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The Bio-based Economy: a New Development Model

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There is no agreed-upon definition of the concept of the 'bio-based economy' (or bio-economy). One of the most widely accepted definitions (European Commission, 2012b) describes it as an economy encompassing the sustainable production of renewable biological resources and their conversion into goods and services for final, as well as intermediate, consumption. As such, it encompasses not only traditional economic activities, such as agriculture, fishing, aquaculture and forestry, but also recently developed industries, such as bio-technologies and bio-energy. Overall, in 2009 the bioeconomy in Europe accounted for 1 trillion euros value added, with an approximate market size of over 2 trillion euros and around 21.5 million jobs (Clever Consult, 2010). The prospects for further growth are more than promising: according to the OECD (2009), by 2030 on average the use of biotechnologies is estimated to contribute up to 35% of the output of chemicals and other industrial products that can be manufactured using biotechnology, up to 80% of pharmaceuticals and diagnostic production and some 50% of agricultural outputs across OECD countries.

The bioeconomy, thanks to its strong innovation potential, encompasses a large part of the task of addressing global challenges, from the contributions of industrial biotechnology through environmental applications to climate change issues, improved health outcomes, and feeding global populations with better yielding crops and better delivery of nutrients and vitamins in foods. In short, the bioeconomy holds at least some of the cards to ensure long-term economic and environmental sustainability.

However, technological solutions per se are not a guarantee of success. Indeed, the challenges above call for a profound change in the policy environment as well as the research sector. Addressing global challenges requires a move from sectoral policy frameworks and governance mechanisms to a more integrated approach (EuropaBio, 2011). The very crosscutting nature of the bioeconomy offers a unique opportunity to address in a comprehensive and systemic manner inter-connected societal challenges. This ambitious approach is fully embedded in the EU Commission's Strategy "Europe 2020" (European Commission, 2010), which calls for building a bio-based economy by 2020 as a key element for supporting an economy based on knowledge and innovation, as well as in "Horizon 2020" (European Commission, 2011), the new EU framework programme for research and technological innovation (2014-2020), and in the recent EU Commission Communication on "Innovating for Sustainable Growth: A Bioeconomy for Europe"

(European Commission, 2012a). The overall objective of all of these frameworks is a re-focusing of the European development model, promoting a bio-based economy to foster economic growth and job creation.

At the same time research activities and the higher education system should be re-oriented. This is already happening at different scales as witnessed, for example, by the launching of the above-mentioned EU Horizon 2020 research programme, the blossoming of international research cooperation frameworks (such as the EU-LAC Bioeconomy Working Group), the birth of new Institutes/Departments focusing on the bioeconomy (see, for example, the Bioeconomy Institute at Iowa State University) or networks of institutions/researchers (such as the Bioeconomy Network at Michigan State University, the Bioeconomy Science Center at the University of Aachen, the International Consortium on Applied Bioeconomy Research) as well as new postgraduate programs (such as the Master of Sciences in Management of Bioeconomy, Innovation and Governance at the University of Edinburgh). All of these initiatives share the common view that research and education must be re-oriented towards a more comprehensive model based on the 'convergence' of different disciplines, acknowledging that while a deep disciplinary background remains vital, robust cross-disciplinary education/research is essential to address complex issues.

The Italian Association of Agricultural and Applied Economics (AIEAA) is part of this process. The reasons for establishing AIEAA are rooted in the challenges above, as well as the implied changes in the topics/methods in the field of agriculture and applied economics (Viaggi *et al.*, 2012; Sckokai, 2012; Schmid *et al.*, 2012) and the activities carried out by AIEAA over the past year or so reflect these reasons. The idea of launching *Bio-based and Applied Economics* (BAE), the AIEAA's official journal, is deeply rooted in the awareness of those changes. This is also the reason for which the theme of the first AIEAA conference, held in Trento on 4-5 June 2012 was "Towards a Sustainable Bioeconomy: Economic Issues and Policy Challenges" aimed at discussing challenges and opportunities offered by the bio-based economy, specifically focusing on what research, innovation and policy can do to foster economic growth and provide an alternative development model to address global challenges.

The papers included in this issue of BAE are all from that symposium and provide an overview of the wide range of topics debated in Trento¹ (cf. <http://www.aieaa.org> to download the full set of papers and presentations), focusing on some of the most important bioeconomy issues, such as biofuels, innovation, GMOs and product differentiation. In particular, Esposti deals with the evolution of the knowledge and innovation system implied by the biotechnology revolution in agriculture (though many of his remarks are also applicable to other bioeconomy sectors). The paper, commencing from a conventional science-based approach, highlights the emergence of some system failures and the need for a new conceptualization and design, discussing policy implications at the EU level. Moschini *et al.* make a thorough assessment of the state of the art of the economics of biofuels, analyzing the pivotal role played by some critical policies in the sector's performance over the last decade and providing an overall assessment of the impact of biofuels on the economy and on the environment. Sckokai and Varacca analyze product and brand

¹ The papers published in this issue were submitted to the journal in answer to a call open to a selection of the papers presented at the conference. They underwent the regular double blind peer review process adopted by the journal before final acceptance.

competition in the Italian breakfast cereal market, demonstrating the presence of patterns of substitution within products sharing the same brand and similar nutritional characteristics. Finally, Mora *et al.* analyze the socio-economic drivers affecting the use of GM animals in livestock and pharmaceutical industries and review the risks and benefits implied by the adoption of GM animals from the point of view of the life sciences.

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