Enabling Environment for Circular Bioeconomy Sector in Burkina Faso

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Acronyms and Abbreviations

AAEC	Alliance Africaine de l'Economie Circulaire
AB/AOC	Alliance for Biodigester in West and Central Africa
ABNORM	Trade ministry agency for standardization, metrology and quality
ACEA	African Circular Economy Alliance
AfDB	African Development Bank
AfDB	African Development Bank
ANVAR	National Agency for the Valorization of Research results and Innovations
AVIF	Association des Vidangeurs du Faso 'Septic Tank Cleaners Association of Faso'
BOAD	Banque Ouest Africain de Développement
BADF	Agricultural Bank of Burkina Faso
CBE	Circular Bioeconomy
CE	Circular Economy
CIRB	Comité Inter Professional du Riz du Burkina
CNRST	National Center for Scientific and Technological Research
COP	Conference of the Parties
COVID-19	Coronavirus Disease 19
CPF	Confédération Paysanne du Faso
CTVD	Centre de Traitement et de Valorisation des Déchets
DEX-ASS	Direction de l'Exploitation Assainissement 'Department of Sanitation Exploitation'
DFS	Decentralized Financial System
DGPSA	Direction Générale des Prévisions et des Statistiques Agricoles
DINASENE	National Directorate of Maintenance, Cleaning and Beautification Services
DSTM	Direction des Services Techniques Municipaux
ECOWAS	Economic Community of West African States
EEA	European Environmental Agency
EPA	Enquête Permanente Agricole
EPI	Environmental Performance Indicator
ERF	Environmental Response Fund
FBDES	Burkinabe fund for economic and social development
FIE	Environmental Response Fund
FONAFI	National fund for inclusive finance

GCF	Green Climate Fund
GEF/GPF	Global environnement Facility Small Grants Program
ILO	International Labor Organization
INDC	Intended Nationally Determined Contributions
INSD	Institut National de la Statistique et de la Démographie
LT-LEDS	Long-term Low Greenhouse Gas Emission Development Strategy
MIS	Market Information System
NGO	Non-Governmental Organisation
NPS	Nature-Positive Solutions
ONEA	Office Nationale de l'Eau et de l'Assainissement
ONASENE	Office National de l'Assainissement et de l'Environnement
PAE/JF	Program for Economic Empowerment of Young people and Women
PAIF/PME	Project to support the financial inclusion of Small and Medium-sized enterprises
PNA	National Climate Change Adaptation Plan
PNB-BF	Programme National de Biodigesteur - National Biodigester Program-
PNDES-II	Second National Economic and Social Development Plan
PNDD	National Policy for Sustainable Development
PNIEDD	National Program for Investment in the Environment and Sustainable Development
PNSAN	National Food Security and Nutritional Policy
PNSR II	Second National Rural Sector Policy
PPFIB	Populations to financial services in Burkina Faso
PPP	Public-Private Partnership
RDS	Rural Development Strategy
HI	Harvest indices
RND	Référentiel National de Développement
RRR	Resource Recovery and Reuse
SDG	Sustainable Development Goals
SDGD	Schéma Directeur d'Aménagement des Déchets -Ouagadougou Waste Management- Master Plan
SDR	Stratégie de Développement Rural (Rural Development Strategy)
SIAO	Salon International de l'Artisanal de Ouagadougou
SNADDT	Schéma National d'Aménagement et de Développement Durable du Territoire
SME	Small & Midium-Size Enterprise
SONABEL	Société Nationale Burkinabè d'Electricité du Burkina Faso
SONAGESS	Société National de Gestion du Stock de Sécurité Alimentaire

STBV	Station de Traitement de Boues de Vidange
STEP	Station d'Epuration
TAP	Transition Action Plan
UDP	Urban Development Project
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNPCB	Union national des producteurs du coton du Burkina Faso
UNPSB	Union Nationale des Producteurs Semenciers du Burkina Faso
UNCTAD	United Nations Conference on Trade and Development
UNECE	United Nations Economic Commission for Europe
VAT	Value Added Tax
WEF	World Economic Forum
WAEMU	West African Economic and Monetary Union
WWTP	Waste Water Treatment Plan

Summary

Burkina Faso has a huge opportunity and natural resources to develop circular bioeconomy (CBE) sector. The agricultural sector employs 63% of the employed workforce and contributes to 16% of the Gross Domestic Product. Large production of cereals results in large quantities of agricultural residues. In a country where the industrial sector is still in its infancy, CBE solutions offer significant opportunities for reconfiguring economies, labor and resource use. However, implementing CBE solutions remains at small scale and scaling up faces numerous challenges. This report reviews the enabling environment - drivers, barriers, and opportunities for promoting CBE initiatives in the country and presents conclusions and recommendations.

1. Introduction

Circular bioconomy (CBE) have emerged as effective tools for triggering a sustainable development process consequent to the fear of cascading risks, growing instability in the world market and the recent Coronavirus disease 19 (COVID-19) pandemic. Promoting the development of business models towards CBE can help countries meet the Sustainable Development Goals (SDGs) and the needs of growing population while supporting vulnerable and marginalized groups (Schroder et al., 2018, Rodriguez- Anton et al., 2022).

Burkina Faso has a huge opportunity and natural resources to develop CBE. In the country, the agricultural sector employs 63% of the employed workforce and contributes to 16% of the Gross Domestic Product. National statistics indicate that in 2021 the largest national productions were maize (1,853,509 tons), followed by sorghum (1,643,721 tons); millet (705,344 ton); cowpea (704,539 tons); cotton (696,635 tons, including fiber and seeds) and peanuts (630,525 tons) (INSD – EPA, 2021-2022).

This considerable production of cereals results in large quantities of agricultural residues. Though there are no statistics on the amounts of agricultural residues, we can estimate based on the "harvest indices" (HI) provided by the agronomy literature. In agriculture, the harvest index is the ratio between the marketable yield of a crop and the total amount of biomass that has been produced, expressed as dry matter. HIs of 0.42 - 0.27 - 0.26 - 0.45 - for maize, sorghum, millet, and cowpea, respectively, correspond to a total biomass production of 1,722,710 tons, which can therefore be valorized by the CBE (Fageria et al., 2006). In addition, from 2003 to 2014, 95,000,000 tons of non-cultivated and cultivated fodder and crop residues were produced, collected, and stored, with a yearly average production of 8,636,363 tons (SDR 2016-2025). Despite the interest in the CBE field for Burkina Faso, the application and the development of the concept face challenges, and food insecurity and precarious living conditions persist in Burkina Faso (INSD, 2022). Burkina Faso SDGs indicators are still low in Burkina Faso (PMA, 2022). The country's populations are still characterized by poor access to drinking water, poverty and poor health (Table 1).

Table 1: Fact sheet of Burkina Faso (PMA, 2020)

Item	2015	2020	2030
Inhabitants	18.1		27.2
Population Density (pers/s.q.km)	66.2		99.6
Life Expectancy	58		63
Mortality rate (%)	67		45
Per Capita Gross National Income (2011, USD)	1591		
SGD 1: No Poverty			
• Access of electricity (%)		20	
• Access to improved water sources (%)		66	
• Access to improved sanitation facilities (%)		13	
SDG3: Good Health and Well-Being			
• Unmet need for family planning (%)		29	
• Family Planning Demand Satisfied (%)		36.6	
SDG4: Quality Education			
• Never (%)		52	
• Primary (%)		22	
• Technical/Tertiary		25	
SDG5: Gender Equality		1	
• Married by age 18 (%)		45	
• First birth by age 18(%)		27	
SDG6: Clean Water and Sanitation			
• Open defecation (%)		63	
• Shared facility (%)		8	
• Improved, not shared facility (%)		16	
• Non-improved facility (%)		13	
• Access to improved main drinking source (%)		42	

In Burkina Faso, where the industrial sector is still in its infancy and characterized by a cheap labor force, CBE approaches offer significant opportunities for reconfiguring economies, labor and resource use. However, implementing CBE approaches remains isolated at tiny scales and scaling up faces serious challenges (Sanfo et al., 2022). Little has been done on the CBE sector and there is a dearth of a report on many aspects of CBE from a developing country like the Burkina Faso. Hence, this report aims to fill these gaps. This report will further help educate academics and non-academics on Nature-Positive Solutions (NPS) for CBE approach to waste recycling and repurposing in Burkina Faso. Promoting this

knowledge will help policymakers and the private sector to create incentives and innovative opportunities, value CBE networks, and its value chains. The report will answer the following question: are the existing political, regulatory, institutional, and financial frameworks relevant and conducive to resource recovery and reuse (RRR) companies to meet the challenges of CBE in Burkina Faso?. Using grey literature review and text mining, stakeholder consultation exercise, experts and key informants' interviews through a well-designed survey form, this report reviews Burkina Faso CBE and policies in various sectors. Furthermore, it examines the enabling environment (drivers, barriers, and opportunities) for promoting CBE initiatives in the country and presents conclusions and recommendations.

2. Overview of the Circular Bioeconomy Sector in Burkina Faso

2.1. History of waste management

The notion of CBE requires considering what was once treated as "waste" as a resource or raw material for another production cycle as well as fostering reuse and extension of a product's service life through repair, upgrades and retrofits. Some significant periods have shaped the history of waste management in Burkina Faso. Since the country's independence in 1960, policies and regulations governing waste management have been pursued but have remained limited.

Waste management and sanitation policies and regulations have existed and have been implemented for a while now in Ouagadougou, the capital city, where waste is most prevalent, then it gradually moved to in the second city, Bobo-Dioulasso, largest and subsequently in the other cities across the country. Six main periods can be distinguished in the history of waste management in Ouagadougou (table 2). Initially, the municipal board was the main entity and actor responsible for the waste management and sanitation in the city from 1958 to 1968. Texts and laws on waste management have been passed since the 1960s, the municipal decree of 03/25/1960 prohibiting inappropriate waste disposal is an example of such laws. Between 1968 and 1979, the municipality transferred responsibility to a private company, the Nakoulma Company 'Société Nakoulma. Due to lack of financial resources, the contract between the municipality and the Nakoulma company was terminated. From 1979 to 1986, during the period of revolution, the government through the municipality took back the waste management and sanitation. Some offices such as National Office of Sanitation and Environment (Office National de l'Assainissement et de

l'Environement, - ONASENE -) and National Directorate of Maintenance, Cleaning and Beautification Services (-DINASENE-) were created. The period of revolution was also marked by collective operations of public cleaning known as "Operations mana-mana" which means in the local language "cleaning operation". After this period, financial and other difficulties arose again in the earlier 1990s. From 1991 onward, the government offices, ONASENE and DINASENE established a public-private partnership (PPP) approach to monitor and evaluate waste management and sanitation with waste collection fees varying between UD$ 0.50 and UD$ 2 per household, depending on the neighborhood (Bayili, 2002).

Table 2: Major changes in Waste Management in Burkina Faso

Time Periods	Main Entity Responsible/ Waste management system
From 1958 to 1968	• Municipality
1968- 1979	• Private company (Nakoulma Company 'Société Nakoulma')
1979- 1986	• Municipality • Proactive policy • Collective operations for the cleaning of the various neighborhoods known as "Operations mana-mana" which means in the local language "cleaning operation".
1986- 1991	• Centralized management • Creation of public offices ONASENE & DINASENE
From 1991- Onward	• Public-Private Partnership (PPP) • Decentralized waste management • Polluter pays" principle through the partial recovery of operating costs • Application of collection fees varying between UD$ 0.50 and UD$ 2 for household waste collection set between depending on the neighborhood of residence

The Department of Municipal Technical Services (Direction des Services Techniques Municipaux, DSTM) was also created in 1993 with the same responsibility ONASENE. In 2000, the municipality implemented its Urban Development Project (UDP), supported by the World Bank and some NGOs. 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 influence the shaping of environmental policy at both the national and international levels. It should be noted that most waste

recovery activities are carried out in the informal sector and under unacceptable conditions. Although the NGOs and Small and Medium Enterprises (SME's) represent some cases of formal organizations with legal entities. The government and its development partners are however pretty committed to reversing these trends by implementing research and development projects and programs. Some other private waste management companies were created, and opportunities for improving local waste recycling and repurposing capacity emerged.

2.2. Circular bioeconomy practices in Burkina Faso

CBE practices have existed in Burkina Faso for decades. Inorganic and organic solid and liquid waste have been recycled and repurposed into valuable products. Methods of using used oil drums and cans as means of transporting and storing water in households have existed for generations. There are many other examples today, such as using used cans to package and distribute homemade spices, the recycling and repurposing of plastic waste into buckets, and other valuable products. Used tires are one of the significant inorganic and solid waste for the CBE sector in Burkina Faso. Used tires can be recycled and repurposed into useful products such as shoes, bins, flowerpots, or roundabouts at junctions. They are now widely used to make security devices for the national armed forces.

Organic solid wastes like biomass, comprising of agricultural residues and household organic waste are also widely used in the circular bioeconomy sector. The widely used circular bioeconomy in Burkina Faso is composting. Composting activities were also practiced in the past in the mixed crop/livestock integration practices. It consists of farmers supplying livestock raisers or their livestock with crop residues. The integrated system makes it possible to use animal waste as organic manure to fertilize farmers' croplands and improve soil fertility. Moreover, at the northern edge of the commune, an association of women transforms organic waste into compost (Sanfo et al., 2022). The Association Wend Bénédo 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 create employment for women. Organic waste includes urban wet waste from food but also from organic refuse from the cemeteries, vegetation waste that is trimmed along streets and elsewhere in the commune. According to Kabore et al. (2011), 71% of cereal farmers and 73% of nurserymen used municipal wastes as source of organic matter. In addition, CBE is being practiced in the agri-food industry sector. However, recycling and repurposing agricultural and food residues are underdeveloped due to the level of technological advancement in Burkina Faso. Cotton and groundnut cakes from cotton and seeds and groundnut residues are the significant outputs. After the oil has been extracted from the oil seeds, the residues are recycled into cakes after

adding additives (fat, salt) and used by farmers and livestock raisers to feed animals. According to the literature, 100 kg of cotton fiber production generates 165 kg of seed. One ton of seeds provides about 200 kg of oil, 300 kg of shells, and 500 kg of oil cake (Trans, 1994). During the 2021 cropping season, cotton seed production was estimated at 433,753.867 tons, with a total of 216,876 tons of oilseed cake, which is very useful for breeding.

Moreover, in the suburbs of Ouagadougou, a food processing company recycles and repurposes mango residues into natural vinegar. The repurposed raw vinegar is widely exported to Europe, where it is most appreciated and popular. Another example is food potash in rural areas. Most households produce their potash for culinary purposes from millet residues. In the livestock sub-sector, the detritus of the slaughtered animals, especially the skin, are recycled into leather, used by artisans and the leather and fashion industry to design functional and added value products such as handbags, belts, shoes, and hats. In the forestry sector, non-timber forest products such as shea nuts are used in CBE value chains. The residues from the production of shea butter are used in traditional housing to enhance the damp proofing of house walls.

The CBE is also applied to the water and energy sector. CBE models for social and solidarity-based companies, such as NGOs exist. These models produce methane that can be used not only for culinary purposes but also to produce electricity. Organic solid waste, including crop residues, are recycled and repurposed into biochar and compost. For example, water hyacinth (Eichhornia crassipes), an invasive plant in aquatic environments, is collected and repurposed into biogas and compost. In addition, in the capital's suburbs, a technical landfill center on 70 hectares is planned to operate from 2005 to 2025. The CBE is practiced there with compost production from organic household waste. A project not yet started plans to collect the methane generated as fuel. This methane is so far released into the atmosphere or burned by a flare, which is not the indicated process.

Still, in Ouagadougou, the National Office of Water and Sanitation (Office Nationale de l'Eau et de l'Assainissement-ONEA, DEX-ASS-) provides tap water in cities throughout the country. In the commune of Ouagadougou, under their DEX-ASS, a sewer system that serves significant buildings like government offices, large hotels and some households in the downtown area are maintained. The sewer system empties into the first of many large open basins at the water treatment plant (Station d'Epuration, STEP) in an industrial sector of the Kossodo neighborhood in the northeast corner of the commune. There, flowing from one basin into another, the water is treated naturally first by anaerobic bacteria and then by

aerobic bacteria. The recycled water then flows through pipes and canals to irrigate market gardens nearby.

The Kossodo plant also includes a Septic Sludge Treatment Station (STBV, Station de traitement de Boues de Vidange), where the septic tank cleaners empty their tanker trucks. Some of the septic sludge runs through a biodigester to produce biogas. The biogas is supposed to run a generator contributing to the country's electric grid through SONABEL (Société Nationale Burkinabè d'Electricité), but the generator has not been functioning. Financial constraints arose and the digestate, the biodigester's product that can serve as compost, was also not used due. Two other ONEA STBVs are located on major highways that leave the commune of Zagtouli, a rural area on the southwest border of Ouagadougou, and Gonsin, a village in the district of Sourgoubila, on the northwest border of Ouagadougou. Financed by the African Development Bank (AfDB), the stations were opened in 2014. Two new stations are planned for two other significant highways leaving the south of the district but neither has sites, yet. There is no timeline for either the new STVBs or the redevelopment of the STEP. All three STBVs present many challenges, causing problems for the mechanized septic tank cleaners and tensions between their association, AVIF, and ONEA. After the stations were built, it became illegal to dump septic sludge anywhere within fifty kilometers of the district boundaries.

2.3. Gender consideration in the circular bioeconomy sector

In Burkina Faso, women and youth are heavily involved CBE processes, particularly waste management, including agricultural residue collection, separation, recycling, and recovery. Though women and youth are key agents of family well-being and economic development, they are among the poorest, most marginalized people (DGPSA, 2008). In addition to women and youth, children also involved in waste recycling channels against the International Labor Organization (ILO) recommendations in the country's national legislation (CEAS, 2021). The involvement of children in the waste recycling and repurposing is dangerous because they are unaware of the dangers of the job.

While the actors active in the CBE sector: households; collectors; associations; SMEs; and local authorities, have accused one another of being responsible for these waste management system challenges, some observers have argued that the issues 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, characterized by unhealthy practices, clandestine collectors, and illegal dumping (Dos Santos 2015).

3. Policy and regulatory framework for circular bioeconomy sector

3.1. Understanding the political landscape

CBE governance in Burkina Faso is very new and fragile. The governance of the CBE sector is considered in the short-, medium- and long-term planning. During the year 2021, a short- and medium-term environmental charter, the RND 2021-2025 -Second National Economic and Social Development Plan -RND-PNDES-II was developed. The aim was to protect the environment and promote a green low-carbon resilient and inclusive economy. Although the RND does not directly describe the concept and objectives of CBE, they are implied in need to undertake trade-offs for a transition to a green economy. The RND 2021-2025 respects multilateral agreements (e.g. UNFCCC), and all stakeholders that are involved in the implementation of the strategic plan have committed to i) comply with environmental legislation; ii) adopt consumption and production patterns; iii) promote clean technologies in food and non -food production and processing system, to reduce water and energy consumption; iv) reduce waste generation and Greenhouses Gases emissions and v) protect environment and ecosystems.

However, Burkina Faso's Environmental Performance Indicator (EPI) fell from 43.71 in 2016 to 38.3 in 2020, a drop of more than 5 points. The revision of legislation framework and plans revealed: i) an inadequacy and a weak application of legislative and regulatory texts on the environment, CBE and sustainable development; ii) a weak consideration of CBE issues in actions and budget plans; iii) a little consideration of green finance to support entrepreneurship and green investments, including the CE and CBE sector (CPDN, 2015).

After the unexpected outbreak of COVID-19, terrorist attacks, and humanitarian crisis, a Transition Action Plan (TAP) was developed in May 2022 from 2022 to 2025. Though the TAP is designed to follow up the strategic axes and objectives of RND-PNDES-II, it focuses on resolving security and humanitarian emergencies rather than promoting the economy. Beyond the RND-PNDES-II, Burkina Faso has several short- and medium-term environmental sectoral policies that aim at developing the CE and CBE sector. Some of these sectorial policies have direct implication on the CBE sector. For instance, the gender unit of National Climate Change Adaptation Plan (NAPA) 'Plan national d'adaptation aux changements climatiques (PANA)' of the Ministry of Environment, Green Economy and Climate Change (MEEVCC) supports activities related to CBE. Through a project implemented in 2019-2020 the NAPA gender unit organized three training workshops of USD 16, 000 in waste recovery composting for 80 women from the 13 regions of Burkina Faso. In addition, the Environment, Water and Sanitation Sectoral Policy (PS-EEA, 2018-

2027) (Politique Sectorielle « Environnement, Eau et Assainissement » (PS-EEA, 2018-2027)) investigates in waste recycling and repurposing. It set up two plastic waste processing and recovery centers in Bobo Dioulasso and Dori. In 2011, through this policy, the government purchased 5,628 tons of plastic waste for recycling and repurposing. Through its actions, the Environment, Water and Sanitation Sectoral Policy, has been of great support in waste management, recycling and repurposing. 6% of solid waste has been recovered in 2011. The proportion of recovered waste has increased to 9% in 2015. The number of districts with a functional solid waste management system has increased from 9% in 2014 to 22% in 2016. During 2012, the actions of the country National Determine Contribution (NDC) allowed the production of shea residues/fines amounted to 258,122 tons. In addition, the processing of the shea residues/fines made it possible to market 48,183 tons of shea butter, 42,484 tons of soap, 2,340 tons of ointment. The processing of 'néré' seeds produced 35,904 tons of soumbala. The processing of bilinite seeds produced 1,277,299 liters of oil and 3,322 tons of soap. Ouagadougou Waste Management Master Plan 'Schéma directeur de gestion des déchets (SDGD)' considers the recovery of waste as a priority. SDGD help recycle and repurpose solid organic waste into compost.

A long-term specific strategy document for the CBE has not yet been widely implemented. However, interest in the CBE has existed since 2010 in political and strategic reference frameworks through the notions of green economy, waste and agricultural residues recovery. By contributing to solid and liquid organic and inorganic recycling and repurposing, the CBE are integrated into the broader framework of the green economy. Three major policy reference documents address the CBE in the long term.

The largest policy reference was the general report of the National Prospective Study "Burkina 2025" developed in 2005. The long-term low greenhouse gas emission development strategy (LT-LEDS) advocated by COP 21 is still under perspectives. The benchmark considered that the new lifestyles of the populations, particularly those of the cities, carry threats for the environment. These threats are related to the production of household waste, wastewater, waste oil, polluting gases, pesticides and chemical fertilizers. The country National Plan for the Sustainable Development 'Schéma national d'aménagement et de developpement durable du territoire (SNADDT), 2040' proposes concrete responses to the issue of sustainable development in Burkina Faso. In addition, the National Policy for Sustainable Development (PNDD) to 2050 supports green investments. Through this policy, Burkina Faso created a political, legal and institutional framework to promote sustainable development in partnership with all sectors, including the public-private partnership. The private sector contributes to promote responsible and sustainable modes of production and consumption and progressive transition towards CBE. It ensures

the mobilization of international and sovereign funds, create incentive to encourage people to pay taxes for financing sustainable development of CBE.

In summary, the revision of the political framework showed a little political intention and initiative in terms of CBE. They are respectively translated into strategies, regional action plans, projects and programs. For example, the National Biodigester Program (PNB-BF), phase 3 2022-2026 well represents the concept of CBE. It aims at providing with households at least 26,000 medium-sized biodigesters producing biogas and at least 1,585,000 tons of compost from animal waste and agricultural residues. In ten years (2010-2020), the first two phases of the program have built 13,480 biodigesters, giving 80,000 people access to a clean energy and making Burkina Faso the third most biodigester-owning country in Africa.

3.2. Understanding the institutional landscape

The institutional framework in Burkina Faso is strong but not stable. It is greatly changing due to political instability and challenges faced by the government. Several institutions are carrying out coordinated and complementary actions to either directly or indirectly promote CBE. Since 2021, Burkina Faso has been a member of the African Circular Economy Alliance -ACEA- (Alliance Africaine de l economie Circulaire -AAEC-), which currently has 8 member countries (Burkina Faso, Rwanda, South Africa, Nigeria, Ghana, Cote d'Ivoire, Benin and Sudan).

ACEA is a coalition led by governments of its member countries. The overall goal of AAEC is to generate economic growth, jobs and positive environmental outcomes. ACEA serves as a platform for the transition to a CBE at national, regional and international levels. The platform is built around three key components: (i) policy development, (ii) leadership and advocacy, and (iii) scaling up of businesses and projects in the CE. The country is also member of the Alliance for Biodigester in West and Central Africa (AB/AOC) and hosts the alliance's headquarters. The biodigester is a major example of a CBE value chain.

Beyond these multilateral CBE institutional frameworks, Burkina Faso has several national institutions that support the promotion of the CBE. For example, through its Permanent Secretariat of the National Council for Sustainable Development and its technical directorates, the Ministry of Environment Energy, Water and Sanitation is the core of the national support system for the CBE. Beyond ministries, several other institutions have shown interest in CBE. These institutions include the 368 municipalities of the country and other development partners (e.g. United Nations; European Union; NGOs; RRR companies and Civil society organizations). The municipalities and their departments and centers (e.g.,

DSPH, waste collection center, Waste Treatment and Valorization Centre) oversee the collection, treatment, and recycling of solid waste. The Municipal Department of Landscape Development and Park Management has responsibility over public parks and the Green Belt of Ouagadougou (Sanfo et al., 2022).

3.3. Regulatory and administrative context

The regulatory and administrative frameworks for the CE and CBE in Burkina Faso are aligned to bilateral and multilateral agreements of UEMOA, and ECOWAS. Some useful national and international laws and regulations that govern the CBE sector are discussed here. The Law n°006-2013/AN on the environmental code in Burkina Faso sets out the basic rules governing the CBE sector. It defines responsibilities for household waste and agriculture residues recycling and repurposing. The Law No. 17-2018/AN on the Agro-Sylvo-pastoral, Fisheries and Wildlife Investment Code aims to promote productive and inclusive investments including small-scale semi-industrial processing of agro-sylvo-pastoral, fisheries and wildlife residues. The Law n°055-2004/AN of December 21, 2004, on the General Code of Territorial Authorities sets up the orientation of decentralization, the powers and means of action, the bodies and administration of territorial authorities. It also plans, monitors and evaluates districts and regions duties with respect to environmental and household waste and agricultural residues management.

The Law n° 022-2005/AN, the public hygiene code in Burkina Faso deals with the issue of public hygiene in Burkina Faso to preserve and promote waste recycling and reuse, and safety sanitation. Beyond these laws and regulations different decrees regulate the operationalization and the implementation of laws by providing useful framework for the implementation of CBE. Law No. 026 - 2007/AN which is currently under review, promotes the use of compost from agricultural residues. The law n°025-2017/AN regulates the sanitary protection of plants, products and other regulated items, including products derived from modern biotechnologies.

Finally, the law n°026-2017/AN on the control of pesticide aims to ensure the regularity of production, experimentation, import, export, packaging, transport, distribution, storage, use and destruction of the pesticide to promote the use of recycled compost in the agriculture sector. As multilateral agreement, Burkina Faso has ratified about 60 international environmental agreements including CE and CBE (CPDN Burkina Faso, 2021). The country is a member of the Conference of the Parties (COP) to the UNFCCC and the Paris agreement and has developed its NDC 2021-2025, which addresses the issue of waste recovery, and therefore the CBE. The Country shows a willingness to support the CBE sector through the

implementation of projects and programs for climate change adaptation and mitigation (e.g., methane recovery projects from wastewater treatment at the Kossodo WWTP and from the landfill of CTVD, recycling and repurposing of 200,000 m3 of feacal sludge into biogas, etc.). For valorizing the livestock sector through the CBE sector, the NDC 2021 has foreseen the harvesting and storage of 10,000 tons of crop year until 2030. This forecast is not very ambitious because, from 2003 to 2014, 95,000,000 tons of natural and cultivated fodder and crop residues were produced, collected, and stored (Burkina Faso Rural Development Strategy 2016-2025, 2015 'Stratégie de développement rural à l'horizon 2016-2025 du Burkina Faso, 2015'). This represents an average annual production of 8,636,363 tons over the period.

3.4. Fiscal incentives and customs

Few taxes and customs incentives are available for the CBE sector in Burkina Faso. However these incentives are not solely aimed at CE and CE sector. Sources of incentives are offered by the tax and investment code law No. 038-2018/AN. The overall goal of this law is to promote productive investments contributing to the economic and social development of the country. It aims to create and develop activities oriented towards developing local raw materials and environmental protection. This law, therefore, governs the CBE sector. It promotes new investments and large-scale projects (a private project budget of more than USD 150 000 with more than 20 permanent staff). It allows the company whose application is approved to benefit from considerable tax and customs advantages during the first years of operationalization. This investment code offers, via article 17 of the investment code law, an advantage of access conditions to companies in the agro-sylvo-pastoral, fisheries, and wildlife sectors processing raw materials and companies in the renewable energy, environmental protection, environment, and crafts sectors. Depending on the type of operationalization, the code framework, via article 32, equally provides two-year extension taxes benefits and advantages to companies in environmental protection, renewable energy, and craftsmanship. In addition, these companies also benefit from a five-year VAT exemption on duties and property transfers (e.g., equipment, buildings, etc.).

Moreover, Law No. 058-2017/AN imposes a specific VAT (this means that tax is imposed) on importing and manufacturing biodegradable or non-biodegradable plastic packaging and bags. Through article 377, the law further provides a 50% reduction of taxes for companies that have an effective mechanism of recovering, recycling, and repurposing plastic packaging and bags resulting from consuming their products. This regulatory framework is a crucial incentive for the CBE. Though the first two regulatory frameworks benefit and encourage

companies and institutions in the circular economy sector, the sources of VAT and customs benefits and allowances remain little incentive to CBE.

3.5. Obstacles and limits of the political, institutional, and financial framework

Four major constraints limit the successful implementation of the political, institutional and financial framework of the circular economy: implementation inefficiencies, weak regulatory framework, lack of adequate monetary incentives, challenges of human resources.

3.5.1. Implementation Inefficiencies

The analysis of the CBE political, institutional, and regulatory framework offers a business environment rich enough in opportunities and technical and financial support. The study shows existence of a political, institutional, regulatory, and financial framework that guarantees the minimum conditions necessary for the development of the CBE sector. However, it appeared from the stakeholders' consultations (CBE companies and actors and leaders from the government) and observations on the field that the implementation framework of these political, institutional, and regulatory frameworks needs to be improved. Several policy documents intend to support the CBE sector but are not rigorously implemented in the field. For example, the 2014 law and decree prohibiting the production, import, marketing and distribution of non-biodegradable plastic packaging and bags in Burkina Faso are not successfully implemented on the ground.

3.5.2. Weak regulatory Framework

The institutional framework often lacks operational means in the field. For instance, During the interviews, officials from the Ministry of Agriculture mentioned the lack of working standards to ensure effective control of the regulations on the use of pesticides in agricultural practices. The same applies to the regulatory framework system for environmental protection, which is slightly not often respected or complied with. As the regulatory frameworks are rarely used, some companies are hardly engaged and seldom committed to environmental protection and CBE. The CBE sector often faces technological and financial constraints and profitability issues (e.g., slightly adapted new technologies that are yet to experiment and inefficient, increased labor and health risks, etc.).

3.5.3. Lack of adequate monetary incentives

The tax and customs benefit and advantages that the regulatory system offers are still little incentive and are seldomly implemented. For example, the law implementation decree that prohibited the production, import, marketing, and distribution of non-biodegradable plastic packaging and bags in Burkina Faso since 2014 has not been effectively implemented on the field. In addition, the opportunities offered by the business environment often remain unknown to CBE actors in the area due to a lack of communication, monitoring and evaluation system for these opportunities.

3.5.4. Challenges of financial and human resources

Generally, many CBE players and actors are poorly trained and not well educated. They often operate in the informal sector with low technical capacity and lack customized training and expert services on CBE business models. They also lack funds to improve their skills and have little access to financial resources. Public funding (environmental intervention fund, green climate fund, etc.) mainly goes to NGOs and nonprofit institutions as subsidies through calls for projects and program proposals, whereas responding to these calls for proposals requires technical expertise and fundraising skills.

Furthermore, the CBE companies and actors have little or no access to the private funds, which in most cases, are difficult to access. The conditions for obtaining loans are a little flexible and require guarantees, rationing, high-interest rates. Therefore, the current private financial schemes exclude many small and medium-sized CBE enterprises. As a result of these challenges, only the more prominent and better-structured organizations can take advantage of the opportunities offered by political and regulatory frameworks. These institutions have more access to financial resources and technical support than the SMEs actors.

4. Financing circular bioeconomy sector

4.1. Public and private funding sources for circular bioeconomy

There are several sources of funding for the CBE sector. However, these funding sources are not explicitly directed to the CBE sector but include other environmental and sustainable development aspects. In this report, we describe some of these funds to build a sound knowledge base on the financing schemes of the CE sector. There are public and private funding sources, including grants, credit, and private equity funds.

The Environmental Response Fund (ERF) (Fonds d'intervention pour l'environnement, FIE) is responsible for the mobilization, management, allocation, and monitoring of financial resources intended for activities contributing to achieving Burkina Faso's environmental objectives. ERF promotes sustainable practices in the energy sector. ERF resources consist of state subsidies, tax and royalty incomes, contributions from international financial mechanisms, and technical and financial partners.

The Green Climate Fund (GCF) is an operating entity of the financial mechanism of the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris agreement. GCF aims to support efforts at the global scale to meet the challenge of climate change - https://www.greenclimate.fund/countries/burkina-faso -. It often finances and supports climate change adaptation and mitigation projects and programs. In Burkina Faso, Coris Bank International is the institution authorized to manage the GFC funds through national bids.

The Burkinabe Fund for Economic and Social Development (FBDES) mission is to support the implementation of economic and social development by i) promoting existing businesses and creating new businesses companies (e.g.., SA, SARL), supporting companies and institutions that create jobs and disseminating shared held portfolios through its Startup program. FBDES often launch calls for project proposals to help young companies that are involved in the CE sector.

In addition, some development projects allocated funds to the circular economy sector through dedicated windows (e.g., Project for the Promotion of Inclusive Finance for the Access of Low-Income Populations to Financial Services in Burkina Faso - PPFIB-, National Fund for Inclusive Finance – FONAFI-, Program for economic empowerment of young people and women - PAE/JF-, Project to support the financial inclusion of small and medium-sized enterprises -PAIF/PME-).

Recently, some funding resources have been created to finance the EC sector. The African Development Bank (AfDB) Circular Economy Facility is one of these newly launched sources of funds. The AfDB Group recently launched (May 2022), the African Circular economy Facility in Accra, Ghana. The Bank Group's Board has approved the facility of Directors. The fund will channel, finance, and mitigate risk in innovative circular economy business models. The funds will support the country-led African Circular Economy Alliance (ACEA) in integrating the circular economy into African green growth strategies.

Other dedicated multi-donor trust funds (BOAD, AfDB, UNDP) also aim to support the EC sector. The multi-donor trust fund will operate over five years. The Government of Finland and the Nordic Development Fund will transfer initial funds of €4 million to the AfDB to help achieve the objectives of CBE. The fund will focus on three strategic areas: institutional capacity building to strengthen the regulatory environment for CE innovations and practices, private sector support through a business development program, and technical assistance to the African Circular Economy Alliance. However, the operationalization and implementation at the national level are not yet effective. Finally, crowdfunding sources present multiple perspectives and opportunities for the CE sector but are still currently poorly developed.

4.2. Financial sector involvement in circular bioeconomy

The financial sector is not exactly involved in the CBE of Burkina Faso. There is no exceptional support for the EC and CBE sector or special treatment for RRR projects. The Banking systems and loan processes for RRRs projects and CBE sector funding consider the exact requirements of financial profitability and risk minimization. Bank requirements (e.g., financial statement, business plan, high-interest rates, reaching 12%, deposit, pledge, etc.) too costly by RRR actors and promoters.

The banking system is exclusive as informal sectors and small sized CBE business models, have little assets, perform poorly and therefore present higher financing risks. To fill this gap, Decentralized Financial Systems (DFS) have been recently promoted as financial inclusion alternatives in the country. However, these financial systems are monitored and evaluated and must apply credit rationing systems. Of the 16 banks in the banking system, only the public Agricultural Bank of Burkina Faso (la Banque Agricole du Faso, BADF) is dedicated to financing business value chains in the rural sector. The Bank also finances EBC businesses models that recycle and repurpose agricultural residues into useful and added value product (e.g., oil mills that recycle and repurpose process cotton seeds (CITEC, SAVOR, SAPHYTO), SMEs that process cashew nuts, sunflower sugar cane and mangoes, (SN-DAFANI, SOSUCO). BADF is a significant source of funding for the circular bioeconomy sector.

Several public and private technical support institutions for the CBE operate in Burkina Faso. Technical services offered by these institutions include training, extension, services, scientific, supervision and technological support services. However, these institutions are interested in a broader sector and are not focused on the CBE sector only. The main structures are i) the incubators with a mission to incubate CBE business models cases (e.g., la ruche, la fabrique, Burkina Start-up, etc.); ii) Burkina Faso national biodigester program (PNB/BF) which is a program of the Ministry of Agriculture. The program trains and

supports model households in biodigester technology (recycling and repurposing organic solid waste, including agricultural residues into compost and biogas), service companies, consulting, marketing and communication.

Other institutions exist but are operating indirectly in the bioeconomy sector. The National Agency for the Valorization of Research Results and Innovations (ANVAR) of the Ministry of Higher Education, Research and Innovation design, implement, disseminate, monitor and evaluate the policy and strategies of the Ministry in terms of valorization of research results on circular bioeconomy. ANVAR provides knowledge, technology and know-how for CBE actors, included SMEs. It offers a huge of opportunities for collaboration and networking. The National Center for Scientific and Technological Research (CNRST) provides science and technology research to support sustainable development of Burkina Faso. It develops CBE and CBE technologies and trains the actors for efficient, effective and sustainable CE and CBE sector and sustainable development in Burkina Faso. The country's Trade Ministry and Agency for Standardization, Metrology and Quality (ABNORM) develops and disseminates national standards, technical specifications and codes for good practice, raises awareness and trains actors and stakeholders on standards and quality management tools; ensures quality control of goods and services for import, export and local production and consumption; advises and assist industrial, commercial and service companies in standardization, certification, metrology and quality.

5. Market environment

The CE and CBE market is dominated by informal sector goods and services. Most CBE actors have small shops in random places and are limited to the local markets. However, there are some CBE business models cases being exported outside the national market. such as Group Waka, recycles and repurposes mangoes residues into vinegar which is exported to Europe. Africa Ecology Association recycles and repurposes plastic waste into bags and other items for woven and organic waste into biochar. A few private companies, especially medium and large-size companies and public programs (e.g., national biodigester program) are the main actors in the CBE market, which is dominated by substitute products. These companies have equipped themselves with an efficient information system (e.g., big database management systems, etc.) to access markets and promote their visibility. There is no market, both upstream and downstream, information system for CBE products in Burkina Faso. Existing agricultural market information systems do not consider agricultural residues.

The most important market information system is that of the National Food Security Stock Management Company (Société National de Gestion du Stock de Sécurité Alimentaire -

SONAGESS-). It publishes only grain prices. CBE enterprises and actors play on local informal market. Depending on CBE inputs and outputs, the upstream and downstream market are local and sometimes national (e.g., Ministry of Agriculture calls for bids for the acquisition of organic fertilizer to support farmers). However, social media offers communication options and a great opportunity to promote the visibility of CBE sector, reverse trends and export some business model cases outside the country (e.g. the STEP of ONEA that recycle and repurpose waste water into treated and irrigated water for vegetable irrigation).

The National and International events frameworks are being created and provide privileged showcases for CBE outputs (e.g., the Ouagadougou International Handicrafts Fair (SIAO)). This platform, which is held every two years gives an ideal setting for Burkinabè and African actors and stakeholders to sell their products, including CE and CBE products on national and international markets. Moreover, the National Forum for Scientific Research and Technological Innovations event brings together various national, regional and international institutions for scientific knowledge exchanges and exhibition of research and innovation results to promote and strengthen regional integration and cooperation in Africa. The National Farmer's Days is a yearly framework that aims at building a multistakeholder platform, including farmers, livestock raisers and policy makers, for technical and policy dialogue and actions for sustainable rural development. Finally, the regional fairs of non-timber forest products are events that aim at discovering the forest potential of the region and, above all, at encouraging processors in the development and promotion of local products.

6. Conclusion and policy recommendations

The CBE sector in Burkina Faso is growing. However, CBE practices in Burkina Faso are still not very efficient and adequate. It is characterized with sub optimal use of natural resources and inadequate environmental preservation. Awareness of the impacts of climate and environmental stressors (e.g., extreme weather events such as prolonged dry spells, floods, drought, heat wave) on livelihood and people's well-being have been raised to improve organic and inorganic waste management, recycling, and repurposing systems (Sanfo et al. 2012; CPDN Burkina Faso 2021). In addition, environmental education is increasingly being implemented through several channels (radio, audiovisual, school programs, community animation techniques, etc.) to raise collective awareness of the importance of CBE in supporting the growth and development of the economy.

A positive dynamic is observed in the political, institutional, and regulatory framework. Burkina Faso is a member of multilateral environmental agreements and is increasingly

developing planning frameworks (policies, plans, programs, strategies) and regulations to meet environmental commitments. There are already operational alliances, projects and programs on a national scale (e.g. the national program for biodigesters). The platforms of these alliances offer great opportunities for CBE businesses, and Burkina Faso can benefit from the experiences of other countries. Moreover, the government is open to other regional and global partnerships favoring the CBE.

Although the hostile environment does not fully offer CBE actors the opportunity to fully explore their capacities, successful CE and CBE models 'cases have been recorded (e.g., Faso Biogaz, Wend Benedo, Africa Ecology associations, Group Waka, AROM-H, SOFAB, etc.). These business models' cases involve recycling and repurposing organic solid waste and crop residues into compost, biogas, biochar, and other organic fertilizers. These models we shall further investigate might be sources of motivation and business ideas for new CBE actors and promoters.

In a liberalized economy such as Burkina Faso, with few available personnel and finances in the field and limited public funds to invest, the government has faced difficulties intervening efficiently in this marginal and informal sector. However, among possible public interventions, this report suggests the following:

The political and regulatory framework issues should be resolved through a well-designed national CBE strategy and orientation law with effective and adequate implementation, monitoring and evaluation systems. The CBE concept should also be integrated into the country's global sustainable development policies.

Despite the financial framework failures, it is possible to finance the CBE sector**.** Public funding must be extended to all CBE actors. The current funding systems favor only NGOs (e.g., the Global Environment Facility Small Grants Program – GEF/GPF) and other EC companies (the Green Climate Fund). It is also necessary to increase the volume of funds and facilitate access to SMEs, startups, and incubators. A network to support and train experts and actors involved in CBE on fundraising and environmental impact analysis should be developed. New incentives should be introduced in the tax and investment code to resolve the fiscal framework issues. CBE sector should be exempted from VAT, specifically at the start of activity on the sale of products and taxes on export. It is also necessary to offer to the actors in the field subsidies and apply repressive action and fines on poor organic and inorganic waste management practices.

CBE stakeholders and actors, including small and medium-sized enterprises and incubators, need professional and customized training and technical support (including environmental education, labor law, and health safety) to increase productivity in a relatively technical sector where most actors are young. It is necessary to develop research on CBE and disseminate the results. The government and private industry should stimulate the sale of CBE products through strong and good market information systems and promotional campaigns. It is also necessary to facilitate the export of CBE goods and services.

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