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Quality as Value-added Bioeconomy: Analysis of the EU Policies and Empirical Evidence from Polish Agriculture

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The paper is an attempt to assess the extent to which policies designed and implemented for bioeconomy development in the European Union address the societal expectations for holistically perceived quality delivered not only with product characteristics but also from economic processes as societal and environmental services. It is argued that bioeconomy policy so far fails to address sustainability quality but, being coherent with Common Agricultural Policy, can be shifted in such direction. The policy framework for agriculture development has already shown a drift from quality resulting from sole economic expectations towards quality that addresses the economic, societal, and environmental requirements. On other hand, bioeconomy objectives to deliver food with increased quality and non-food biomass are presenting new challenges for agricultural policy to ensure the coexistence of different production systems aimed at delivering quality.

Key words: bioeconomy, quality, Common Agricultural Policy, coexistence, Poland.

Introduction

The bioeconomy has not been clearly defined yet and is understood in various ways. The most used references to the bioeconomy in the scientific and political debates recognize it as a sector of the economy encompassing different industries or products, a political concept, or a heterodox trend in economics. In the first approach, the bioeconomy is described by size according to various criteria (Adamowicz, 2017; Fuentes-Saguar, Mainar-Causapé, & Ferrari, 2017; Venkatesan, 2018). The second is recognized as a way of managing resources at various levels (Blumberga, Muizniece, Zihare, & Sniega, 2017; Wicki & Wicka, 2016). The third takes into account new ties from coupling of economic and biological processes, valuation of external effects, and economics of substitution of non-renewable raw materials by renewable (Maciejczak, 2017; Wesseler & von Braun, 2017). A narrowly understood concept of bioeconomy presented from industrial-based perspectives leads to excessive simplifications, the results of which are transferred not only to scientific discourse, but also to policy design and social perception. On contrary, the wider view presents the bioeconomy as a holistic approach that, due to its urgent contemporary nature, should be seen from complex and dynamic perspectives. Regardless of adopted perspectives there is a consensus that the development of bioeconomy should be based on two main pillars: the use of renewable biological biomass resources of terrestrial or aquatic origin or waste streams, and the conservation of these resources and production of value-added goods and services in a sustainable way.

Under such assumptions the agricultural and food sector, along with forestry and aquaculture, is considered a fundament of the bioeconomy development, as a biomass of agricultural or food origin is the starting point for all bioeconomy-related value chains. The current scientific debate shifts towards the role of agriculture in providing biomass feedstock for processing of non-food industrial goods and energy (Drejerska & Gołębiewski, 2017). This underlines the importance of quantity of biomass to fulfill growing expectations of industry, which also, thanks to public support, creates smart and innovative solutions that strengthen its competitiveness (Pätäri, Tuppura, Toppinen, & Korhonen, 2016). However one cannot forget that a primary role of agriculture, and through it also the bioeconomy, is to ensure the production of food in a sustainable way, especially to fulfill security needs. Thus agriculture, in a global sense, should enable the world to meet the Sustainable Development Goals of poverty and hunger reduction, ensuring healthy lives (Zilberman, Gordon, Hochman, & Wesseler, 2018), and in a narrower view will make it possible to attain regional or national objectives in the development of bioresource based industries (Organisation for Economic Cooperation and Development [OECD], 2018). Understandably, such an approach creates natural conflicts of interests, with the need for trade-offs, and calls for reinforcement of coherence and synergies, especially on the policy design level

(Viaggi, 2016; Wesseler, Banse, & Zilberman, 2015). In this context the importance of quality issues from both public and private perspectives is rising, which emphasizes the quality of food (Bryden, Gezelius, Refsgaard, & Sutz, 2017). The concept of quality embedded in the bioeconomy is nonetheless narrowly discussed in the scientific as well as political and business spheres. Levidov (2008) argues that quality of agricultural products and activities should imply an alternative type of knowledge-based bioeconomy that, through network connections, adds and captures market value and also prevents agro-industry treadmill effects. Additionally, the US strategic plan for a thriving and sustainable bioeconomy clearly points out that the market success of bioproducts will ultimately depend on producers meeting certain level of quality (US Department of Energy, 2016). Also, the European Union's strategic papers stress that the transition to a sustainable European bioeconomy can be reached through sufficient supplies of safe, high-quality food and bio-based products from the productive and resource-efficient primary production system that benefits from standardization aimed at increasing product safety and quality (Ronzon et al., 2017b). Therefore, quality has already been recognized as a causative factor for the development of the bioeconomy. It has not yet been, however, precisely and adequately identified and recognized.

Today, from a regional perspective, the European Union (EU) is considered as one of the global leaders in political, institutional, and applied bioeconomy development, setting a course for a resource-efficient and sustainable economy of which agriculture is one of the main sectors (De Besi & McCormick, 2015). The EU's agriculture is one of the world's leading producers of food, and guarantees food security for over 500 million citizens. The EU's Common Agricultural Policy (CAP) is under continuous reform and, following a new programming process, is setting the main objectives and measures of post-2020 policy. It is assumed to foster a smart and resilient agricultural sector, bolster environmental care and climate action, contribute to the environmental and climate objectives of the EU, and strengthen the socio-economic fabric of rural areas (Kuhmonen, 2018). In this regard it is important to notice that CAP already recognizes the dual role of organic farming as a system of agricultural production that is designed and used for delivering quality. On the one hand, organic farming in Europe strives to meet consumer demand for high quality products. On the other, it fulfils an important role in securing certain public goods. For the first time in CAP history, under the financial perspective 2014-2020, public good delivery constitutes a significant part of the CAP, especially direct payments (Pillar 1). However, meeting the standards of organic production brings many problems not only endogenous, related to the organization of the farm, but also exogenous, connected to production constraints in a given environment relative to unintended pollution. The example of organic production as an agricultural activity focused on delivering quality can be therefore recognized as good example of the possible thresholds that would occur for bioeconomy development aimed at achieving a certain level of quality.

The paper's objectives are threefold. Firstly, based on the in depth literature review it will be assess how the problem of quality is addressed in the concept of bioeconomy. Secondly, the EU's policy papers for bioeconomy and agriculture development will be reviewed from the perspective of their coherency and exhaustiveness with regard to quality issues of bioresources, especially food. Finally, based on empirical evidence from Polish organic farms with parallel conventional and organic production systems, the importance of coexistence costs for quality assurance will be emphasized.

Data and Methods

The basic research method was the review of policy and scientific papers from the perspective of the proposed quality model. The conceptualization of the quality model for the bioeconomy has been elaborated through the epistemological analysis of the literature. The primary data were obtained from organic farms with parallel production systems during direct interviews using structured questionnaire with closed- and open-ended questions and reviews of their obligatory records. The representative sample of 369 farms was selected using Neyman's optimal allocation (Kozak, 2004) from the official database of organic producers in Poland registered by the Main Inspector of Agricultural and Food Quality in 2014. The criteria for selecting farms for interviews was the status of an organic farm and conducting parallel production from which products were placed on the market as well as size, production type, and geographical location. In-depth direct interviews were conducted in 2015 and 2016.

Approaches to Quality in the Bioeconomy

The perception of 'quality' is a subjective matter in any sphere of life, and especially where agriculture and food products are concerned. There is a common understanding that quality can be recognized as a distinctive attribute or characteristic possessed by something or the standard of something as measured against other things of a similar kind (Oxford English Dictionary, 2015). The epistemological characteristics of quality address this issue as an immanent feature of the product or process, a fulfillment of a set of standards, or a fulfillment of particular expectations (Harvey, 1990).

As emphasized by Bowbrick (1996) with regard to products, it is evident that quality is important in determining price and even market structure. For this reason agricultural economics was the first to develop the economics of quality, focusing mostly on hedonic approaches. Most quality-related theories are based on the realities of agricultural products in agricultural markets. Young and Hobbs (2002) state that the economic literature on quality as initially conceived identified the provision of information and compatibility, or the network externalities approach, as being the driving force for introducing quality standards. Economic gains accrue due to positive network effects which arise when the value of a good to a user increases the more other users adopt the same good or compatible ones (the so called bandwagon effect). Henson (2006) argues that much of the focus of the economic literature in the area of food quality has been on the role of public food quality standards both as policy instruments for regulating food markets and as potential non-tariff measures, although more attention is now being given to the growing role of private food quality standards in the food supply chain. Smith (2009) suggested also that the relations and inter-linkages between public and private standards in national food quality systems and in international contexts are growing. As stressed by Golan, Kuchler, Mitchell, Greene, and Jessup (2001), private and social interests are often distinct and an efficient quality control system operated from a private business perspective may not yield socially efficient outcomes. Firms have incentives to provide high quality in order to gain competitive advantage, but in cases where information available to consumers on which to judge food quality is imperfect, market and legal incentives may be insufficient to give consumers the level of quality and protection that society as a whole would expect. In such cases of information asymmetries and externalities, governments continue to play an important role in correcting market failures by enacting minimum food quality regulations.

Quality attributes of food normally taken into account in an agricultural context, apart from the basic prerequisites of health and safety or taste, relate to specific product characteristics, often linked to geographical origin or production, animal breed or production method, special ingredients, particular production methods often resulting from local expertise, and traditions or observation of high environmental or animal welfare standards (Maciejczak, 2009a). For non-food agricultural products, the basic quality characteristics result from their technical capacity of contaminants (i.e., fibers, starch, oils, solvents, dyes, resins, proteins, specialty chemicals, and pharmaceuticals) or energy source (Wicki, 2017). Some authors link also quality of agricultural products to a broader concept. Murdoch, Marsden, and Banks (2009) argue that quality in the food sector, as is being asserted at the present time, is closely linked to nature and the local embeddedness of supply chains. Lencsés, Takács, and Takács-György (2014), or Papadaki-Klavdianou, Menkisoglou-Spiroudi, and Tsakiridou (2003) in wider perspective, link the quality of agricultural products with the protection of the environment (quality of water, air, soil, biodiversity, landscape, etc.) or contribution to sustainable development (climate change, poverty reduction, etc.).

The above examples show that quality in agriculture and food sector is mostly attributed to products, while process quality is less regarded (see, i.e., Bowbrick, 1992). However, both products and processes are crucial in a holistic approach to the bioeconomy. In this context one needs to stress that the academic discourse on the development of the bioeconomy has not yet considered the issue of quality sufficiently. Whereas there are expectations that the development of bioeconomics shall take place in a sustainable way, we can distinguish three facets of quality in the bioeconomy: economic, social, and environmental. These three dimensions together form a comprehensive approach to sustainable quality in the bioeconomy.

Economic quality in the bioeconomy shall be attributed to both products and processes. Product characteristics comes from the technical attributes of agricultural products. They refer to both their natural composition (i.e., fibers, oils, resins, and other substances) as well as features that are appreciated by users both industry and individual consumers (i.e., organoleptic). The economic quality of bioeconomy also needs to be focused on process and set institutional specifications that it aims to meet. This applies to manufacturing, processing, and transport processes that are carried out in accordance with institutional requirements. The institutional requirements are created by legal regulations and agreements between market agents, as well as in relation to social contracts, traditions, and customs. With regard to agriculture, it is possible to indicate mandatory compliance with the principles of good agricultural practice, production, and processing in accordance with the requirements of organic farming standards, production in accordance with the accepted specifications for traditional and regional products, or transporting animals in accordance with the requirements of their welfare.

The social quality of bioeconomy is largely extended to processes. Those are the same processes that are considered in the perspective of economic quality, but their impact is associated on the one hand with externalities, and on the other with the implementation of policies that respond to the reported social demand. An example of such processes is organic production, which, on the one hand, provides public goods, and on the other hand, results from the implementation of a specific policy supporting such production, due to the growing social demand for food products with higher added value.

The environmental quality in bioeconomy is also mostly attributed to processes. These processes relate to activities that reduce negative pressure on the environment from agriculture and limit the occurrence of its negative environmental effects. In addition, they also contribute to sequestration and create conditions for the development of natural processes and the growth of agroecosystems based on them. An example of such activities may be the impact of agriculture on the basic production resource that is soil. In relation to the soil, it should limit erosion, nutrient depletion, and degradation of water relations and, at the same time, develop the population of beneficial microorganisms that, in interaction with plants, can create an effective production system called the holobiont (Heijden & Schlaeppi, 2015).

All three approaches to quality in bioeconomy are interrelated. Combining economic and social qualities, quality is an element of the market game in which a win-win strategy is implemented, such that both private and public interest are satisfied. These are activities undertaken by economic agents (farmers, processors) for the needs of obtaining economic rent and providing at the same time social benefits (reinforced positive externalities or limited negative externalities) for which they are adequately compensated. An example of such activities is the implementation of agri-environmental programs. Considering social and environmental qualities, it is necessary to consider manufacturing, production, or transport processes that are addressed to society due to their pro-environmental nature. Such activities are reflected in institutional solutions that go beyond legal frameworks. Their reflection is the demand for products from such processes. An example here can be not only organic farming but also local production carried out as part of short supply chains and sold through local consumer food cooperatives, or the use of agricultural wastes for energy production (i.e., methane generation). Analyzing economic and environmental qualities, the focus should be on environmental externalities that are subject to valuation. The more bioeconomy processes will be able to deliver positive externalities in forms of services, the higher their quality will be. At the same time, this quality will be high also when negative external effects are limited, which will increase the value of not only products but also the environment in which production is carried out.

All three dimensions together form a comprehensive approach to the sustainable quality of the bioeconomy. Contrary to mainstream agricultural economic theories related to quality, this approach is less product and more process oriented and contains in its holistic approach the coherent mutually exclusive and collectively exhaustive value adding from production, processing, and transportation activities related to economic, social, and environmental actions that fulfill both private and public expectations for the value of products and services.

Quality Addressed in the EU's Bioeconomy Policy

On February 13, 2012, the European Commission (EC) adopted the strategy "Innovating for Sustainable Growth: A Bioeconomy for Europe." This strategy proposes a comprehensive approach to address the ecological, environmental, energy, food supply, and natural resource challenges that Europe is facing. As stressed in the documents, the Bioeconomy Strategy and its Action Plan aim to pave the way to a more innovative, resource efficient, and competitive society that reconciles food security with the sustainable use of renewable resources for industrial purposes, while ensuring environmental protection. It is assumed that the sustainable production and exploitation of biological resources will allow the production of more from less, including from waste, while limiting negative impacts on the environment, reducing the heavy dependency on fossil resources, mitigating climate change, and moving Europe towards a post-petroleum society. In in this context, the Strategy assumes that the bio-based products and bioenergy can be "bio-based versions" of traditional products or novel products with entirely new and innovative functionalities and potential for new and existing markets. It is also assumed that the EU bioeconomy strategic objectives shall seek synergies and respect complementarities with other policy areas, instruments, and funding sources that share and address the same objectives, such as the Common Agricultural and Fisheries Policies (CAP and CFP), the Integrated Maritime Policy (IMP), and environmental, industrial, employment, energy, and health policies. In 2018 the EC updated the Strategy and announced the launch of concrete measures under three themes: scaling up and strengthening the bio-based sectors, rapidly deploying bioeconomies across Europe, and protecting the ecosystem and understanding the ecological limitations of the bioeconomy. The updated Strategy assigns a greater role to the whole agri-food chain. In addition, the context has changed; sustainability has become the leading framework, with a stronger consideration of issues like the circularity of the economy in general, but also food and nutrition security as well as the major question of inequality.

The European strategic documents for bioeconomy development have been criticized on two fronts. On one hand, the self-critique comes from European decision makers and focuses on how the policy is designed and implemented. On the other, the scientific community is pointing out the discrepancies between the noble idea of sustainable development and real solutions that change the status quo of today's unsustainable activities in a more reductionist than holistic way.

In 2017 the EC reviewed the Strategy and Action Plan (EC, 2017). It was found that the policies mobilized research and innovation (R&I) funding, in particular a doubling of the EU R&I funding dedicated to the bioeconomy under Horizon 2020, and fostered R&I investments in Member States. The work has been focused on developing standards for bio-based products and supporting private investment with major deliverables such as the launch of the BioBased Industries Joint Undertaking. Based on the Strategy, numerous national and regional bioeconomy strategies have been developed in the EU. However, the study by Expert Group (2017) shows that the current policy context highlights the need for a sustainable, circular bioeconomy. The policy context in which the bioeconomy operates has changed significantly since 2012, with EU and global policy developments such as Circular Economy, Energy Union, the Paris Agreement, and the Sustainable Development Goals. The Bioeconomy Strategy and Action Plan are not sufficiently well articulated. In particular, there is no explicit articulation showing how the implemented actions are meant to contribute to the achievement of the objectives.

The studies examining the regional strategies (Fund, El-Chichakli, & Patermann, 2018; OECD, 2018) stress that these policies focus on the valorization of bioresources and innovative solutions for sustainable development, including climate protection and the circular economy. Most countries focus on the production and utilization of biological resources in value chains, underlining that the basic challenge for regional policies for sustainable bioeconomy development is to reconcile food and industrial demands for biomass. It is also emphasized that they do not develop a coherent policy framework, with a balanced approach to market demand and supply and appropriate measures, which links with other policies, especially innovation and taxation. It is concluded that the policy coherence needs to be better addressed, in the design and implementation of both the EU Strategy and Action Plan as well as regional strategies.

From the scientific perspective, as argued by Ramcilovic-Suominen and Pülzl (2018), since their launch in 2012 the EU Bioeconomy Strategy and biomass policies have been criticized for being too narrow, exclusive, unsustainable, and unrealistic. They agree with several authors that currently an industrial perspective dominates the European bioeconomy policy framework, where the role of family farms and small agricultural enterprises is overlooked. Various studies also suggest that the current EU policy framework is too optimistic in terms of the possibilities for a bioeconomy. The policy and application analyses (Bugge, Hansen, & Klitkou, 2016; Pfau, Hagens, Dankbaar, & Smits, 2014; Staffas, Gustavsson, & McCormick, 2013; Wesseler, Spielman, & Demont, 2010) argue that the current EU bioeconomy policy leans towards instrumental approaches to sustainable development as well as weak sustainability. Issues such as social justice, fairness and equity, social and environmental safeguards, and local traditional knowledge in various concerned sectors should be taken into consideration. Creating ambiguities in terms of the ultimate aims of the bioeconomy, such different drivers and contestations, highlight the conflicts of interest that can arise not only between sub-sectors of the bioeconomy but among economic, social, and environmental objectives at European and regional scales.

The other front of critique comes from scientists who argue that the current bioeconomy policies in Europe do not represent a holistic approach, but rather narrowly focus on particular aspects, especially biomass production. Standing Committee of Agricultural Research—Bioeconomy Strategic Working Group (2017) suggests enlarging the policy scope of bioeconomy to cover not only products but also services. The service function arises from the sustainability paradigm and regards ecosystem services provided by the bioeconomy. Bio-based services are often integral to the provision of clean drinking water, the decomposition of wastes, and the natural pollination of crops and other plants. Ramcilovic-Suominen and Pülzl (2018) also argue that the process dimension as linked to sustainable development is not addressed in bioeconomy policies. Maciejczak (2018) pointed out that the process based approach is central to the adaptive efficiency of the whole bioeconomy system. Also, the capability for adaptation plays a crucial role in the policy development. This is because previous decisions in politics, economics, and society—taken before the bio-based transformation paradigm emerged—have shaped the economic system in a way that today hampers the development of a bio-based economy. Path dependencies might lead to a situation in which the bioeconomy faces high regulatory and transaction costs, which in turn may constrain the bioeconomy in unfolding its transformative dynamics.

The above analysis of the policy on the development of bioeconomy in the European Union, both in the pan-European dimension and in the Member States scope, indicates that the issues of quality are addressed in a very narrow scope. This range is related to quality in the economic sense, mostly as meeting certain standards related to the characteristics of products and specifications regarding the method of their production. Despite referring to the sustainability paradigm as a leading concept of development, quality in social or environmental terms is insufficiently addressed. The main reason for such an approach is a product orientation with little attention to processes that bring value-added quality in societal or environmental services.

Agricultural Policy as a Driver of Bioeconomy Change

Agricultural production, together with forestry policy, shall be considered a backbone of bioeconomy development. Agriculture produces not only quality food for humans and feed for animals, but also the feedstock for chemicals, energy, and novel compounds. Thus EU policymakers' intention is that the CAP shall play an essential role in realizing the Juncker priorities, in full coherence with other policies, for harnessing the potential of the bioeconomy (Ivan, 2017). The major aim of this policy option is to pave the way for a more innovative, resource efficient and competitive society that reconciles food security with the sustainable use of biotic renewable resources for industrial purposes, while ensuring environmental protection (Ronzon, Piotrowski, M'Barek, & Carus, 2017a).

The cornerstone in the coherent approach to bioeconomy development in Europe through different programs and instruments is to address societal expectations regarding sustainable food production, in particular concerning food safety and food quality. European citizens are increasingly valuing access to a wide variety of food that carries broader benefits for society, such as organic produce, products with geographical indications, local specialties, and innovative food (Brelik, 2016). Partly thanks to CAP support, organic farming has expanded significantly in the EU, covering almost 7% of utilized agricultural area (UAA) in 2017 compared to 2% in 2000 (Willer & Lernoud, 2018).

But as argued by Kuhmonen (2018), the CAP is also path dependent, which has transformed it into a complex puzzle aimed at solving emerging dynamic societal problems. At its inception, the objectives of the CAP were to have a sufficient amount of food for the population at affordable prices and promote productivity growth, modernization, and structural adjustment in the large agricultural sector. Since then, new concerns have emerged about how to cope with market imbalance and volatility, national exchange rates, environmental concerns, uneven territorial development, and cohesion of the enlarged EU. This enrichment of problems has contributed to the accumulation of complexity in the CAP (Daugbjerg & Swinbank, 2016). Multidimensionality, complexity, and the diversity of the CAP have increased so substantially that none of the extant problems can be resolved without creating new conflicts or collateral damage. Any attempt to resolve, for example, a certain environmental problem will affect the status of many socio-environmental, spatial, policy, market, and farming problems (Feindt, 2010).

The current view on the CAP boils down to the conclusion that it should lead to an increase in the competitiveness of EU agriculture on the world market, while maintaining the level of income of rural residents and the safety of the natural environment (Majewski & Malak-Rawlikowska, 2018). As a result, agricultural policy should support not only its production function, but also non-productive functions, creating foundations for the development of multifunctional and sustainable agriculture, i.e., taking into account economic, social, and environmental criteria. Direct payments have been made the basic tools of farm support. These were intended to compensate for the decline in expenditures on market intervention and export subsidies, but are increasingly detached from the size and structure of production. At the same time, the CAP has become more aware of new challenges related to changes in the natural environment and the need for more efficient use of scarce resources such as water, land, and clean air.

On June 1, 2018, the EC presented legislative proposals on the CAP beyond 2020. These proposals aim to make the CAP more responsive to current and future challenges. As stressed by EC (2018), the future CAP is designed to continue to ensure access to high-quality food and strong support for the unique European farming model, based on nine objectives. The nine objectives of the future CAP are to ensure a fair income to farmers, to increase competiveness, to rebalance power in the food supply chain, climate change action, environmental care, to preserve landscapes and biodiversity, to support generational renewal, vibrant rural areas, and to protect food and health quality.

The CAP is one of the EU policies responding to societal expectations regarding food, in particular concerning food safety, food quality, environmental, and animal welfare standards. Efforts to improve food quality have been part of EU agricultural policy from the development of wine quality labelling in the 1980s onwards. In 1992 the EU introduced a system to protect and promote traditional and regional food products inspired by existing national systems (EC, 2007). Over time, approaches to standardize the quality of both products and processes increased within the CAP. This resulted in the development of rules related to the use of fertilizers, plant protection products, and animal welfare (so-called cross compliance; Maciejczak, 2008). Nowadays citizens are also increasingly valuing access to a wide variety of food that carries broader benefits for society, including addressing critical health issues such as those related to microbial resistance caused by the inappropriate use of antibiotics (Landers, Cohen, Wittum, & Larson, 2012). They also call for standards to be efficiently supervised in a way that allows the maintenance of appropriate quality characteristics. In this context, an example can be the implementation of coexistence practices that ensure effective separation of products from different production systems and the prevention of unintentional contamination of, for example, organic products with plant protection products used in conventional crops. Although the latest evaluation of the greening measures under the Direct Payments Regulation, part of Pillar 1 of the CAP, show that their environmental and climate impacts have been limited and locally specific, making a small contribution towards promoting more sustainable farming practices (Alliance Environnement & the Thünen Institute, 2017), it needs to be stressed that the policy design has established and led to implementation of the institutional framework and practical measures for achieving the quality embedded in the CAP objectives.

Considering the added values that are created as a result of the implementation of the CAP in the form of quality related to economic, social, and environmental aspects, it should be stated that this policy is much more advanced in creating sustainable quality than policies designed for the bioeconomy. Progressing CAP evolution takes into consideration social and environmental goals to a greater extent. At the same time, the CAP is referring more broadly to the quality of agricultural processes providing certain services important from a public perspective and understood as public goods, not only products understood as private goods.

The development of the CAP towards greater sustainability of food production also imposes the need to balance production for industrial needs. These two complementary functions of agriculture cannot be separated. Thus, through the CAP, a solution is defined that synergistically influences the perception of quality delivery by the bioeconomy. Although quality in the economic, social, and environmental aspect is created in the area of the initial elements of the value chain within the framework of basic production, it should be expected that synergy can be transferred up the chain.

Coexistence as a Practical Challenge for Bioeconomy—Case of Polish Organic Farms

Bearing in mind that the CAP strives to produce food with the highest added value not only with economic but also social and environmental quality, and at the same time that under bioeconomy policies the agriculture and forestry shall provide the growing amount of biomass, the question is not merely which production system to focus on, as their goals are often contradictory, but rather how to optimize both. In this context another problem arises: how different production systems can function in ways that do not affect negatively each other. This question is justified if one takes into account the growing organic production in Europe, regulated by restrictions on residues of synthetic plant protection products, and intensive biomass production for energy needs, where such products are widely used. The question of effective separation becomes, therefore, an urgent challenge not only of a political and regulatory nature but above all of a practical scope. The answer

Table 1. Estimated annual costs in zloty (PLN) of coexistence on organic farms with parallel production in 2014 (N=369).

Coexistence cost (PLN/year/farm)	Mean	Share of total coexistence costs (%)	Min	Max	Sample standard deviation
Cleaning machines	1145.2	22.2	451.2	5487	178.5
Spatial isolation in production	662.1	12.8	298.3	758.2	23.5
Spatial isolation in warehouses	325.4	6.3	102.3	652.2	8.2
Spatial isolation in transport	856.8	16.6	256.9	1456.2	86.9
Temporal isolation in production	785.6	15.2	120.2	1078.6	98.6
Temporal isolation in transport	352.2	6.8	82.4	1365	38.9
Labelling	233.1	4.5	112.3	698.4	21.8
Additional unit packages	549.6	10.6	145.7	1659.8	38.4
Keeping records	253.4	4.9	52.9	600.8	16.8
Total	5163.4	100			

Source: own elaboration

must first of all be given by the farmers who, in the process of adapting to market conditions, can use both production modes to optimize their operations. That shows the importance of the coexistence practices and the costs of their implementation.

Coexistence can be understood as simultaneous functioning of various technologies and the production systems based on them, and, as a result, of different products in value chains. This issue is discussed in the economics literature mainly as regards the costs that need to be incurred in order to enable the functioning of systems that compete for resources without eliminating one another. Agriculture-related empirical studies primarily concern issues of coexistence of supply chains based on production systems that use genetically modified organisms and those that do not use such technologies (Maciejczak, 2009b). However, the problem is of a far greater extent. It also extends to the issue of coexistence between a production system based on conventional methods and methods allowing for gaining a higher added value in the form of quality, such as ecologically-based systems (organic, biodynamic). In this respect the implementation of co-existence practices at the farm level is a necessary pre-condition for further efficient competition on the market. If the consumer does not have a guarantee that an organic product, by definition more expensive than a conventional one, was produced in line with the rules assumed, they will not trust it; such mistrust will be expressed as an unwillingness to pay a higher price.

The rules for carrying out organic production define the actions to be taken in order to reduce the risk of contamination and to ensure cleanliness of production. Current European regulations, as well as the new regulation for organic production 2018/848 that will apply from January 1, 2021 (EU, 2018), state that a holding may be split into clearly and effectively separated production units for organic, in-conversion, and non-organic production. Additionally, preventive and precautionary measures shall be taken, where appropriate, at every stage of production, preparation, and distribution. Maciejczak (2016) showed that the basic measures undertaken on farms involve the application of both spatial and temporal separation, especially with regard to crop production. Subsequently, cost occurs with regard to the cleaning of machines and equipment as well as separation areas in buildings and facilities, all in order to eliminate unintentional contamination. What was of great importance to both the farmers and the certification bodies supervising their production was the issue of proper packaging and labeling.

On the basis of the analysis of primary data from the accounting records for 2014 kept by Polish organic farmers that run both organic and conventional production in parallel, the costs of coexistence practices have been identified and estimated. The following coexistence costs, important for the transparency of production, especially organic production, have been identified: machine cleaning, spatial containment of production, spatial containment in warehouses, spatial containment in transport, temporal containment of production, temporal containment in transport, labelling, additional unit packages, and records keeping. These costs are presented in the Table 1.

The category of coexistence costs whose average size in the surveyed farms was the highest was machine cleaning (PLN 1145.2/year). This was related to the fact that farmers did not have enough machines and equipment that they could dedicate only to organic production. Therefore, they allocate them to two systems and when used in organic production, they clean them thoroughly, which requires both time and water resources and appropriate cleaning agents. The transport temporal isolation resulting from the transport of both organic and conventional products separately accounted for significant costs on an average annual basis of PLN 856.8 (16.6% of all coexistence costs).

The costs of temporal and spatial isolation in production amounted on average respectively to PLN 785.6/year (15.2%) and PLN 662.1/year (12.8%). They were related to the use of different types of varieties and production planning. A significantly high share of coexistence costs resulted from activities related to additional unit packaging (10.6%). The costs of keeping appropriate records amounted on average to PLN 253.4/year (4.9%). Generally, the average costs of coexistence for the researched farms amounted to PLN 5163.4/year, which constituted 5.17% of total costs.

Conclusions

Bioeconomy should be perceived as a cluster that agglomerates many sectors of an economy, introducing new connections between them that, as a result, bring new value-added products and services. Through utilizing renewable biological resources to meet societal needs, the bioeconomy represents an alternative mode of growth comprising economic, environmental, societal, and political objectives.

Omitting (too) general assumptions, the current EU bioeconomy policy strongly emphasizes technological solutions and economic efficiency, while addressing the environmental and social aspects to a much lesser extent. This shows that the definition of quality embedded in the EU bioeconomy policy is perceived from a simplified product characteristic perspective, not from holistic view of quality delivered by products and processes in order to fulfill increasing social pressure for sustainable growth. These needs are expressed in anticipation of the quality of products and also processes under which services are delivered through positive externalities.

At the same time the requirements for sustainable quality in products and processes have been imposed on the European agricultural sector, which, together with forestry sector, is considered a backbone of bioeconomy. The CAP policy changes, notwithstanding its path dependent, complex, and multidimensional nature, have already shown a shift from quality resulting from solely economic expectations towards quality that addresses economic, societal, and environmental requirements. This is especially visible in the policy framework designed for value-added food products.

Thus, the coming challenge arising from bioeconomy development is to efficiently address similar CAP quality standards and measures while regulating non-food biomass production, which today is responding mostly to economic expectations. Accordingly, the coexistence of different production systems calls for policy design and practical solutions for effective coexistence within bioeconomy sectors. The Polish case study shows that ensuring food quality through coexistence measures brings additional costs.

The analysis has shown that the quality issues holistically introduced on the institutional level in the Common Agricultural Policy could shape the alternative pathways to sustainable bioeconomy transition. However further research is needed to ensure that bioeconomy development will address public expectations for both product and process quality regarding sustainable growth, which will direct the path for policy design, implementation, and evaluation.

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