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BIO-ECONOMIC ASSESSMENT OF BARLEY CHAIN: RELEVANCE AND SMART, SUSTAINABLE, INCLUSIVE TRIGGER EFFECTS IN THE SHORT CHAIN OF FOOD AND NON-FOOD PRODUCTS - A PROJECT 'S EXPLANATION

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Abstract

In the affirmation of the Sustainable Development Strategy, the agricultural production has a crucial role in the success of the bio-economy (Conway and Barbier, 2013).

The European Commission adopted a strategic action plan called: “*Innovate for sustainable growth: a Bio-economy for Europe*” (OECD, 2011). The bio-economy will be one of the basic topics of the Horizon 2020 program. In this sense, very promising results are coming especially for the cycle of barley. Barley is a cultivation with large diffusion all around the world and with high capability of adaptation regarding to climate and soil variation (Asveld *et al.*, 2011).

Last year a University Network of Central Italy built a Research Project of National Interest entitled “Process and product innovation in the barley food chain for the improvement of quality and environmental sustainability of food and beverages”.

The main objective of the Project is to arrange a bioeconomic evaluation of the barley chain with a particular focus on proposals for the supply chain and to boost the role of barley for the initiation of bio-economic development processes at national and European level.

In this sense, the paper represents a first contribution about a specific part of the research project and, moreover, aims to deliver an example at the academic level about the innovative opportunities of bioeconomic research field.

Keywords: Bio-economy, Barley Production Cycle, Green Economy, Sustainable Development, Innovation

Introduction

The theory of Economics Welfares of Pigou in the permeate management system and the hierarchy of wealth distribution has put in crisis the development model of the I° Industrial Revolution by the first in-depth concrete analysis (Georghescu, 1971). The issue of environmental goods, (their increasing scarcity due to the gradual erosion of a quantitative model of development, market failure due to the presence of free riders in the use of public goods) was placed first in his large economic magnitude (Plihon *et al.*, 2009).

The review of the quantitative model of development, a quality led to the affirmation of the Strategy of Sustainable Development, have been evolved since the late 1970, in which the bio-economy and green economy are the most relevant options (Leonardi, 2010). The same, it's a pillar of topics, confirmed during the World Summit on Sustainable Development on

22-24th June 2012 in Rio de Janeiro. Agricultural production has a crucial role in the success of the bio-economy (Kitchen and Marsden, 2011). The relevance of this approach, to prospects of economic and social development in Europe, are now a new strategic pillar. Just on February 13th the European Commission adopted a strategy to move the European economy towards a greater and more sustainable use of renewable resources (European Commission Communication, 2011).

The Commission's strategy and action plan, "Innovate for sustainable growth: a Bio-economy for Europe", outlines a coherent, inter-sectorial and interdisciplinary approach to the problem. The goal is a more innovative and low emissions, reconciling the demands for sustainable agriculture and fisheries, food security and sustainable use of renewable biological resources for industrial purposes, while ensuring the protection of biodiversity and environment. The plan therefore focuses on three key areas: development of new technologies and processes for the bio-economy, the markets in developing and competitiveness in the fields of bio-economy (Fumagalli, 2007).

The bio-economy will be one of the basic topics for the Horizon 2020 program, and featured research and theoretical insights fascinating especially from 2000 onwards (Jordan *et al.*, 2007). The University of Perugia, with other universities of Central Italy, have created a national project to improve the barley chain and its utilizations and prospective. The main targets of the Research Project are the following:

- to continue, develop and complete the topics covered in the PRIN 2008 project "Barley and beer: product and process innovation";
- to evaluate and classify the raw materials features for cereal-based food, including both solid food (biscuits, pasta and bread) and beverages, in particular beer;
- to study the agricultural conditions for the production of foods with a high functional value through tests on open fields concerning the effect of organic and conventional low input cropping systems, the effect of nitrogen fertilization, and the effect of genotype;
- to arrange a bioeconomic evaluation of the barley chain with a particular focus on proposals for the supply chain. For this aspect the aim of the Project is to boost the role of barley for the initiation of bio-economic development processes at national and European level;

A list of specific objectives for each of the four units is following:

- Operative Unit 1- University of Perugia, Economic and Food Sciences Department (DSEEA)- Enhancement of Bakery products made through the use of high quality and sustainability barley. This Unit is divided in three Work-Packages: study of formulation of bakery products using flour high nutritional and functional value; study of agricultural conditions for the production of foods with a high function value; bioeconomic evaluation of the barley chain with a particular focus on strategies for the supply chain.
- Operative Unit 2 - University of Molise, Department of Food Science, Technology, Environment and Microbiology (UNIMOL) – Development of barley based products with high dietetic and nutritional value.
- Operative Unit 3 - University of Tuscia - Department for Innovation in Biological, Agri-Food and Forestry Systems (UNIVT) – Lager beer production: assessment of a novel enzyme- and membrane-based clarification process and lifecycle greenhouse gas emissions.
- Operative Unit 4 - University of Perugia, Italian Brewing Research Centre (CERB) - Improvement of barley supply chain through the use of organic raw materials process innovations and enhancement of by-products in the production of fermented beverages.

The approach is holistic and interdisciplinary and consequently the researcher group dispose of specific and complementary skills. The skills and/or pilot and pre-industrial plants, available from national and international structures will be used. The Research Unit are four. The authors are member of the Research Unit of Perugia University and their contribution is related to the bioeconomic evaluation of barley chain, with particular emphasis on strategies for the supply chain. The activity is divided in three phases. At the moment the activity is at the level of the kick-off but the expected results are surely attractive. The research units are divided in a Research Body-RB.

Materials and Methods

Concerning the materials and methods the authors describing the activity of the Unit 1 –WP3 that is to them assigned. The research aims to boost the role of barley for the initiation of bio-economic development processes at national and European levels. This is a crop that is well suited to European and throughout the area for its characteristics of hardiness has a comparatively low environmental impact and the production (green or dry) has already shown considerable interest and potential uses ranging from seedling, grass juice, bread, cakes, packaging, bio-mass, till in the art of decorative design. The approach to the Tradi-Ovation (tradition-innovation) can stand for “Territory, Rural Areas, through Development, Innovation, Organization, valorization, user friendly, Technology, ICT sharing, Online Networking”.

Concerning the materials the units research intends to work closely with the technological options for process and product innovation that will emerge from the whole project. It aims to achieve a contribution to the overall results of the project so that those most technologically promising have been given the appropriate assessment to identify the character “of current execution” for a quick transferability and repeatability in the territories in which barley culture is already present and/or adoptable as new areas potentially suitable. The work is identified in three phases:

Phase 1- survey phase, with indexing of technical and economic contents of the various technological options and features of short chain and innovative packaging that will be activated in the project (3 months);

Phase 2- development and evaluation of bio-economic models at farm level and regional commercial and technological options adopted (3 months);

Phase 3- evaluation of the value chain at the supply and territorial chain (6 months).

In details:

Phase 1 - The first phase will take place, on the basis of Access sheets. All the technical and economic base in order to get in quick times to bio assessments (economic, financial, performance, recovery period, energy balance, impacts, sustainability) of the various technological options and features that the project proposes. These data will be important because the type and extent of the same will be derived is the operational models for assessing the next step.

Phase 2 - For each product and merchant choice will be adopted an evaluation at the micro level by focusing on the following aspects: Economic balance; Balance sheet; Cost-benefit analysis and determination of IIR and NPV; Determination of the payback period; Determining, using the technique of funds and flows of energy balance of the process; Evaluation of environmental impacts, employment, export, import; Assessment of

sustainability according to some indexes of the economic, social, environmental, managerial and cultural consistency.

Phase3 - The third phase will pass on the value chain analysis of each process seeing both at micro and at the macro territorial level. It will go to check in particular the ability and speed of liquidity creation process but with attention to the whole supply chain.

Results and Discussion

This paper aim to explain an “exercise” transformed in project to create a model that can be replicated in other contexts. The research try to verify if in the chain of lifecycle of the barley production the capability level to stimulate the concrete best practice of the paradigm of sustainable development strategy, the affirmation of the green economy and the improvement of the imprinting of the agriculture to be a pillar of the new horizon of the bioeconomy.

The aim of the all project is to improve the innovation of products and process along all the lifecycle of barley. In this approach is possible to improve the traditional transformed products, but to introduce the experimentation for the innovative food and not food products. At the moment many countries, companies, cities and citizens recognize that this narrow concept of wealth is not sufficient to explain the extraordinary losses that are occurring, basing their assumptions about levels flourishing of science and more sophisticated economic analysis.

In the global approach the aim of the project is the study of raw materials with high nutritional value from barley chain used in the formulation of food and fermented beverages with improved sensory and functional properties to the satisfaction of consumers.

Furthermore, a specific result is the improvement of the management of food safety in the supply chain. Finally, the by-products obtained along the chain could assure greater environmental sustainability. Another target it's to enhance the barley grain for food use by process and product innovations and by the improvement of dietary and nutritional features, quality and safety of the products obtained (functional products with health claims in accordance with directives and validation of the European Food Safety Authority, EFSA).

The open field project activities intend to evaluate the effect on the environment, food safety and barley technological quality of different cultivation systems of barley for human consumption and therefore cover both the biscuits with high functional value production chain and the fermented beverages. The open field experimental activities aim to evaluate the effect of agronomic variables of environmental sustainability of cultivation, technological quality of grain used for the production of solid foods with a high functional value or fermented beverages and food safety.

Particular attention will be given to the effects of the agricultural phase on the grain's beta-glucans content; hopefully, the content of beta-glucans will be stressed to increase content for the production of biscuit, while it will be stressed to decrease the beta-glucans content when intended for the production of beverages.

The open field tests will provide the project with the grain produced with different farming processes and, above all, accurately plotted; this condition is essential to define correctly the impact of agricultural phase on the subsequent technological steps in the functional foods production.

The carbon foot-printing will be evaluated and measured on samples of: beer from different production scales (from industrial to hand-crafted) and different packaging (bottle, keg,

cans); dried pasta and biscuits on the basis of agronomic inputs. Finally, a specific result we expect by the study of chemical and nutritional features of spent grains that will be carried out, with particular attention to carbohydrates structure, antioxidant fraction, and their effects on performance, health and quality of growing lambs and rabbits meat.

Conclusion

Over the past 25 years, while the world economy has more than doubled, up to 60 percent of the world's ecosystem services covered by the Millennium Ecosystem Assessment are being degraded or used unsustainably. Each year, 13 million hectares of the world's forests - the size of Greece - disappear. According to the UNEP Year Book of 2012, 24 percent of the total area has already suffered declining health and productivity in the quarter century due to unsustainable land use. Some types of conventional and intensive agriculture are causing soil erosion rates 100 times more than the rates at which the nature of the soil can be formed in the first place habitats such as forests, peat lands and grasslands in developing countries alone could be converted into arable land, losses aggravating the ecosystem life and biodiversity (Benner and Lofgren, 2007). Emissions of greenhouse gases continue to rise, pushing the planet towards the 2° C threshold beyond which the scientist some fear could become irreversible environmental changes.

Hence the need to think to root an economy that points to a new vision of wealth that does not mean regression return to the center but above all the man, nature and innovative services and efficient for a democracy more possibly happy (Meadows *et al.*, 1972). Flexible and inclusive economy, which provides a better quality of life for all within the ecological limits of the planet. Below we highlight the key principles on the Green Economy emerged from the work of various institutions and scholars (Carlson, 2007).

The European bioeconomy today has an annual turnover of about €2 trillion and employs more than 22 million people, approximately 9% of the total EU workforce. Its further development will significantly contribute to reducing the dependency on fossil resources and offers opportunities for growth and jobs (Morin, 2006). Building the bioeconomy is one of the great research and innovation challenges within Horizon 2020, the proposed European Union Framework Programme for Research and Innovation for the years 2014 - 2020.

The Bioeconomy Strategy “Innovating for Sustainable Growth: A Bioeconomy for Europe” adopted by the European Commission on 13 February 2012 wants to make this vision a reality for Europe by addressing bioeconomy related challenges in a comprehensive and sustainable manner (Tyndall *et al.*, 2011). Its implementation will build momentum for strengthening European competitiveness, making the bioeconomy a powerhouse for economic growth and job creation in Europe and beyond. The concept of the bioeconomy should be more strongly integrated into European policies. In particularly the Common Agricultural Policy should take the bioeconomy much more into account. This economic concept is composed of numerous new value chains to which farmers, fishermen, and forest and aquaculture managers will add significant value (UN-WECD, 1987).

This requires a higher degree of training for new skills and competences which undoubtedly will lead to higher earnings and the creation of new businesses. New facilities and infrastructure will be required to effectively use the available biomass resources. Investments in establishing and optimizing infrastructures and logistical capabilities are crucial to ensure that all biomass can be mobile. In particularly the target of the WP3, assigned at the authors, is to verify also how are the possible new products alongside all of the barley productive chain in the approach of low input process and reduce-reuse-recycle (3R Regulation).

This not for following the hypothesis of the degrowing economy but for leaving a true impulse for the creation of new high level of wealth by the agriculture in a sustainable way. In this option could be possible that the future generations, that in 2050 will be a 9 billion in our planet, are able to live in a desirable happiness era.

Particularly the WP3 of the Unit-1 of the Research Project has a revolutionary content and wants to be a step to contribute to transform the logic overtake approach of the measurement of the welfare of the Nations with the GNP (Gross National Product) in that more attractive of the GNH (Gross National Happiness) and to achieve a concrete target of the affirmation of the bioeconomy strategy.

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