Florianópolis could hinder the successful implementation of the municipal law on OW management. To this end the political agenda should focus on the support of the existing community waste management activities that, thanks to their historical and cultural influence on the civil society, could potentially lead to a better management of the OW. This could be obtained through reducing the workload and financial commitment of the public services and raise the citizens' awareness on household waste management. Citizens household waste management has been the main topic of the third and last article of the manuscript. This section tried to assess an aspect that could positively influence the waste management habits. How the participation in UA activities affects the household OW management habits? Literature suggests that UA is involved in the OW management both from a technical point of view (OW valorization process) as well as an awareness raising activity. Their relationship has been addressed in the literature describing the urban metabolism concepts. The main objective of this section of the manuscript is assessing the differences in term of household OW treatment and management, between Urban Agriculture Participants (UAP) and other citizens. The results showed that UAP are more willing to self-treat their organic waste whether they have or not space in their household for installing a small composting system. The results are particularly relevant since they show that UA, rather than being just a food providing activity, also supports environmental education and several ecosystem services such as household OW management. Furthermore, UAP are more likely to treat their OW through community composting initiatives. The third article highlights the role of community waste management initiatives, especially considering that most of these initiatives are low budget bottom-up initiatives. On the other hand, the lack of a monitoring system for this type of OW treatment increases the risks of health problems and water contamination. To this end community OW initiatives should be supported in order to reduce potential risks and promote the local communities' empowerment, especially in marginal communities.

The main thesis achievements consist, in the first place, in providing an analytical framework for scholars aiming at addressing the relation between waste management and UA. The framework developed in the first section of the study can be applied to different contexts. Furthermore, the results from the empirical analysis in the second and third part of the study provide useful indications for

local policy makers in order to define effective UA and OW policies. Possible strategies, derived from the results, have been discussed in the conclusions of the different sections of the study.
Looking at the elements emerging from the three articles, actions like the FCL need the involvement of several stakeholders and a certain level of participation from all the citizens involved. The implementation of similar initiatives in other contexts, need to consider relevant factors such as the historical background, the territorial variety, the existing networks and the citizens' environmental commitment. This last aspects, can be considered as the key driver that led to the implementation of the FCL and should not be ignored when proposing similar model of Municipal Solid Waste management. The results also show the weaknesses of the UFSC method and for this reason it should be considered only when other alternatives are not viable. These weaknesses mainly refer to its operational requirements (time and space demanding) rather than the quality of the final compost.
An advisable strategy that could ensure good level of composting safety, by reducing the amount of workload for the central composting yard, is to increase the number of small composting yard. This implies the provision of legal recognition and financial support to all those small initiatives already operating in the territory, thus allowing them to overcome the 500 kg per day limit.
A further aspect that the work is highlighting is how the analytical framework adopted allowed to design a comprehensive picture of the relation between actors involved in UA and waste management system. This aspect is particularly crucial for let policy makers and waste management stakeholders, to take into consideration the other social parts that are involved in the system. Particularly, they should take in consideration how existing informal realities in Florianopolis manage to treat up to 2% of the total Organic Waste without receiving any funds or support. This data is particularly relevant if we consider that the public systems did not manage to treat more than 5,5% of the OW collected.
Finally, the work presented confirms and reinforce what has emerged in the literature regarding the role of UA in the organic waste management. In particular, while most of the literature focuses on assessing the use of composting technique in UA, our work highlights the importance of consider UA as an activity that raises the awareness on this theme. Looking at the potential impact that UA at community level has in treating the OW, we can assume that UA will have a determinant role in supporting the FCL implementation. It is worth to mention that, UA is indeed promoted by local governments. However, a lack of structural organization in terms of decision making; shared vision; networking; tools and seeds provision; best practices sharing, might hinder the comprehensive and streamlined approach that is needed in order to integrate UA in waste management system.
Even though the manuscript addressed a broad range of topics related to OW and UA, several limitations emerged which need to be addressed in future research developments. A first limitation lies in the lack of a real assessment of UAP drivers. The manuscript did not provide a description of how these drivers differ within the UAP and influence their participation in UA. Even though this topic has been addressed through the first section of the manuscript, it has not been properly developed in the UA analysis. This was mainly due to the focus of the study on the paramount role of OW management in Florianópolis, which can provide a useful insight not only to the local policy makers, but to different urban areas with different socio-economic characteristics. As reported in the first section of the manuscript the UA drivers are key elements in order to assess the right strategies for UA development in an urban context; to this end this aspect should be addressed in future research developments. A further aspect that partially limited the quantitative analysis was mainly related to the lack of information on household food-waste, particularly relevant in order to define the citizens OW management habits.
Future research development should aim at improve the analytical framework and test its validity in other contexts as well as overcome the two main limitations emerged from the manuscript. The analytical framework improvement could lead to a better definition of local policies that, in turn, could contribute to support the sustainable development of the future cities, taking into account the importance of managing the urban metabolism outputs and turning them into possible input in order to improve the urban metabolism sustainability.

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Annex 1: English version of the Questionnaire

The aim of this research is to describe the motivations of Florianópolis residents to participate in Urban Agriculture activities (community gardens, gardens with medicinal plants, productive backyards, ...), and which are their habits in the management of household organic waste. We inform that the collected data will be treated anonymously and will be used only for scientific purposes. Thanks for your collaboration!

Experiences in Urban Agriculture

The following section aims at addressing your experience in Urban Agriculture (UA) activities, Please answer the following questions.

- Do you practice UA? [Yes] [No]
- Is it a shared gardening activity or do you practice UA in your backyard? [Shared] [Backyard]
- Since how long do you practice UA?
  - ☐ [less than 3 months]
  - ☐ [between 3 and 6 months]
  - ☐ [between 6 and 12 months]
  - ☐ [between 1 and 3 years]
  - ☐ [more than 3 years]

- Why did you start practicing UA? (You can choose more than 1 option)
  - ☐ Psychological and Physical Health
  - ☐ Environment
  - ☐ Education
  - ☐ It is part of my background
  - ☐ Socialization
  - ☐ It decorates the space
  - ☐ It supports my food security
  - ☐ It reduces my food provision costs
  - ☐ I earn Money through products sales
  - ☐ Protest against the food system
  - ☐ Other...

Organic Waste Management

The following section aims at describe the organic waste management habits you usually perform.

- Do you know what Organic Waste is? [Yes] [No]

If you do not know what organic waste is, you can find a brief description at the end of the questionnaire. Pleas, take a look before continuing the questionnaire

- Do you separate your household organic waste? [Yes] [No]
- Since how long have you started to separate your household organic waste?
  - ☐ [less than 3 months]
  - ☐ [between 3 and 6 months]
  - ☐ [between 6 and 12 months]
  - ☐ [between 1 and 3 years]
  - ☐ [more than 3 years]

- Can you please indicate which of the following factor influence your decision to start separating you household organic waste? (you can indicate more than 1 option)
  - ☐ School and education
  - ☐ Family
  - ☐ Friends
  - ☐ It is mandatory in the place where I live
  - ☐ Television
  - ☐ Internet
  - ☐ Working in th vegetable Garden
  - ☐ Other...

- Which destination do you give to your organic waste

  - ☐ Collected by a private enterprise
  - ☐ Collected by COMCAP
  - ☐ I bring them to a Voluntary Collecting Point
  - ☐ I make my compost
  - ☐ I throw it directly in the plants
  - ☐ I use it for animal feeding

- How often do you produce food waste after a meal?

- ☐ Never
- ☐ Almost Never
- ☐ Sometimes
- ☐ Often
- ☐ Always

- How often do you keep your food leftovers in order to consume it in the next meal?

  - ☐ Never
  - ☐ Almost Never
  - ☐ Sometimes
  - ☐ Often
  - ☐ Always

Demographic information

Please, provide us the following information. We remind you that all the data will be treat anonymously and they will be used for scientific purposes only.

- Age …….
- Gender ……
- Occupation ……
- Neighborhood

  .....

- Educational level .....
- Members of the household? N.....
- Monthly income (998 R$ as minimum wage):
  - ☐ Less than 1 minimum wage;
  - ☐ Between 1 and 3 minimum wages;
  - ☐ Between 3 and 5 minimum wages;
  - ☐ Between 5 and 7 minimum wages;
  - ☐ More than 7 minimum wages

Do you have any further suggestion or contribution to add to the questionnaire? Thanks for your collaboration.

Organic waste: Organic waste are all those residues deriving from vegetables or animal. Most of the domestic organic waste is produced by food leftovers, peels, etc…. Here is an explanatory picture: