

# CIRCULAR BIOECONOMY OF AGRI-FOOD VALUE CHAINS

## Innovative, sustainable, and circular business models' contributions to sustainable diets and food systems

*Paolo Prosperi*

### Introduction

According to the High Level Panel of Experts on Food Security and Nutrition (HLPE), the global food system is composed of environmental, societal, institutional, and infrastructural elements, including inputs, processes, and all relevant activities for food production, processing, distribution, preparation and consumption, and the related socio-economic and environmental outcomes (HLPE, 2017). Currently, the globalised food system is characterised by its exposure to multiple drivers of change and by its unsustainability in terms of environmental and socio-economic impacts of food production and consumption. There is a pressing need to orient global strategies towards a more sustainable food system that “delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised” (HLPE, 2014, p. 31). Moreover, great amounts of agricultural products and food are regularly wasted; food systems need to be reconsidered to lessen or avoid system inefficiencies.

Food consumption is therefore strongly connected with the sustainability outcomes of food systems, as it can shape the environmental, social, and economic impacts of systems, including the dynamics related to food and waste. A key dimension of sustainable diets endorses practices and techniques from production to consumption that contribute to preserving the ecological environment by maintaining or reducing greenhouse gas emissions, controlling water and land use, nitrogen and phosphorus inputs, and chemical pollution. It also includes efforts to

reduce plastics in food packaging and minimise the loss and waste of agricultural products and food.

Enhanced knowledge and tailored sustainable practices are needed in all phases from production to consumption, including practices that shape consumption behaviours and take into account the efficient management of biophysical materials. These complex behavioural dynamics, involving a plethora of activities and stakeholders, require organisation of practices, activities, and interactions dedicated to sustainability. Businesses and entrepreneurs play crucial roles in building and managing food supply that support sustainable consumption. Thus, sustainable diets require business models that consider the complexity of food systems, the dynamics among different stakeholder roles, and the efficient management of biophysical materials.

### **How circular bioeconomy contributes to sustainable food systems and diets**

The transition to more sustainable food systems and diets strongly builds on the approach of bioeconomy. Bioeconomy is an economic sector whose basic activities of production—transformation and valorisation—and building blocks—materials, chemicals, and energy—originate from living matter and renewable biological resources instead of non-renewable fossil resources (Allain et al., 2022; Diakosavvas & Frezal, 2019; McCormick & Kautto, 2013). In current strategic planning for policies related to economic growth and ecological transition, bioeconomy is increasingly considered by states and intergovernmental organisations as a strategy to support United Nations Sustainable Development Goals (SDGs) and the Paris Climate Agreement. The agricultural and food sectors are central to bioeconomy as they provide the biological resources for production and are a major supplier of biomass (Diakosavvas & Frezal, 2019). In general, the bioeconomy approach represents a critical opportunity to address wicked societal challenges such as food security, climate change, economic development, and limited natural resources. However, because of an increased competition between food supply and non-food biomass production, bioeconomy cannot inherently be defined as sustainable since tensions and economic, environmental, and social trade-offs emerge between the different allocations of food, feed, fuel, and fibre (Allain et al., 2022). Moreover, the bioeconomy concept was originally intended as a component of environmental economics theories and has a weak sustainability stance, since it pledges substitutability between human capital and natural capital and doesn't target a complete change of the dominant economic system (Loiseau et al., 2016).

Bioeconomy is an important opportunity for improving the sustainable development of agri-food systems, by activating interventions around inefficiencies in linear food economies due to loss of productivity, energy, natural resources, and waste production. In particular, these food system inefficiencies generate high levels of pollution, greenhouse gas emissions, and related environmental, social, and economic costs (Jurgilevich et al., 2016). A bioeconomy approach seeks to “contribute(s) to sustainable production and consumption and resource-use

efficient agri-food systems in an economically, socially and environmentally sustainable manner” (FAO, 2021, p. 1); consequently, new business models and innovations become essential. In so doing, biomass needs to be valorised across value chains. It is therefore necessary to overcome a linear production approach by the “cascading use” of biomass and the reuse of waste materials (Diakosavvas & Frezal, 2019). These techniques are more specific to a circular economy approach as a set of practices and tools to improve the sustainability of food systems.

According to Haas et al. (2016), circular economy is an economic sector that “improve(s) resource efficiency mainly by closing the resource loop and by stopping the wasteful use of resources” (p. 261). Circular economy follows the steps of industrial ecology and is a concept grounded in theories of ecological economics. It takes a macroeconomic approach that integrates a strong sustainability perspective; in contrast with the bioeconomy, circular economy stands for radical change from the linear economic system (Loiseau et al., 2016) and aims at enhancing the life of materials and resources by increasing efficiency and recycling. With regards to food systems, circular economy aims to reduce agricultural and food waste, lessening the environmental and social impact while preserving economic growth. Circular bioeconomy can significantly reduce the negative impacts of resource extraction and pressure on the environment and can contribute to restoring biodiversity and natural capital. For example, business models of circular bioeconomy keep biomass local as long as possible and replace petrol-based and non-renewable materials with ones that are bio-based. With regards to biodiversity protection and restoration, circular bioeconomy is also characterised by agroecological practices that foster intraspecific crop diversity to manage pests and pathogens, and also build on green manuring, rotations that include legumes, soil cover, integrated plant nutrient management, conservation agriculture, and integrated manure management (Gomez San Juan & Bogdanski, 2021). All flows among the agri-food value chains—including input supply to consumption, waste, and recycling—are to build in closed-loop food systems (Lu & Halog, 2020). It may be more accurate to refer to circular bioeconomy when circular economies overlap with bioeconomy by encompassing production, consumption, and waste valorisation of bio-based resources to minimise environmental impact, to improve efficiency, to harness the full potential of materials, and to create value-added products such as bio-based products, bioenergy, food, and feed (Carus & Dammer, 2018). Circular bioeconomy practices involve sharing, reusing, remanufacturing and recycling, cascading use, utilisation and valorisation of organic waste and side streams, bio-based products, and improving resource efficiency.

In practice, circular bioeconomy is a system that foreground goals of health and environmental sustainability into food systems through orienting public policies and consumer food demand towards the preservation of natural landscapes and by environmentally-friendly and healthy production (Campos & Madureira, 2019). Therefore, food systems based on circular bioeconomy aim to be regenerative, resilient, non-wasteful, and healthy, through techniques that reconnect nutrient loops for restoring degraded soils, minimising the use of fertilisers and pesticides, and thus, cultivating non-toxic, healthier, and less

wasteful food supplies (Ellen MacArthur Foundation, 2015). For instance, in circular bioeconomy systems, fertilisers can be obtained from natural production of bacterial biofilms as bio-fertilisers, bio-pesticides can be produced based on organisms such as bacteria, fungi, viruses, yeasts, and others, and bio-plastics for packaging can be obtained through lactic acid fermentation or bacterial polyester fermentation (Gomez San Juan & Bogdanski, 2021). Such practices should be accompanied by tailored business design for less costly production that is directly linked with consumption and regenerative techniques. Digital solutions have an important role in facilitating the coordination of flows of information and materials between stakeholders since they allow data gathering, sharing and analysis to design the most appropriate business models for resource use, efficiency and impact. A transition of food systems towards a circular bioeconomy would, therefore, strengthen their sustainability and resilience, by valorising biomass resources and waste as well as by implementing disruptive social and technological innovations.

### **Building specific business models for circular bioeconomy within agri-food value chains**

While sustainability and circularity are currently considered as coupled principles contributing to the functioning of social-ecological systems, circularity is still difficult to operationalise in the transition of food systems towards sustainability (Wigboldus, 2020). The functioning principles of circular bioeconomy simulate dynamics from natural systems to optimise the efficiency of systems (Ellen MacArthur Foundation, 2015). If the dominant economic model of our food system is linear and follows a “take-produce-consume-discard” logic (Jurgilevich et al., 2016, p. 2), the circular economic model needs to assume that economic growth moves beyond the assumptions of abundant primary resources and unlimited waste disposal, and considers waste as a resource through practices of input reduction, reuse, repair, refurbishing, and recycling of existing materials and products. For circular bioeconomy to substantially influence food systems, circular business models need to be activated to reduce waste, re-use food, use by-products and food waste, and recycle nutrients.

Food systems are an overarching opportunity to apply circular bioeconomy as a new economic model towards SDGs; however, blending theory with practice is not an easy task (Fassio & Tecco, 2019). This challenge must be addressed by combining feasible circular business practices consistent with the circular bioeconomy theory, while monitoring the impacts on efficiency and sustainability of the interventions. For this purpose, coherent and efficient sustainable business models that contribute to sustainable diets are central. A business model describes the logic of a business and it explains how companies and individuals (e.g., farmers, processors, entrepreneurs, industrial organisations, cooperatives, etc.) create, deliver (to customers and consumers), and capture value. Value refers to economic value and, more broadly, involves socio-economic and ecological values (Casadesu-Masanell & Ricart, 2010; Rosenstock et al., 2020; Teece, 2010). More specifically,

in relation to business models in circular bioeconomy, according to Nußholz's (2017) definition,

a circular business model is how a company creates, captures, and delivers value with the value creation logic designed to improve resource efficiency through contributing to extending useful life of products and parts (e.g., through long-life design, repair and remanufacturing) and closing material loops.

(p. 16)

These sustainable business models imply significant shifts to generate sustainable agri-food value chains, and require a re-think of how to organise and carry out practices and business while obtaining consistent benefits and return on capital investments (Hilmi, 2018). In that sense, a business, its entrepreneurship, and the connected economic actors and stakeholders of the value chains—and, therefore, their business model organisations—need to function in an efficient way, while reducing impacts on inputs, land, energy, and water resources and providing food sustainability and resilience to stress and shocks (ESCWA, 2014). The constant necessity in circular bioeconomy is to provide and recapture value from business at each stage of the value chain, by lessening the use of ecological assets and alleviating detrimental impacts (or even providing positive outcomes) while also implementing disposal and recycling patterns of generated waste (Hilmi, 2018). Therefore, providing and recapturing value at each stage of the value chain requires a strong coordination for a strategic and efficient value chain management of available material flows, as well as clear governance arrangements for decision and policy making in connection with institutional stakeholders.

### **Circular bioeconomy needs specific governance for sustainable diets and food systems**

Building on these assumptions, it is clear that circular business models are urgently required to shift toward food production and processing that are more sustainable and to consumer dietary patterns that are healthier. While a business model can be conceived at an individual level, it is practically interconnected within an ecosystem of stakeholders of the value chain as well as from institutions. A European study showed that for circular bioeconomy to be effective, the involvement of diverse actors in participative governance was crucial, but still rarely used (Overbeek et al., 2016). For value chain dynamics, governance represents “how various firms across the entire chain are coordinated (or strategically linked) in order to be more competitive and add more value” (FAO, 2014a, p. 9). Moving towards sustainable business models needs to go beyond re-thinking production, consumption, and recycling practices and the related environmental sustainability, economic profitability, and social viability. It requires re-thinking of how organisations, firms, and various private and public stakeholders and institutions throughout the entire chain are coordinated and interact to strategically achieve common

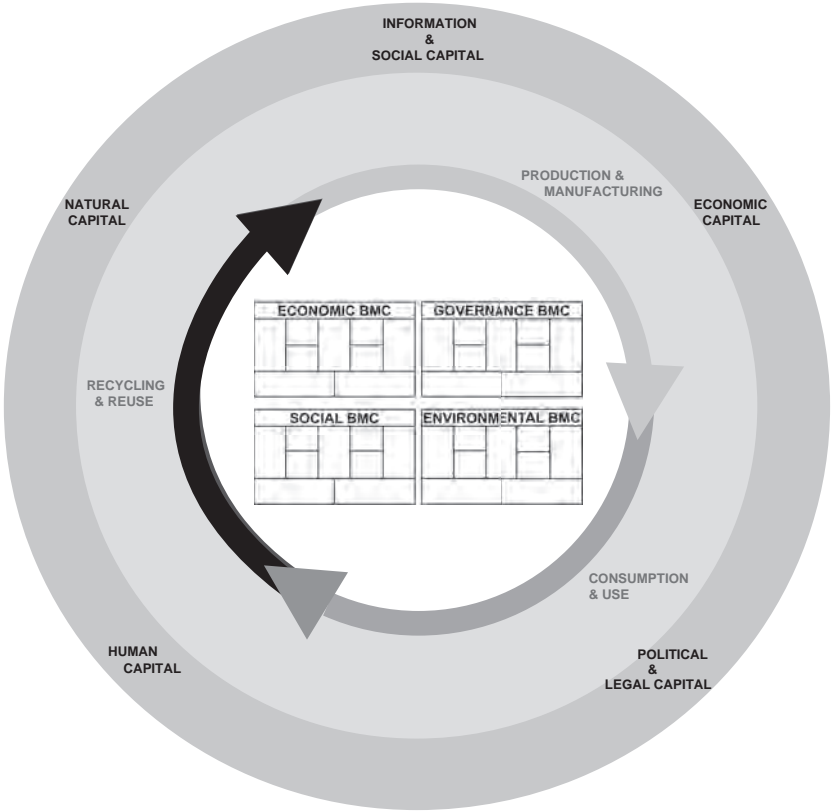
sustainability goals. The development of sustainable and circular business models will then need to embed specific governance outputs and dynamics that improve coordination and efficiency among stakeholders interacting in value chains.

According to Kanie et al. (2014), governance is considered the “fourth pillar of sustainable development (complementing the environmental, social, and economic pillars)” (p. 6). Consistently, governance is also included as one of the four dimensions of sustainability for agri-food systems (FAO, 2014b). In food systems, governance includes the interaction of public actors (e.g., local authorities, governments, intergovernmental organisations, etc.), civil society (e.g., non-governmental organisations and social movements), and private sector actors (e.g., businesses, producer organisations, coordinated value chains, etc.) (HLPE, 2020). More specifically, governance within agri-food supply chains “refers to the nature of the linkages both between actors at particular stages in the chain (horizontal linkages) and within the overall chain (vertical linkages)” (FAO, 2014a, p. 10). However, from an operational point of view, the governance approach cannot only refer to business-related elements. Key also for the development and transition to sustainable business models are elements such as information exchange, price determination, standards, payment mechanisms, contracts, market power, lead firms, and wholesale market systems. Governance, with related decision support tools, is one of the main areas of action for implementing food system transformation, together with the economic, political, cultural, and social aspects (Béné et al., 2020). Integrating governance in the design of sustainable business models for food systems implicates the involvement of different actors—especially consumers—in decision making and deliberative dynamics (Wilkins, 2005). For example, stances from consumer initiatives can be integrated in the design of sustainable business models, similar to what occurs in the co-construction of food policy plans, such as in the functional model of The Milan Urban Food Policy Pact. This integration would encourage and strengthen the control of local communities over agricultural and food systems (El Bilali et al., 2021). It is necessary to promote coordination between actions and stakeholders within the cycles of production and consumption and, therefore, coordination between goals for economic growth and environmental and social objectives at different time scales (short and long terms) (Fassio & Tecco, 2019). Basically, what is needed is what Fritsche et al. (2020) define as *sustainability governance* that coordinates the integration of flows of resources, materials, and information in activities of recycling and re-use of residues and waste. This governance would contribute to avoiding risks of lacking availability and access to resources in regions from which biomass would be imported.

Previous research has developed frameworks for circular business models that include holistic considerations of the business environment within which circular bioeconomy activities are carried out (Antikainen & Valkokari, 2016; Joyce & Paquin, 2016). However, specific and systemic governance components—such as fairness, transparency, ethics, accountability, etc.—were not identified and tackled in depth for circular bioeconomy. For these reasons, an innovative design of

circular bioeconomy business models is proposed here, within the circular bioeconomy dynamics, through adding the governance dimension beside the original Osterwalder and Pigneur's (2010) Business Model Canvas and the Joyce and Paquin's (2016) Triple Layer Business Model Canvas, as shown in Figure 40.1.

The new framework shown in Figure 40.1 illustrates the circular flow within a bioeconomy (production and manufacturing, consumption and use, recycling and reuse) characterised by multidimensional management (economic, environmental, social, governance) of a business model. Knowledge production and the creation of innovation in the field of sustainable development are important for society and emerge from knowledge exchange between the five societal subsystems of the Quintuple Helix model (Carayannis et al., 2012) that are represented by natural capital, economic capital, human capital (i.e., education systems), information and social capital (i.e., media-based and culture-based public), and political and legal capital.



*Figure 40.1* Multidimensional circular bioeconomy Business Model Canvas (BMC) framework. Source: Created by the author.

## Quadruple Layered Business Model Canvas: Circular bioeconomy business for sustainable diets

The original Business Model Canvas structures the economic functioning of a business in nine organisational components: Value proposition; customer segments; channels; customer relationships; activities; resources; partners; and costs and revenues. The Environmental Business Model Canvas is composed of nine building blocks: Functional value; use phase; distribution; end-of-life; production; materials; supplies and out-sourcing; environmental impacts; and environmental benefits. The Social Business Model Canvas is structured by nine components: Social value, end-user, scale of outreach, societal culture, governance, employees, local communities, social impacts, and social benefits (see Osterwalder & Pigneur (2010), for the original Business Model Canvas, and Joyce & Paquin (2016), for the environmental and social models). While a governance component is included in the latter Social Business Model Canvas, as mentioned above, the specific governance building blocks for a systemic approach to circular bioeconomy business environments are not identified or developed. Therefore, the new Governance Business Model Canvas of circular bioeconomy builds on a novel organisation of a set of governance components, inspired by different literature sources such as FAO (2013, 2014a, b), Devaney et al. (2017), and El Bilali et al. (2021).

The Governance Business Model Canvas of circular bioeconomy is shown in Figure 40.2 and is composed of nine building blocks: 1) Effectiveness and efficiency value; 2) participation and inclusiveness; 3) business ethics, 4) holistic man-

<b>TRANSPARENCY</b> Flows of information on circular bioeconomy, understandable and freely available to those stakeholders and entities affected by organisational decisions.	<b>FAIRNESS &amp; RULES</b> Rules, standards, common law that are adopted for a fair distribution of circular bioeconomy power, resources and outcomes.	<b>EFFECTIVENESS &amp; EFFICIENCY VALUE</b>  Good governance structure of the circular bioeconomy guarantees that the cascading principle guides stakeholder activities.	<b>HOLISTIC MANAGEMENT</b>  Management strategies that address complexity of circular bioeconomy (management plan, full-cost accounting)	<b>PARTICIPATION &amp; INCLUSIVENESS</b>  Patterns of equitable participation for genders, vulnerable and less represented groups in economic development matters, including all actors in decision-making processes, from producers to consumers.
	<b>ACCOUNTABILITY</b>  Circular bioeconomy governing actors must be answerable to all public and private stakeholders affected by their activities, for decisions made and actions taken.		<b>BUSINESS ETHICS</b>  Mission statements that take into account ethical principles and moral or ethical problems that may arise in circular bioeconomy business environment.	
<b>GOVERNANCE RISKS &amp; COSTS</b>  Costs and risks of participation in circular bioeconomy business organisations and networks.			<b>GOVERNANCE BENEFITS</b>  Benefits to the circular bioeconomy business for participating in partnerships (value chains, business and institutional networks).	

Figure 40.2 Governance Business Model Canvas: Circular Bioeconomy Business. Source: Created by the author.



agement; 5) fairness and rules; 6) accountability; 7) transparency; 8) governance risks and costs; and 9) governance benefits.

The central governance value proposed from a circular bioeconomy business—such as individual or collective business, a business organisation, or a value chain—is identified in the *Effectiveness and Efficiency* of coordination arrangements between economic actors, which allows the best use to be made of resources without harming the environment and ensures that the cascading principle guides stakeholder activity (Devaney et al., 2017). Circular bioeconomy business needs to be based on *Equitable Participation* of genders and vulnerable and emerging groups, including all actors in decision-making processes from producers to consumers (Devaney et al., 2017). *Business Ethics* (or *Corporate Ethics*) in a circular bioeconomy business environment addresses ethical principles and moral or ethical problems (e.g., according to a mission statement) (El Bilali et al., 2021; Gualandris & Kalchschmidt, 2016). *Holistic Management* guarantees the system complexity of circular bioeconomy (e.g., through management plan and full-cost accounting) (El Bilali et al., 2021; Savory & Duncan, 2016). *Rules (and Fairness)* standards (e.g., labelling and criteria for bio-based goods) and common law must be followed for developing circular bioeconomy business and a fair and impartial distribution of bioeconomy power, resources, and outcomes must exist (Devaney et al., 2017). With regards to *Accountability*, public and private actors must be answerable for their decisions and actions to the public, institutional stakeholders, and those affected by their activities (Devaney et al., 2017). With regards to *Transparency*, in a circular bioeconomy business environment information must be understandable and made freely available to those affected by organisational stakeholder decisions (Devaney et al., 2017). Activating and maintaining governance implicates *Risks and Costs* for the business model that invests in network participation and engagement, as well as *Benefits* from partnership integration, such as in value chains and business and institutional networks (FAO, 2014a).

In a nutshell, a circular bioeconomy business model that effectively contributes to sustainable food systems and diets will need to propose not only economic, environmental, and social performance but also effective and efficient performance in terms of systemic governance (i.e., coordination within a business environment composed of many private and public stakeholders). For this to be operationalised, targeted efforts and investments in terms of guaranteeing information transparency, stakeholders' accountability, and the establishment of rules and fairness will support stakeholder participation and inclusiveness, key holistic approaches for management strategies and ethics in business.

Table 40.1 provides the development of a multidimensional business model canvas, with the aim of structuring a rationale that explains how the economic, environmental, social, and governance dimensions of circular bioeconomy contribute to sustainable diets and food systems. The logic of each business model builds on the principles and practices that explain the economic, environmental, and social roles and functioning of circular bioeconomy and the related outcomes of sustainable diets and food systems, as illustrated in the first three sections of this chapter and in Figure 40.1. For the governance dimension, as introduced earlier,

Table 40.1 Quadruple Layered Business Model Canvases: Circular Bioeconomy Business contributing to Sustainable Diets

Economic Business Model Canvases		Environmental Business Model Canvases		Social Business Model Canvases		Governance Business Model Canvases	
Value Proposition	<i>Value proposition</i>	<i>Functional value</i>		<i>Social value</i>		<i>Effectiveness &amp; Efficiency value</i>	
	Supply of accessible and profitable agricultural and food products.*	Supply of agricultural and food products from environmentally friendly practices.*		Supply of healthy, nutritious, fair, desirable, culturally respectful agricultural and food products that provide welfare and wellbeing for people, animals, eco-systems.*		Good governance actions that ensure that the cascading principle guides stakeholder activity and coordination.*	
Value Delivery	<i>Customer segments</i>	<i>Use phase</i>		<i>End-User</i>		<i>Participation &amp; Inclusiveness</i>	
	All people. Consumer diversity according to nutritional, cultural and social needs, and preferences.	Consumer management of food products (e.g., water and energy consumption).		Consumer acceptance and appreciation in terms of taste, physiological needs, cultural preferences.		Patterns of equitable participation and inclusion of all actors concerned in the agri-food environment.	
	<i>Channels</i>	<i>Distribution</i>		<i>Scale of Outreach</i>		<i>Business Ethics</i>	
	Available channels adapted for each diverse group of consumers (large retail, local/short supply chains, Internet, green public procurement, etc.).	Low environmental impact means of transportations (including packaging), sustainable logistics management.		Diffusion and communication of actions, knowledge and benefits around circular bioeconomy/sustainable diets principles across involved and affected stakeholders.		Establishment of a business mission statement including ethical problems that might arise in circular bioeconomy/sustainable diets process.	
	<i>Customer relationships</i>	<i>End-of-life</i>		<i>Social Culture</i>		<i>Holistic Management</i>	
	Affiliation, communication schemes, awareness campaigns, sustainability labels, standards, certifications.	Consumer behaviour in managing food loss, waste, packaging use, reuse, recycling, disposal (e.g., level of adoption of circular food behaviours).		Consultation and deliberative practices to connect circular bioeconomy/sustainable diets actions more strongly to society (e.g., social responsibility, social dialog platforms).		Implementation of strategies that consider the complexity of circular bioeconomy/sustainable diets dynamics through a system approach.	

## Value Creation

<i>Activities</i>	<i>Production</i>	<i>Governance</i>	<i>Fairness &amp; Rules</i>
Agriculture and food related activities (input supply, primary production, processing, packaging, distribution, retail, marketing, logistics).	Production activities based on environmentally friendly practices and on the “cascading use” of biomass and the reuse of waste materials: Sharing; reusing; remanufacturing; recycling; minimisation, utilisation and valorisation of organic waste; improving resource and eco-efficiency; regenerative agriculture; agroecology; packaging with organic or reusable materials).	Forms of organisations of the business involved in circular bioeconomy/ sustainable diets. Main principles for establishing fair arrangements with stakeholders (transparency, accountability, etc.).	Normative tools, rules, standards, common schemes that allow equal power within agri-food value chains and connected business and institutional environments.
<i>Resources</i>	<i>Materials</i>	<i>Employees</i>	<i>Accountability</i>
Agricultural land, processing structures, distribution infrastructures, patents, brands, workforce and intellectual resources, financial assets, informatics, etc.	Bio-physical stocks used to render the functional value. Bio-based materials used to provide sustainable food and packaging from environmentally friendly and circular bioeconomy practices.	Employees engaged in circular bioeconomy/ sustainable diets. Their working and welfare conditions, training, skill development, level of expertise, support programs.	Traceability and measurement of each stakeholder regarding each role, responsibility and decision made.
<i>Partnerships</i>	<i>Supplies and outsourcing</i>	<i>Local Communities</i>	<i>Transparency</i>
Network of suppliers and partners that make the business model work (all actors involved in agri-food systems).	Primary resources used such as water, energy.	Relationships—with local communities as resource and materials suppliers—considering the respect of main circular bioeconomy/sustainable diets principles.	Information system (including digital technology) that guarantee traceable, free, and understandable flows of information across agri-food value chain steps.

(Continued)

Table 40.1 (Continued)

	Economic Business Model Canvas	Environmental Business Model Canvas	Social Business Model Canvas	Governance Business Model Canvas
Value Capture	Costs Economic costs from all activities, resources extraction and utilisation, partnerships developed.	Environmental impacts Ecological costs from production and distribution activities, materials' utilisation, resource consumption, supplies exploited, emission activities.	Social impacts Social costs of resource consumption, natural capital losses, health effects, working conditions, cultural impacts.	Governance Risks & Costs Governance negative impacts from lack of coordination or information shared, transaction costs, risks of inefficiency and corruption, maladministration, excessive bureaucracy, unfair competition, power imbalances, exclusion, and top-down approaches.
	Revenues Economic benefits from revenues, sales, trade.	Environmental benefits Environmental impact reduction, ecological and regenerative actions from all production, distribution, exploitation, optimisation, consumption actions.	Social benefits Social benefits from circular bioeconomy/ sustainable diets actions (e.g., skill development, community partnership, local wellbeing, protection of cultural traditions).	Governance Benefits Governance positive impacts from increased accountability, transparency, effectiveness, fairness and participation (including bottom-up and deliberative approaches).

Source: Created by the author.

★ From/within circular bioeconomy process / Sustainable and bio-based food products.

the new business model canvas builds on the building blocks shown in Figure 40.2. Here, business is understood in its largest sense, from the micro level of individual business to collective business (e.g., clusters, cooperatives, etc.), as well as large business organisations and entire value chains.

### **Strategies for effective circular bioeconomy business towards sustainable diets**

Science and policy are increasingly acknowledging the key role of innovations in circular bioeconomy for triggering transition and opportunities in agriculture, fishery, forestry, and waste sectors by providing biomass, increasing carbon sinks, and managing land and marine ecosystems sustainably, while improving employment and value creation in rural areas (Fritsche et al., 2020). In this process, strong connections with society can help to shift from an economy based on fossil resources to a circular bioeconomy more oriented towards renewable biological resources (Overbeek et al., 2016). Building on previous works and literature, this chapter has so far argued that for this transformative approach to be operationalised, specific sustainability governance is necessary, also to guarantee and improve inclusiveness through people and stakeholder participation. A participatory governance of circular bioeconomy should consist of proactive involvement of private and public stakeholders through communication, consultation, and deliberative practices. Specifically regarding business, the implementation of circular bioeconomy practices can be supported by policy tools and guidelines that foster participation of all stakeholders, including citizens, as well as the engagement of public and private networks, with particular emphasis on local clusters of enterprises for collective actions. Such networks should be engaged to identify their mission and objectives for the improvement of sustainable diets and food systems through circular bioeconomy, and the instrumental roles, activities and responsibilities of each actor and supportive bodies, such as institutions, consumers, and civil society networks.

The technical aspects of a collective transition to circular bioeconomy requires, in parallel, governance and stakeholder coordination at different scales—through rules and institutions to secure a general equilibrium and viability of social, political, cultural, environmental, and economic factors. In general, a good governance process will allow movement towards improved efficiency in private/public management and administration, modernisation of value chains, transparency, fairness, participation, and avoiding corruption (FAO, 2014a; Devaney et al., 2017). In fact, innovative technologies and food waste reduction alone, within a circular bioeconomy for sustainable diets, cannot reorient market and institutional imperfections against waste and overexploitation of natural resources and environmental and health externalities. Those management imperfections are manifest as social costs emerging from natural capital consumption and loss, as well as from information and communication asymmetries and health impacts. To overcome these pitfalls, it is possible to act on supply and demand by combining market-oriented and technology-driven measures that include: a) Sustainability labels, standards, and certification for new bio-based products; b) green public procurement initiatives;

c) awareness campaigns for consumers about circular bioeconomy food products (claiming the virtuous sustainability character of such products); d) evaluating and improving the sustainability performance of local, healthy food supply chains with less waste; and e) supporting regenerative agricultural practices such as agroecology through large-scale retailing (Diakosavvas & Frezal, 2019; Ellen MacArthur Foundation, 2015). For circular bioeconomy business, strategic efforts need to be oriented towards coordination, integration, participation, trust and knowledge, and information sharing within private and public stakeholder networks. These actions need to be implemented while encouraging supply through policy incentives and regulatory frameworks for different economic uses of biomass such as food, feed, bio-based products, and bio-energy, to enhance the value generated from biomass and creating value chains. In the meantime, the demand for sustainable food from circular bioeconomy needs to be propelled by setting the conditions for informed consumer behaviour—such as comprehensible labels—as well as through communication on the benefits generated across value chain steps and actors from using biobased products (Diakosavvas & Frezal, 2019).

On the demand side, consumer behaviour is crucial in the transition towards circular bioeconomy businesses in food systems as food consumption impacts human health, the environment, economy, and society. It is, therefore, necessary to understand which options of circular food behaviours exist and how consumers perceive them, and what are the related consumer needs, willingness, and degree of acceptance. Food consumption patterns are tightly connected to collective and personal identity, traditions, food culture, and value orientations of citizens (Jurgilevich et al., 2016). In particular, the factors that influence the acceptance of consumers with regards to sustainable diets from circular bioeconomy are multiple, diverse, and can coexist within the same contexts. More specifically, business-to-consumer relationships are considered a pillar for consumer acceptance, with specific regards to food businesses that integrate circular bioeconomy practices. The main drivers of consumer acceptance and participation include the awareness and dependency of food provisioning (strong supplier-consumer relationship), the size of the city where consumption is targeted (in urban contexts recycling activities are more likely to be implemented), convenience of recycling practices (opportunity of cost reduction, or compensation, from recycling), social awareness (social pressure for recycling), and consumers' education and income (Borrello et al., 2020). Awareness campaigns and actions should also consider that there are different levels of adoption even within consumers that already accept and proactively implement practices of circular bioeconomy in their dietary habits (e.g., preventing and reducing food waste, buying foods with upcycled<sup>1</sup> ingredients, purchasing food with packaging made of renewable material, etc.). Do Canto et al. (2021) classified different circular food behaviours that can contribute to sustainable diets as: Linear behaviours (adoption of the available options in the market and reducing food waste to positively impact on the environment), transitioning behaviours (adoption of strongly innovative products, upcycled food products, surplus food, seasonal foods, packaging-free foods, participation in alternative food networks and food waste initiatives), and circular behaviours (directly applying

circular practices at home, closing the resource loop through product reuse and recycling). Institutional and research projects, aimed at different scales at involving consumers in circular bioeconomy for sustainable food systems and diets, can be implemented through different participatory tools and techniques, such as circular food design (Sijtsema et al., 2020), building inclusive business models (Rosenstock et al., 2019), persuasive communication on “pro-circular” behaviours and values (Muranko et al., 2018), as well as the implementation of Participatory Guarantee Systems (PGS).<sup>2</sup>

## Conclusion

Such diversity and multidimensionality of opportunities, targets, actors, interactions, level of intervention, performance, and outcomes within circular bioeconomy in agri-food sector activities call for designing new policy mixes and new evaluation approaches for sustainable food systems and diets (Galli et al., 2020), supported by a rigorous, transparent and fair flow of knowledge across the Quintuple Helix pillars (i.e., economic system, education system, media and culture, political system and natural environment). The multidimensional circular bioeconomy framework and the Governance Business Model Canvas developed in this chapter aim to contribute to this multifaceted process of knowledge creation, sharing, and innovation for evidence-based evaluation and policy formulation. Therefore, multilevel governance is central for implementing such policy tools—through strong bottom-up approaches and participation of relevant stakeholders—to effectively address challenges in agriculture, food, rural development, environment, forestry, energy, research and innovation, waste, and climate change, and to accelerate the development of circular bioeconomy in agricultural and food systems.

## Notes

- 1 “Upcycled ingredients and food products elevate food that would otherwise be wasted to higher uses and have tangible benefits to the environment and society.” (Spratt et al., 2021, p. 7).
- 2 “Participatory Guarantee Systems (PGS) are locally focused quality assurance systems. They certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks, and knowledge exchange” (IFOAM—Organics International, n.d.).

## References

- Allain, S., Ruault, J. F., Moraine, M., & Madelrieux, S. (2022). The ‘bioeconomics vs bioeconomy’ debate: Beyond criticism, advancing research fronts. *Environmental Innovation and Societal Transitions*, 42, 58–73.
- Antikainen, M., & Valkokari, K. (2016). A framework for sustainable circular business model innovation. *Technology Innovation Management Review*, 6(7), 5–12.
- Béné, C., Fanzo, J., Haddad, L., Hawkes, C., Caron, P., Vermeulen, S., Herrero, M., & Oosterveer, P. (2020). Five priorities to operationalize the EAT–Lancet Commission report. *Nature Food*, 1(8), 457–459.

- Borrello, M., Pascucci, S., Caracciolo, F., Lombardi, A., & Cembalo, L. (2020). Consumers are willing to participate in circular business models: A practice theory perspective to food provisioning. *Journal of Cleaner Production*, 259, 121013.
- Campos, S., & Madureira, L. (2019). Can healthier food demand be linked to farming systems' sustainability? The case of the Mediterranean diet. *International Journal on Food System Dynamics*, 10(3), 262–277.
- Carayannis, E. G., Barth, T. D., & Campbell, D. F. (2012). The Quintuple Helix innovation model: Global warming as a challenge and driver for innovation. *Journal of Innovation and Entrepreneurship*, 1(1), 1–12.
- Carus, M., & Dammer, L. (2018). The circular bioeconomy: Concepts, opportunities, and limitations. *Industrial Biotechnology*, 14(2), 83–91.
- Casadesus-Masanell, R., & Ricart, J. E. (2010). From strategy to business models and onto tactics. *Long range planning*, 43(2-3), 195–215.
- Diakosavvas, D., & Frezal, C. (2019). Bio-economy and the sustainability of the agriculture and food system: Opportunities and policy challenges. *OECD Food, Agriculture and Fisheries Papers*, 136.
- Devaney, L., Henchion, M., & Regan, Á. (2017). Good governance in the bioeconomy. *EuroChoices*, 16(2), 41–46.
- do Canto, N. R., Grunert, K. G., & De Barcellos, M. D. (2021). Circular food behaviors: A literature review. *Sustainability*, 13(4), 1872.
- El Bilali, H., Strassner, C., & Ben Hassen, T. (2021). Sustainable agri-food systems: Environment, economy, society, and policy. *Sustainability*, 13(11), 6260.
- Ellen MacArthur Foundation (2015). *Growth within: A circular economy vision for a competitive Europe*. Ellen MacArthur Foundation.
- ESCWA (United Nations Economic and Social Commission for Western Asia). (2014). *Green agricultural value chains for improved livelihoods in the Arab region*. ESCWA.
- FAO (2013). *Sustainability assessment of food and agricultural system: Indicators*. FAO.
- FAO (2014a). *Developing sustainable food value chains – Guiding principles*. FAO.
- FAO (2014b). *SAFA Sustainability assessment of food and agriculture systems - Guidelines version 3.0*. FAO.
- FAO (2021). *Bioeconomy for a sustainable future*. FAO.
- Fassio, F., & Tecco, N. (2019). Circular economy for food: A systemic interpretation of 40 case histories in the food system in their relationships with SDGs. *Systems*, 7(3), 43.
- Fritsche, U., Brunori, G., Chiamonti, D., Galanakis, C., Hellweg, S., Matthews, R., & Panoutsou, C. (2020). *Future transitions for the bioeconomy towards sustainable development and a climate-neutral economy: Knowledge synthesis Final Report*. Publications Office of the European Union.
- Galli, F., Prosperi, P., Favilli, E., D'Amico, S., Bartolini, F., & Brunori, G. (2020). How can policy processes remove barriers to sustainable food systems in Europe? Contributing to a policy framework for agri-food transitions. *Food Policy*, 96, 101871.
- Gomez San Juan, M. & Bogdanski, A. (2021). *How to mainstream sustainability and circularity into the bioeconomy? A compendium of bioeconomy good practices and policies*. FAO.
- Gualandris, J., & Kalchschmidt, M. (2016). Developing environmental and social performance: The role of suppliers' sustainability and buyer-supplier trust. *International Journal of Production Research*, 54(8), 2470–2486.
- Haas, W., Krausmann, F., Wiedenhofer, D., & Heinz, M. (2016). How circular is the global economy? A sociometabolic analysis. In H. Haberl, M. Fischer, F. Krausman, & V. Winiwarter, (Eds.), *Social ecology* (pp. 259–275). Springer.
- HLPE (2014). *Food losses and waste in the context of sustainable food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security*. FAO.
- HLPE (2017). *Nutrition and food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security*. FAO.



- HLPE (2020). *Food security and nutrition: building a global narrative towards 2030. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security*. FAO.
- Hilmi, M. (2018). A field practitioner's perspective on developing green food value chains. *Food Chain*, 7(1), 1–24.
- IFOAM – Organics (n.d.). *Participatory guarantee systems*. Retrieved March 29, 2022, from <https://www.ifoam.bio/our-work/how/standards-certification/participatory-guarantee-systems>
- Joyce, A., & Paquin, R. L. (2016). The triple layered business model canvas: A tool to design more sustainable business models. *Journal of Cleaner Production*, 135, 1474–1486.
- Jurgilevich, A., Birge, T., Kentala-Lehtonen, J., Korhonen-Kurki, K., Pietikäinen, J., Saikku, L., & Schösler, H. (2016). Transition towards circular economy in the food system. *Sustainability*, 8(1), 69.
- Kanie, N., Zondervan, R., & Stevens, C. (2014). *Ideas on governance 'of' and 'for' sustainable development goals*. Conference Report. United Nations University Institute for the Advanced Study of Sustainability. Retrieved from [https://collections.unu.edu/eserv/UNU:6195/conference\\_report.pdf](https://collections.unu.edu/eserv/UNU:6195/conference_report.pdf)
- Loiseau, E., Saikku, L., Antikainen, R., Droste, N., Hansjürgens, B., Pitkänen, K., ... & Thomsen, M. (2016). Green economy and related concepts: An overview. *Journal of Cleaner Production*, 139, 361–371.
- Lu, T., & Halog, A. (2020). Towards better life cycle assessment and circular economy: On recent studies on interrelationships among environmental sustainability, food systems and diet. *International Journal of Sustainable Development & World Ecology*, 27(6), 515–523.
- McCormick, K., & Kautto, N. (2013). The bioeconomy in Europe: An overview. *Sustainability*, 5(6), 2589–2608.
- Muranko, Z., Andrews, D., Newton, E. J., Chaer, I., & Proudman, P. (2018). The pro-circular change model (P-CCM): Proposing a framework facilitating behavioural change towards a circular economy. *Resources, Conservation and Recycling*, 135, 132–140.
- Nußholz, J. L. (2017). Circular business models: Defining a concept and framing an emerging research field. *Sustainability*, 9(10), 1810.
- Osterwalder, A. & Pigneur, Y. (2010). *Business model generation: A handbook for visionaries, game changers, and challengers*. John Wiley & Sons.
- Overbeek, G., de Bakker, H. C. M., Beekman, V. (2016). D2.3: Review of bioeconomy strategies at regional and national levels. BioSTEP project. Retrieved from [https://bio-step.eu/fileadmin/BioSTEP/Bio\\_documents/BioSTEP\\_D2.3\\_Review\\_of\\_strategies.pdf](https://bio-step.eu/fileadmin/BioSTEP/Bio_documents/BioSTEP_D2.3_Review_of_strategies.pdf)
- Rosenstock, T. S., Lubberink, R., Gondwe, S., Manyise, T., & Dentoni, D. (2020). Inclusive and adaptive business models for climate-smart value creation. *Current Opinion in Environmental Sustainability*, 42, 76–81.
- Savory, A., & Duncan, T. (2016). Regenerating agriculture to sustain civilization. In I. Chabay, M. Frick, & J. Helgeson, (Eds.), *Land restoration*. Academic Press.
- Sijtsma, S. J., Fogliano, V., & Hageman, M. (2020). Tool to support citizen participation and multidisciplinary in food innovation: Circular food design. *Frontiers in Sustainable Food Systems*, 4, 1–12.
- Spratt, O., Suri, R., & Deutsch, J. (2021). Defining upcycled food products. *Journal of Culinary Science & Technology*, 19(6), 485–496.
- Teece, D. J. (2010). Business models, business strategy and innovation. *Long range planning*, 43(2–3), 172–194.
- Wigboldus, S. (2020). *On food system transitions & transformations; Comprehensive mapping of the landscape of current thinking, research, and action*. Wageningen Centre for Development Innovation, Wageningen University & Research.
- Wilkins, J. L. (2005). Eating right here: Moving from consumer to food citizen. *Agriculture and Human Values*, 22(3), 269–273.