

# Waste Recycling and Repurposing to Address SDG 11 in Burkina Faso: Do Multi-stakeholder Platforms Matter?

Safiétou Sanfo, Oblé Neya, Sylvestre Da,  
Seyni Salack, Joseph Amikuzuno,  
Bizoola Zinzoola Gandaa,  
Kwame Oppong Hackman,  
and Kehinde Olufunso Ogunjobi

## Abstract

Poor waste management and uncontrolled waste disposal cause pollution and blocked drainage facilities, leading to flooding and water stagnation, increasing the risk of diseases, and eroding local progresses toward achieving the Sustainable Development Goals (SDGs). Recycling and repurposing liquid and solid waste for urban and periurban agriculture, green spaces, and green energy on the other hand benefit social and ecosystem resilience and can contribute to SDG11. This chapter considers the uneven progress in Burkina Faso where the transgressive behavior

of garbage producers leads to illegal garbage dumping, equipment obsolescence, insufficient maintenance, and the lack of support from authorities. We show how the creation of a participatory Multi-Stakeholder Platform (MSP) can lead to better collection, recycling, and repurposing of wastes. The results showed that (1) the practice of liquid and solid waste management involves several interacting stakeholders, (2) these interactions generate complex problems hardly resolved by a single (few) stakeholder(s), and (3) an MSP is a good approach toward solving these complex problems.

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S. Sanfo (✉) · O. Neya · S. Da · S. Salack  
K. O. Hackman · K. O. Ogunjobi  
WASCAL, Competence Centre,  
Ouagadougou, Burkina Faso  
e-mail: [sanfo.s@wascal.org](mailto:sanfo.s@wascal.org); [neya.o@wascal.org](mailto:neya.o@wascal.org);  
[da.s@wascal.org](mailto:da.s@wascal.org); [salack.s@wascal.org](mailto:salack.s@wascal.org);  
[Hackman.k@wascal.org](mailto:Hackman.k@wascal.org); [ogunjobi.k@wascal.org](mailto:ogunjobi.k@wascal.org)

J. Amikuzuno · B. Z. Gandaa  
University of Development Studies (UDS),  
Tamale, Ghana  
e-mail: [amikj26@yahoo.com](mailto:amikj26@yahoo.com);  
[naa.bizoola1970@gmail.com](mailto:naa.bizoola1970@gmail.com)

## Keywords

Urban waste management · Waste-water-energy nexus · Multi-stakeholder platform (MSP) · Burkina Faso

## 6.1 Introduction

As a result of rapid urbanization, waste management, sanitation, and hygiene have become major urban concerns in West Africa. Inadequate disposal and household waste gathering in the streets

block drainage systems, streams, and landfills and threaten health in residential areas in West African cities (Onibokun 2002). This is not just a problem of poverty. In Burkina Faso, rapid economic and population growth are the result of population expansion and rising affluence. Waste generation in the capital city of Ouagadougou increases in direct correlation with income growth (UNEP 2011). With 600,000 metric tons of waste generated per year, an increase in population (from three million people in 2020 to an expected nearly six million in 2030, according to INSD (2019)), waste production will also increase exponentially. Out of the 600,000 metric tons of waste, only 300,000 metric tons are collected. The other 300,000 metric tons remain uncollected, resulting in illegal dumping of garbage which prevents rainwater from draining properly. Uncollected waste in the city of Ouagadougou favors flash flooding, causes water pollution, and increases the risks of cholera, diarrhea, and other waterborne diseases. The insufficient awareness of the population about the benefits of repurposing organic waste and domestic sewage combined with the inadequate waste management infrastructure further worsens the problem of sustainable waste disposal and recycling. Although research is increasingly showing the importance and the potential of the waste-water-energy nexus, this approach is only in its infancy in Burkina Faso. This is likely to delay progress on achieving the SDGs.

When it comes to urban and periurban agriculture (UPA), food ingredients (i.e., legumes, vegetables, and fruits) for the capital city of Ouagadougou are provided by gardeners in the center and suburbs of the city. Besides legumes, vegetable, and fruit gardening, UPA activities include plant nurseries for trees and flowers and dairy and poultry production for meat. UPA contributes to food security and promotes green urban spaces (GUS) as well as soil biodiversity (Hoorweg and Munro-Faure 2008; Bellfield 2015). However, this contribution is becoming increasingly unreliable due to negative effects of rapid demographic increase. Rural-urban migration is decreasing the availability of land in the capital city and increasing related land tenure

insecurity and conflicts. Low investment in the recycling of liquid and solid wastes (e.g., food scraps, domestic sewage, livestock manure) to meet agricultural and green energy needs (compost, treated water, and biogas) has also led to heavy reliance on chemical fertilizers in UPA and dependence on wood and charcoal energy as household cooking fuels. Increase in wood and charcoal fuel consumption has adverse impacts on the urban environment, including outdoor and indoor air pollution, with associated health problems. Therefore, a good use of the integrated approach of waste, energy, and water could help to achieve SDG 11 and related urban goals.

In the past, urban waste, energy, and water management were generally considered and treated separately. Nowadays, we are witnessing a more integrated approach in the management of these key sectors and the ways in which nexus thinking can contribute to meeting global development goals (Boas et al. 2016; Liu et al. 2018). Understanding the synergies between waste, water, and energy, as well as related sectors such as food, enables trade-offs to be identified and addressed in city management and contributes to urban resilience and efficiency (Sperling and Berke 2017; Terrapon-Pfaff et al. 2018). For example, water is not only needed to support livelihoods, such as drinking water services, domestic and livestock purpose, aquaculture, irrigation, and food production, but also to produce energy, including hydroelectricity and biofuel production. Conversely, the production of drinking water and waste treatment requires energy, waste can be used to generate bioenergy, and treated wastewater can be used for crop irrigation. Reducing the quantity of waste in drainage canals of urban areas can prevent flash floods, and waste recycling also produces clean water and compost as soil nutrients. Therefore, a better collection, recycling, and repurposing of solid and liquid waste benefit both UPA and GUS.

Foregrounding the waste-water-energy nexus is key for any city or region wanting to make progress on the SDGs. Our argument is not just that the SDGs themselves are overlapping, are linked, and can be reinforcing of each other but that, in an urban context, it is not possible to inter-

vene in one part of the urban system (like water or waste) without understanding the impact of those actions on other dynamics. This chapter builds on a study that investigated the potential of trans- and inter-disciplinary, participatory, and proactive research approaches to better address the waste-water-energy nexus in Burkina Faso. These approaches bring together different key stakeholders to manage the complexity of the framework. The chapter will answer the following questions: How can better liquid and solid waste management produce more effective utilities and products, including treated water, compost, and biogas? How can stakeholder collaboration through multi-stakeholder platforms (MSPs) help resolve the complex issues associated with the waste-water-energy nexus in an urban city like Ouagadougou? Across the chapter, we show how the waste-water-energy nexus contributes to the advancement of a wide range of SDG targets and paves the way for the implementation of SDG 11, to “make cities and human settlements inclusive, safe, resilient and sustainable,” particularly target 11.6 which sets “to reduce by 2030 the negative environmental impact of cities per inhabitant, including by paying particular attention to air quality and management, particularly municipal, of waste.” We will also demonstrate how it contributes to many other SDGs, including SDG 3 (Health), SDG 6 (Water and Sanitation), SDG 7 (Energy), SDG 8 (Work and Economic Growth), SDG 12 (Responsible Consumption), SDG 13 (Climate Action), and SDG 14 (Life Below Water) (Wang et al. 2018; Forti et al. 2020).

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## 6.2 Waste-Water-Energy Nexus: Tracking the Links Toward SDG 11

An acknowledgement of the nexus between the waste, water, and energy sectors and their connection to other sectors such as food is central to achieving sustainable development in its environmental, economic, and social dimensions (Biggs et al. 2015; Stephan et al. 2018). However, despite the need for more integrated approaches to urban management in African cities, nexus approaches

are only at their infancy stages. The roots of the waste-water-energy nexus lie in waste-to-energy processes, wastewater treatment, and anaerobic digestion processes. These have been well developed in the global North to maximize the efficient use of resources while reducing current environmental impacts (Kalair et al. 2019; Portney et al. 2017; Mancini et al. 2021). Waste recycling and repurposing are understood to mean all the provisions allowing for the collection, transport, and environmentally sound disposal of waste, taking into account health (public health), economic, social (attitudes of populations), and environmental considerations (Cheng and Urpelainen 2015; Cobbinah et al. 2017).

Efficient recycling and repurposing of liquid and solid organic wastes into compost and irrigation can supply energy for communities while improving sanitation conditions and fertilizing agricultural lands (Kaudal and Weatherley 2018). According to Gremillion and Avellan (2016), a nexus approach centered on wastewater treatment and recovery can link cycles of water, waste, energy, as well as food systems. Rich in carbon and nutrients, wastewater has the potential to supply greenhouse gas (GHG) neutral energy for households and irrigate and fertilize crops. Capturing the resources contained in wastewater can improve human and ecosystem health, reduce GHG emissions, and improve food and energy security. Access to energy in turn is essential to meeting development challenges, such as poverty, gender inequality, poor health and education services, and food insecurity (Bhatia and Angelou 2015; Masud et al. 2007; Spalding-Fecher et al. 2005). Waste-to-renewable energy technology, in particular anaerobic digestion and biogas technologies, is therefore well positioned to address global waste challenges and contribute to the achievement of some of the key SDGs (Kaudal and Weatherley 2018; Ghodsvali et al. 2019). Global progress is, however, dependent on implementation in every part of the world, including less well-researched places that face severe challenges of urban management, like the city of Ouagadougou in Burkina Faso.

### 6.3 Context of Burkina Faso

From Burkina Faso's independence (August 5, 1960), various waste management methods have been implemented in the city of Ouagadougou, but they have always been of limited effectiveness due to the limited importance given by the authorities to waste recycling and repurposing. The lack of human and financial resources and the poor hygiene practices of local inhabitants have also compounded the issue. The rapid increase in waste production due to a high demographic growth (4.4% per year according to INSD 2019) has resulted in the removal and treatment of solid waste becoming a major problem for the city of Ouagadougou. The modernization of Burkinabè society and especially the fast pace of urbanization of the city have made it urgent to (re)organize waste management more efficiently—a challenge which keeps evolving.

Five main periods can be distinguished in the history of waste management in Ouagadougou. During the period immediately after independence and until the 1970s, Ouagadougou implemented a waste management system inherited from colonial times, in which the municipal board was the main entity responsible for the task. In 1968, the municipality transferred responsibility to a private company called *Société Nakoulma*. Between 1979 and 1986, due to a lack of financial resources, the contract between the municipal authority Ouagadougou and *Société Nakoulma* was terminated, and the municipality took back the responsibility for waste management. In 1986, the *Direction Nationale des Services d'Entretien de Nettoyage et d'Embellissement* (DINASENE) was created and was devoted to the task throughout this period of the revolution, which was also marked by collective operations of public cleaning known as "Operations mana-mana." Financial and other difficulties arose again in the 1990s, and the National Office of Sanitation and Environment (*Office National de l'Assainissement et de l'Environnement*, ONASENE) established a public-private partnership (PPP) approach to handling waste management with waste

collection fees varying between UD\$ 0.50 and UD\$ 2 per household, depending on the neighborhood (Bayili 2002). New waste management companies were created, but there was a lack of formal governing structure and constant failure to comply with environmental regulations. The collected wastes were often dumped at inappropriate places, sometimes only a few hundred meters away from settlements.

In 1993, poor management and the deterioration of the situation forced the municipal council to take over the management of the sector through the Department of Municipal Technical Services (*Direction des Services Techniques Municipaux*, DSTM). From 2000 on, the World Bank supported the municipality through its Urban Development Project (UDP). The main objective was to lay the foundations for the "polluter pays" principle through the partial recovery of operating costs. The polluter pays principle is one of the internationally recognized principles that influences the shaping of environmental policy at both the national and international level. By decentralizing and implementing a strategic plan for the sanitation of the city of Ouagadougou (French acronym PSAO), in 2001 a department responsible for the cleanliness and hygiene of the city was established. Private waste management companies were created, and opportunities for the improvement of local waste recycling capacity emerged. In 2004, a Master Scheme for Waste Management (*Schéma Directeur de Gestations des Déchets*, SDGD) was set up by the Sustainable Development Department (*Direction du Développement Durable*, French acronym DDD) under the framework of the Canadian DESSAU-SOPRIN study. The main objective was to improve the collection of household waste, in particular by setting up 35 collection centers and a technical center located on the northern outskirts of the capital, later called Center for Waste Processing and Recovery (*Centre de Traitement et de Valorisation des Déchets*, CTVD). To this end, the city was divided into 12 zones (*Arrondissements*), whose management was entrusted to private entrepreneurs (small- and medium-sized enterprises, SMEs). By establish-

ing these centers and this new division, the city's Sustainable Development Department tried to reduce the number of uncontrolled landfills to cope with the threat of an unhealthy and degraded environment (Ouattara 2006).

From 2009 onward, the rapid growth of the population, uncontrolled urbanization (due to the rural exodus, among other reasons), and impoverishment have made it difficult to organize the sector (AAPUI Arcade 2009). As result of rural-urban migration, the city of Ouagadougou has been expanded by informal settlements with poor and marginalized population that are largely disconnected from the formal systems of city management (AAPUI Arcade 2009). In informal settlement areas, locally known as “non-lotis,” settlement patterns are unplanned, with no specific access to roads. The situation is made worse by the lack of running drinking water and electricity. In these neighborhoods, unlike the formal areas, waste is dumped in the nearest public space or in the canals. The unplanned expansions of the city and these practices have put added pressure on the waste management system, which was already experiencing difficulties in the formal areas. While the actors active in the sector, including households, collectors, associations, SMEs, and local authorities, have accused one another of being responsible for the situation, some observers have argued that the issues faced by the waste management system were multidimensional: legislative and regulatory; financial; institutional and organizational; technical; political and strategic; anthropological; environmental; and scientific. The combination of these uncontrolled factors explains the current situation (Dos Santos 2015), which is characterized by unhealthy practices, clandestine collectors, and illegal dumping. Uncontrolled waste disposal causes pollution, inhibits storm water drainage, aggravates floods, and increases disease risk and therefore puts the achievement of the SDGs at risk. After describing the methods (see Sect. 6.4), the results are discussed in Sect. 6.5. The last section of this chapter concludes by discussing the study's implications for reporting progress on SDG 11.

## 6.4 Exploring Inter- and Trans-disciplinary Approaches to Facilitate SDG 11 Implementation

### 6.4.1 Study Area

The city of Ouagadougou (1° 31' 05" W, 12° 21' 58" N) is the capital of the Province of Kadiogo. Since 2009, the city has had 12 districts divided into 55 areas (see Fig. 6.1), with residential areas in both formal and informal settlements. In the informal settlements, the buildings have roofs essentially made of metal sheets without ceilings, which is not very favorable to health. The situation is made worse by the lack of drinking water and electricity. The walls are generally made of traditional and poor-quality construction material, locally referred to as *banco*. This is indicative of poverty levels among this population but also of the perceived temporary nature of informal settlements and the expectation of relocation by the government to formal settlements. In this area, settlement patterns are unplanned with no specific access to roads. In contrast, the buildings in formal settlements are covered with metal sheets and sometimes have a ceiling, or a concrete roof, thus improving local living conditions. However, one still encounters *banco* walls that contrast with concrete walls, indicating unequal incomes among the population. While the dwellings in formal settlements benefit from health and sanitation services such as household waste collection, informal settlements lack basic services and seem to be left behind (Ouattara 2006).

Ouagadougou is a rapidly growing city. With the current population estimated at 2.6 million inhabitants, the population of Ouagadougou could reach six million in 2030, or three times the current population (INSD 2019). This rapid urban population growth is a major challenge for the waste management sector. Using participatory, proactive, and MSP approaches, this chapter builds on a trans-disciplinary study that investigates how to better collect, manage, and repurpose organic liquid and solid waste to benefit UPA and GUS and generate biogas for urban and periurban sustainable development.

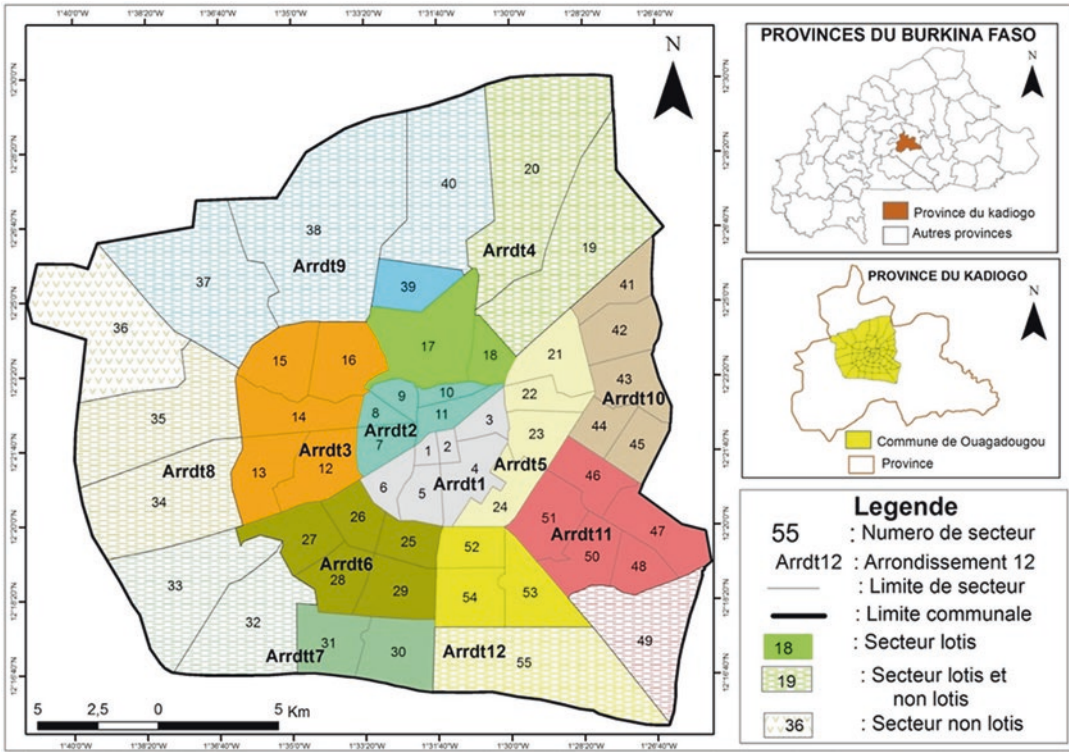


Fig. 6.1 Map of Ouagadougou. (Source: authors)

Trans-disciplinary research and the creation of MSPs require the collaboration between academics and non-academics from several disciplines to meet, interact, and deepen discussions for knowledge sharing (Pohl et al. 2017). Such an approach is therefore crucial for overcoming silo practices and thinking and for the implementation of nexus approaches to sustainable development (Ghodsvali et al. 2019; Sesan et al. 2021; Totin Vodounon et al. 2021). This study was a team effort with several partner institutions, including the municipal assemblies, private companies, and other relevant stakeholders. The research team from the West African Science Service Centre on Climate Change and Adapted Land Use (WASCAL) in Ouagadougou, Burkina Faso, and the University for Development Studies (UDS) in Tamale, Ghana, included agronomists, economists, climatologists, botanists, geographers, water engineers, anthropologists, and hydrologists. Researchers and development professionals worked together as a team, with each team

member having specific roles and responsibilities in building the MSPs in order to advance the sharing of best practices and integrating and producing new knowledge to improve the waste management system for the benefit of UPA and GUS in the city of Ouagadougou.

### 6.5 Stakeholder Consultation and Dialogue Toward Multi-Stakeholder Platforms

Several meetings and workshops with relevant stakeholders were convened in order to build Multi-Stakeholder Platforms (MSPs) for knowledge creation and sharing toward proper waste disposal for clean cities and sustainable development. The various stakeholders organized themselves into working groups with specific roles for the smooth running of the MSPs. Throughout the city of Ouagadougou and beyond, our stakeholders were variously linked within a value network

of waste recycling and recycled products. Key stakeholders included government agencies; cleaners, including septic tank cleaners; waste collectors and sorters; waste transporters; transformers, including compost producers, farmers, and livestock raisers; growers, including market gardeners, and nursery owners and assistants; and households and other waste producers. Stakeholder consultation and dialogue through workshops contributed to a better understanding of the places and different roles of the multiple actors within the waste value network and socio-ecological landscape. Stakeholders met each other, some for the first time, described the work that they do, and presented the various issues that concern them within their particular contexts (see Table 6.1).

During meetings, experts and water and sanitation engineers coordinated discussions on the following themes: centralized waste recycling facilities and their management systems; organic waste processing and the possibilities of enhancing those capacities; community engagement and participation in organic and plastic waste and domestic sewage collection and processing; and problems and challenges associated with organic and plastic waste recycling and lessons learnt.

Issues related to processing organic waste into green energy and nitrogen-rich fertilizer were led by waste-to-energy companies with support from livestock farmers and vegetables growers. All stakeholders contributed to the building and the running of the MSPs.

In order to better explore the links and relationships that surround the collection, recycling, and reuse of organic liquid and solid waste in Ouagadougou, we used the value network approach, superimposed on the landscape of the commune and its periphery (Block et al. 2008; Nederlof et al. 2011; Hein et al. 2017). Importantly, we brought some of the key stakeholders in this network together, whose roles in the provision and management of key urban services are not always well known or understood (Jimu 2008). Workshops used a landscape approach and stakeholder mapping exercises. While landscape approaches are used by many researchers and development practitioners in

rural and forested areas, they are also applicable to cities because urban landscapes similarly represent socially produced spaces with natural resources, waterways, vegetation, soils, and climate (Hein et al. 2017). Stakeholder workshops

**Table 6.1** List of engaged stakeholders and their respective roles (Source: authors)

Stakeholders	Role
Government offices and agencies <ul style="list-style-type: none"> <li>• Department of Sanitation Exploitation (DEX-ASS, <i>Direction de l'Exploitation Assainissement</i>) of ONEA</li> <li>• Municipalities</li> <li>• DSPH (DSHP, <i>Direction de la Salubrité et l'Hygiène Publique Département</i>)</li> <li>• Municipal Department of Landscape Development and Park Management (DAPGP, <i>Direction des Aménagements Paysagers et de la Gestion des Parcs</i>),</li> </ul>	ONEA, Burkina Faso's National Office for Water and Sanitation develops, manages, and protects drinking water distribution and manages household and business sewage collection in urban and periurban areas. It produces biogas, compost, and treated water for irrigation. ONEA also provided two well-trained and experienced experts on liquid waste repurposing who helped coordinate all activities and MSPs. The municipalities and DSPH oversee the collection, treatment, and recycling of solid waste, the waste collection center ( <i>Centre de Collecte des Déchets</i> , CCD), and the Waste Treatment and Valorisation Centre ( <i>Centre de Traitement et de Valorisation des Déchets</i> , CTVD). The Municipal Department of Landscape Development and Park Management has responsibility over public parks and the Green Belt of Ouagadougou.
Waste collectors and sorters "Economic Interest Groups" ( <i>Groupements d'Intérêt Economique</i> , GIEs) <ul style="list-style-type: none"> <li>• <i>Action Protection de l'Environnement</i> of Tampouy, Arrondissements 3 and 9, and Peng Wende of Bogodogo, Arrondissement 5</li> </ul>	Waste collectors and sorters are women's associations. Women organize themselves into groups. Each group is responsible for an intervention area. Household waste collection is done from door to door. The working equipment consists of carts equipped with donkey traction systems, donkeys, and an old bag for waste collection. In the early 2000s, the municipal administration encouraged associations of mostly women who were already picking up garbage in their neighborhoods to group together in <i>arrondissement</i> -based Economic Interest Groups (GIEs, <i>Groupements d'Intérêt Economique</i> ) so that they and some small- and medium-sized businesses (PMEs, <i>petites et moyennes entreprises</i> ) could answer bids for tender from the municipality for trash collection.

(continued)

**Table 6.1** (continued)

Stakeholders	Role
<p>Cleaners</p> <ul style="list-style-type: none"> <li>• Mechanized septic tank cleaners: Septic Tank Cleaners Association of Faso (<i>Association des Vidangeurs du Faso, AVIF</i>)</li> <li>• Brigade Verte</li> <li>• Association that trims the trees</li> </ul>	<p>Several groups of people—associations and small and medium businesses—work to clean the city of Ouagadougou, and most are in some way connected with organic waste through the potential to produce compost, water, and gas. Ouagadougou has associations that clean the cemeteries, a sewer system that removes septic sludge from government buildings, large hotels, and other large buildings in the downtown area. Almost all the rest of the liquid waste from households, businesses, schools, hospitals, and other buildings flows into septic tanks or latrines. The sludge is removed from both by either mechanized or manual septic tank cleaners.</p>
<p>Waste transporters</p> <ul style="list-style-type: none"> <li>• EBTE</li> <li>• SONAF</li> </ul>	<p>EBTE and SONAF are contracted by the city of Ouagadougou to transport mixed waste bins from some of the CCDs to the CTVD. EBTE is the oldest, and SONAF, only a few years old, is an offshoot of EBTE. The two SMEs collaborate together like older and younger companies.</p>
<p>Waste transformers</p> <p>Solid and liquid waste transformers</p> <ul style="list-style-type: none"> <li>• Compost: Women Association Wend Bénédó</li> <li>• Irrigation water: Kossodo Step by ONEA</li> <li>• Biogas: PNB-BF</li> </ul>	<p>Transformers recycle solid and liquid wastes into products for use in other economic sectors. In the organic waste value network of Ouagadougou, some of the organic garbage and vegetation waste produced in the city is transformed into compost. Manure and septic sludge are processed through biodigesters into biogas and compost. In ONEA's anaerobic and aerobic basins, sewage is transformed into water for irrigating gardens. PNB-BF, the National Biodigester Program of Burkina Faso, supported by SNV, a Dutch development organization, focuses on promoting and installing household biodigesters for periurban cattle farmers.</p>

(continued)

**Table 6.1** (continued)

Stakeholders	Role
<p>Growers</p> <p>Market gardeners</p> <ul style="list-style-type: none"> <li>• Association Koom Ramenyé in Kossodo, Arrondissement 4</li> <li>• Cooperative of Boulmiougou, in Boulmiougou, Arrondissement 6</li> </ul> <p>Nursery owners</p> <ul style="list-style-type: none"> <li>• Burkina Verdoyant, in Ouaga 2000, Arrondissement 12</li> <li>• Teel Tissé, in Bissiguin, Arrondissement 8</li> </ul>	<p>Wherever there is water and space in the commune, and often with permission from the municipal administrations of the commune and arrondissements, people have planted market gardens and tree nurseries. The market gardeners and nursery owners are very small businesses, most likely informal, but they provide people and households with incomes and the population of the commune with vegetables, fruits, ornamental and medicinal plants, and trees. Many growers are grouped into site-based associations or cooperatives.</p>
<p>Farmers and livestock raisers</p>	<p>Farmers on the periphery of the commune and people who raise livestock in their households within the commune and in the periphery provide manure and sometimes compost to the growers within the value network. There are few dairy farmers within the 5-kilometer periurban limit. Their need for pasture has pushed them further away from the growing density of houses around the urban area.</p>
<p>Nongovernmental organizations (NGOs)</p>	<p>Different NGOs have intervened in the waste collection, sorting, and repurposing of association's life and work. For example, CREPA trained the women to create a high-quality compost, and others, such as Grand Lyon from France, have built infrastructure and brought equipment, such as a large sifter, and a mechanical chopper for tree limbs and other vegetation.</p>
<p>Households and other liquid and solid waste producers</p>	<p>Households, hotel, restaurants, and government offices produce waste. Households must pay an average fee of US\$ 1.29 to collect their waste depending on their place of residence.</p>



are the sort of collaborative knowledge sharing exercises that drive integrated solution design and politically negotiated settlements that lay the foundation for effective SDG implementation. In the different stakeholder workshops, we took a landscape perspective to envision how different stakeholders were linked together by streets and waterways and through diverse markets and green spaces across the commune (Figs. 6.2 and 6.3).

In the workshops, the landscape perspective allowed us to bring many things to the table, such as the complexity of different challenges and diverse possibilities. In the workshops, we could discuss the integration of concepts like the recuperation and reuse of organic waste, agriculture and horticulture, green urban spaces, and global development goals such as the SDGs. In addition, the landscape perspective allowed us to establish networks among stakeholders, including government partners, civic organizations, and the private sector.

## 6.6 Stakeholder Interactions in the Waste-Water-Energy Nexus to Address SDG 11 in Burkina Faso

Knowledge exchange through MSPs in the waste management sector played a key role in enabling interactions among relevant non-academic stake-

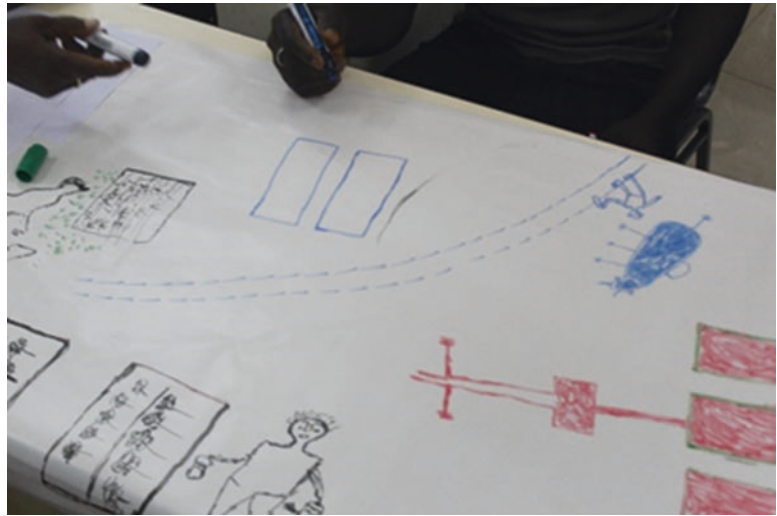
holders, as well as between them and academic stakeholders. The waste value network's story takes place in a commune that is rapidly changing, demographically and politically in national and municipal administrations and policies. Stakeholder consultation and various stakeholder meetings through the MSPs showed that the liquid and solid waste value network in Burkina Faso is a complex system and a story of potentials in which several stakeholders interact. The investigations showed many common points among the stakeholders and the issues that connect them. While all stakeholders are concerned for their incomes and the financial well-being of their families, most stakeholders in nearly all stakeholder groups expressed personal interest in the cleanliness of the commune.

The results showed that the stakeholders could be classified into four categories: government agencies, cleaners, transformers, and horticulturists (gardeners and plant nursery owners) (see Table 6.1). One of the peripheral groups of stakeholders, namely, farmers and livestock raisers, was added to the transformer category because their manure and compost are sold to gardeners and plant nursery owners. At first sight, it would seem that all these different actors should be almost linearly connected: from waste producers through collectors, transformers, and horticulturists to consumers, but the results indicated that relationships are ramified and sometimes interwoven.

**Fig. 6.2** Women waste collectors and sorters discussing and listing the problems they face at the MSP meeting in Ouagadougou, June 11–13, 2019. (Source: authors; photo credit: Qualifa Inoussa)



**Fig. 6.3** Vegetable growers drawing a map of their landscape at the MSP meeting in Ouagadougou, August 8–10, 2018. (Source: authors; photo credit: Qualifa Inoussa)



Within the waste value network, stakeholders are informally linked through inputs and outputs (Table 6.2). For instance, the compost women depend on inputs of a variety of organic garbage and refuse by waste collectors and cleaners. Their inputs include the sorted waste from the waste collection center. They also receive other organic refuse, from associations that clean the cemeteries and others who trim vegetation along streets and elsewhere in the commune. The output, i.e., the compost from the waste composter, is sold to horticulturists, representing vegetables growers and plant nursery operators. Dialogues through MSPs revealed that there were conflicts between these different actors. For instance, the market gardeners were in conflict with ONEA, Burkina Faso's National Office for Water and Sanitation, whereas the plant nursery operators and the women who composted were in disagreement with the municipalities.

The conflict between the market gardeners and the ONEA is related to the use of the treated wastewater. The gardeners attributed the color and smell to “product,” thinking some sort of chemicals had been added to the water. They claimed that the water burned the leaves of their plants such as spinach, okra, and indigenous herbs (*amaranth* and *malohiya*), used in sauces. However, the gardeners had never raised these suspicions. They reported being fearful that the land and treated water could be taken away from

them if they were perceived as being hostile toward, or critical of, ONEA administrators. Most poor and marginalized women who garden are key agents of their families' well-being and economic development. Therefore, leaving ONEA's market gardening sites means no income for these women and their families. This could exacerbate the situation of food insecurity and the lack of schooling for children, especially the daughters of these women. Likewise, the plant nursery owners and the women recycling waste into compost had conflicts with the municipalities. The plant nursery operators have much better visibility for sales and a more constant source of water, but neighbors constructing multi-story buildings complain that the nurseries with their tall trees would block future businesses within these buildings. The municipality decided to expropriate the lands which had created frustrations among the two groups of stakeholders.

The conflict between the municipality and the Wend Bénédó—the association of women who manufacture compost—is mainly related to financial issues. The Association Wend Bénédó was created in 2005 to answer the needs of the commune, which wanted to both reduce the amount of garbage that goes into the landfill and also create employment for women. Though Wend Bénédó operates like a small cooperative business, the Public Health and Hygiene Department (DSPH) still pays a small salary to

**Table 6.2** Stakeholder interactions (Source: authors)

Group of stakeholders	Inputs	Outputs	Associates
Government offices and agencies <ul style="list-style-type: none"> <li>• Department of Sanitation Exploitation (DEX-ASS, <i>Direction de l'Exploitation Assainissement</i>) of ONEA</li> <li>• DSPH (<i>Direction de la Salubrité et l'Hygiène Publique</i> Department)</li> <li>• Municipal Department of Landscape Development</li> <li>• Municipalities</li> </ul>	<ul style="list-style-type: none"> <li>– Training, infrastructure, and equipment</li> <li>– International financing</li> <li>– Master plan for waste</li> </ul>	Title (gray card), insurance, inspection, certificate and allow operations sewage and septic sludge system	Waste collectors and sorters, cleaners, waste transporters, growers, farmers and livestock raisers, nongovernmental organizations, households, and other liquid and solid waste producers
Waste collectors and sorters Economic Interest Groups (Groupements d'Intérêt Economique, GIEs) <ul style="list-style-type: none"> <li>• <i>Action Protection de l'Environnement of Tampouy</i>, Arrondissements 3 and 9, and</li> <li>• <i>Peng Wende of Bogodogo</i>, Arrondissement 5</li> </ul>	Trash, adapted uniforms, face masks and rubber gloves, shovels, brooms, sieves, and other tools	Mixed garbage in large bins, organic garbage in large bins, paper, cardboard, plastic, other reusable items, fine soil, sand, gravel, compost, and donkey manure	Government offices and agencies (DSPH, Ministry of Environment), waste transporters, waste transformers (Wend Bénédó), GIEs (garbage sorters), municipalities
Cleaners <ul style="list-style-type: none"> <li>• Mechanized septic tank cleaners: Septic Tank Cleaners Association of Faso (<i>Association des Vidangeurs du Faso</i>, AVIF)</li> <li>• Brigade Verte</li> <li>• Association that trims the trees</li> </ul>	Truck, working pump, hoses, boots, gloves, cloth, face masks	Septic sludge	Government agencies (Ministry of Environment, ONEA, municipalities), waste transporters, municipalities, waste transporters
Waste transformers Solid and liquid waste transformers <ul style="list-style-type: none"> <li>• Compost: Women Association Wend Bénédó</li> <li>• Irrigation water: Kossodo Step by ONEA</li> <li>• Biogas: PNB-BF</li> </ul>	Training, infrastructure, and equipment (concrete basins, large sifter, mechanical chopper, organic garbage, motorized tricycle, lands, rubber gloves and boots, shovels, rakes, pitchforks, small sifters, buckets, and large pans)	Compost	Growers, household, business owners, government agencies (municipalities, ONEA, DSPH)
Growers Market gardeners <ul style="list-style-type: none"> <li>• Association Koom Ramenyé in Kossodo, Arrondissement 4</li> <li>• Cooperative of Boulmiougou, in Boulmiougou, Arrondissement 6</li> </ul> Nursery owners <ul style="list-style-type: none"> <li>• Burkina Verdoyant, in Ouaga 2000, Arrondissement 12</li> <li>• Teeli Tissé, in Bissiguin, Arrondissement 8</li> </ul>	Land, water from ONEA's wells or basins, buckets and watering cans, motorized pumps and fuel, pickaxe or small hoe, shovels, wheelbarrows, rakes, clippers, cotton waste, seeds, chemical fertilizers, pesticides and herbicides, black earth (black dirt), manure and compost, and information and knowledge from the Ministry of Agriculture	Vegetables and fruits, ornamental plants, medicinal plants, fruit trees, garden services, and various plants	Growers, vegetable and fruit vendors, households, and government offices (municipalities, Department of Landscape Development)

(continued)

**Table 6.2** (continued)

Group of stakeholders	Inputs	Outputs	Associates
Farmers and livestock raisers	Land, barns, stables, milking sheds, borehole, motorized pump, fuel, storage tank, breeding stock, veterinary care and pharmaceuticals to maintain health, motorized tricycle, and biodigesters	Livestock for meat, milk, eggs, hides, compost, and biogas	Growers, government offices (municipalities, ONEA, DSPH (DSHP, <i>Direction de la Salubrité et l'Hygiène Publique</i> ) Department, Department of Landscape Development), and households
Nongovernmental organizations		Training, construction of infrastructure, and supply of equipment	International association directors, project directors, agents
Households and other liquid and solid waste producers			Waste collectors, growers, government offices and agencies (municipalities, farmers, and livestock raisers)

the women (US\$ 1.80 per day) and provides them with space and water at no cost. But the association buys phosphate and manure to add to their compost mixture, and has bought a motorized tricycle and pays for its fuel. It also pays two men (US\$ 2.70 per day) to drive the tricycle and help them with heavy work. When they need to sort trash that comes from other sources than the waste collection centers, the association hires more women to help them. The DSPH would like them to become independent of the small salaries the commune pays them. The women in turn were very angry because they will face external challenges. The association has so far not been able to sell enough compost to expand. It is also possible that an association is not the correct structure to foster an independent and flourishing business. Moreover, the women's association blamed the municipality for not being active in training them on how to raise funds. These women, while they have many good ideas, lack some of the skills necessary to carry the ideas out, including understanding how to find technical and financial partners and how to apply for national or international funding.

Another key outcome from the discussions around the MSP exercises is the lack of communication and trust among stakeholders. For example, several people do not know that there are

different types of compost for sale at the Waste Treatment and Valorisation Centre (CTVD). The treatment process for wastewater by ONEA was also clarified during the discussion of the gardeners' exercises. The roles and responsibilities of the different organizations were also not always clear among partners, such as the municipality and the associations that process waste.

These conflicts and miscommunication prevent a smooth integration and relationship among the different stakeholders for good practices of the waste-water-energy-food nexus (Daniels 2004; d'Alençon et al. 2018). A wide growing literature has shown that a smooth relationship between formal and informal actors plays a key role to the effective functioning of the waste-water-energy-food nexus (Sarkar and Pansera 2017; Smith et al. 2017). Smith et al. (2017) have reported that the responsiveness of some informal actors to the growing needs of many urban dwellers places them in the role of grassroots innovators, who build technologies, processes, and linkages from the bottom up and, in so doing, fill important service gaps despite their marginal status in society.

In addition, during the workshops, the stakeholders were able to list issues that prevent them from being effective in the waste-water-energy-food nexus and proposed new landscape features

(Table 6.2). Besides addressing their issues, a major outcome of the discussions enabled through the MSP was a common and increased understanding among network actors of the value-adding components of the waste value network and the interactions that enable them to co-found solutions for the many existing problems. Through the processes of knowledge co-production and exchange facilitated by the MSP, some of the long-standing barriers to relevant stakeholders' cooperation and to an effective and efficient functioning of the waste-water-energy-food nexus, in the study areas, were lowered. Some gains became immediately apparent, including the establishment of channels of communication between government agencies and horticulturists in Ouagadougou regarding the quality of treated water used in market gardens and the cancelling of plans by city authorities to evict plant nursery operators from the spaces they occupy in the city. The success of a multi-stakeholder platform in solving complex problem requires human (leadership) and financial resources but also effective collaboration, trust, time, and attention by all participating stakeholders.

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## 6.7 Conclusion

Investing in the waste-water-energy-food nexus for the sustainable development of African cities is vital for the achievement of the SDGs, especially SDG 11 (Herslund and Mguni 2019; Bel and Warner 2008; Araral 2009; Tan 2012). The city of Ouagadougou has a rapidly growing population which has led to an increase in waste production and a growing demand for water, energy, electricity, and food to feed the young and expanding population (Dos Santos 2015). Moreover, the needs for water, sanitation, energy, and food of Ouagadougou city dwellers are already exposed to climate and environmental stressors (*ibid.*).

Recycling and repurposing liquid and solid waste from the city of Ouagadougou for UPA, GUS, and green energy enhance sanitation and contribute to food security, urban embellishment,

and population well-being. Our study illustrates the possibility of promoting the effective functioning of the waste-water-energy-food nexus through consultations and collaboration between stakeholders in the liquid and solid waste value chain. Using a proactive, participatory, and trans-disciplinary approach, the study illustrates the processes of engaging all actors through co-construction and knowledge sharing organized around a multi-stakeholder platform.

Stakeholder's dialogues revealed complex problems and conflicts among stakeholders active in the waste-water-energy-food nexus. Results indicated that many of the complex problems and difficulties that different groups of stakeholders face within the value network of solid and liquid wastes resulted from the fast demographic growth and the rapid urbanization that have not been followed by changes and improvements in infrastructure, the network of waste collection, recycling, and repurposing. A common concern was the uncontrolled garbage dumping everywhere in the city, as well as the garbage dumped in the open storm sewers.

Uncontrolled liquid and solid waste disposal is caused by unlawful behavior of the population, and government agencies have not been able to manage the consequent growth in waste production. The lack of equipment, infrastructure, and training, the outdated laws and regulations, a slow bureaucracy, and high turnover of public officials, from ministers to mayors, further contribute to the disorganization and slow development of the system. Old infrastructures must be upgraded, and new structures built in order to accommodate all of the waste that the city produces and to benefit the waste-water-energy nexus. The engaged consultation framework could be structured as a multi-stakeholder platform that holds general assemblies for representatives of all concerned organizations that clean the city of Ouagadougou and recycle and reuse its waste. Besides these assemblies, a multi-stakeholder platform also holds various ad hoc meetings that bring appropriate members together around specific issues. Human and financial resources and institutional reform are necessary to increase infrastructure capacity for managing

liquid and solid waste, but consolidated MSPs are needed to accommodate all the necessary changes, interactions, and transformations.

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