Advanced Studies in Biology, Vol. 15, 2023, no. 1, 91 - 96
HIKARI Ltd, www.m-hikari.com
https://doi.org/10.12988/asb.2023.91658

From Waste to Resource:

the New Frontier of Agri-Food Waste

Mario Peppe and Davide Peppe

Parinama S.r.l.- Via Piemonte, 1
04022 Fondi (LT) Italy

Abstract

According to the Food and Agriculture Organization of the United Nations (FAO), about one third of all food produced in the world is lost or wasted in the transition between producer and consumer. In Europe, approximately 87.6 million tons of food are lost every year.
The European Union has intervened on more than one occasion to try to put an end to this phenomenon. In particular, it recently issued the waste directive with which it invited Member States and their citizens to reduce the production of food waste between primary production and distribution; reduce food waste in families and encourage food donations; monitor and evaluate the implementation of the respective food waste prevention measures.
The EU has given further impetus to the fight against food loss and waste with the presentation of the European Green New Deal. This also includes the new action plan for the circular economy, with which the European Union has provided for a system for the reuse of discarded agri-food products.
In the Farm to Fork strategy, the EU is committed to reducing food waste per capita at retail and consumer levels by 50% by 2030 and to providing tools for the reuse of agri-food waste, again from an circular economic point of view.
Italy intends to strengthen the strategic role of the agricultural, food and forestry sectors within the complex national economic system and in the European and international context, starting from the territories in which these activities are concentrated. It is therefore necessary that sustainability e inclusiveness become levers of competitiveness at sectoral and territorial level. To do this, it is necessary transform into value, in particular, the opportunities that can derive from the ecological transition, exploiting the bioeconomy, digitization, the circular economy, the reduction of food waste and agroecology.
The objective of this work is to demonstrate how agri-food waste can become a resource and contribute to achieving the objectives set by the European Green New Deal.

Keywords: sustainability, waste, circular economy

1. Introduction

The company Parinama S.r.l. is a company in the fruit and vegetable sector, in relation to the distribution of fruit and vegetables, which in 2022 decided to undertake an experimental action entitled Waste to Circular Economy. This project aims to develop a solution that allows the recovery of the organic fraction produced during the company's production cycle. The aim of the project is to develop a solution in a circular economy perspective for the recovery of organic waste and its use in the agricultural sector.
The uncertainty of this research is the basis of the project and specifically, the possibility of using by-products in the agricultural and agri-food sector, never experienced by the Company to date. It was necessary to develop innovative and experimental protocols. For the implementation of the innovation transmission model in the company - taking into account the implementation difficulties from an organizational point of view, an articulated experimentation was devised carried out with specific programs in the year 2022.The current market is subject to continuous change, due to the constant evolution of science and technology, variables that can significantly change the economic context in which companies from all over the world face. Innovation, which has become the main driver for growth, if applied to introduce innovative methods of production of goods or services, inevitably leads to the improvement and increase of company performance, while also promoting efficient development. More than 2.5 billion tonnes of waste are produced every year in the European Union. The EU is updating waste management legislation to promote the transition to a circular economy, as an alternative to the current linear economic model. In March 2020, the European Commission presented, under the European Green deal in line with the proposal for the new industrial strategy, the action plan for a new circular economy which includes proposals on the design of more sustainable products, waste reduction and on empowering citizens, such as through the 'right to reparation'. Resource-intensive sectors, such as electronics and information and communication technologies, plastics, textiles and constructions, enjoy specific attention.
In February 2021, the European Parliament voted for the new Circular Economy Action Plan, calling for additional measures to achieve a zero-carbon, environmentally sustainable, toxic-free and fully circular economy by 2050. Also included are stricter recycling standards and binding 2030 targets on the use and carbon footprint of materials. An attempt will be made to experiment with technologies which, once they have passed the experimental phase, will present characteristics of reliability and efficiency such as to be able to guarantee their safe use even in difficult conditions. In the field of economics and company management, the perspective of "looking to the future" is undoubtedly one of the fundamental strengths that allow the company itself to continue to live and grow over time. At the basis of this objective it is essential to define the strategy to be adopted, i.e. the set of decisions aimed at building and defending a competitive

advantage in the long term, trying to achieve an effective correspondence between the objectives and the resources of the organization and market opportunities. In particular, with the definition of the strategy, the company decides which services to implement, which market segments to serve, through which methods.
We can speak of a project work that identifies the direction to follow and the methods to be implemented to achieve certain objectives. The latter are defined according to the evolution of the relationship between the company and the environment in which it operates.

2. Materials and methods

From a methodological point of view, the study carried out within the company saw the following analyzes and operational phases both developed within the internal research work and from external consultancy and research activities.

2.1 Innovation process

In accordance with its vision and strategy for innovation and according to the objectives, the Company has established an innovation path that covers the phases relevant to the project. The innovation process for choosing the project within the Company was based on the "innovation funnel" method.
The organization has ensured that the quality and quantity of information is appropriate and useful to meet the required objectives. These must be obtained from reliable sources and be articulated clearly, accurately and completely. A function/activity schedule was also defined, the information flow mapped and the added value of the various activities evaluated. The strategic decision-making process relies on the outcome of information interpretation and value-added analysis. The action proposals are focused on:
• preventive planning in case of changes or modifications in the analyzed environment,
• the exploitation of opportunities,
• risk reduction,
• the implementation of improvements to address limitations and inefficiencies,
• the formulation of new development and innovation ideas,
• cooperation with potential collaborators,
• assessment of the impacts and interactions between different technologies, products and processes,
• monitoring to identify new market opportunities for the organization as well as to provide justifications for abandoning those with low potential.

The project envisaged the use of organic by-products produced by the company's production cycle, through an innovative "Smart Cara" machine which allows the conversion of waste food products into a soil conditioner useful for agriculture.
The machine was installed on the farm and used by the employees for the production of the soil improver for the agricultural sector. The qualifying activity of the study conducted in the interest of the project was, as detailed below, the use

and valorisation of agro-food waste (wet-organic waste) by means of a patented compacting system which allows for the transformation of the aforementioned waste into resources to be re-used in agriculture. Indeed, the main innovative element of the project was expressed in the possibility of converting agri-food by-products into a resource, thus increasing the eco-sustainability of the food life cycle and associated waste and thus representing a innovative solution for sustainable management of wet-organic waste in environmental, social and economic terms. In fact, the sustainable disposal of waste represents, to date, an inevitable challenge for the economy and the environment even more so, in the regional socio-economic horizon, being the Lazio Region, on the national scene, among the major producers of waste . The valorisation of residual waste, finding use in agriculture to support production, in fact promotes a substantial reduction in the problems associated with the management, collection, transport and storage of the same.
A similar technological solution aimed at the recovery and valorisation of waste actively contributes to transforming waste into a resource capable of generating a profit and fully coinciding with zero waste, green and circular economy policies. In fact, by combining an innovative technological platform with a high level of operational refinement, it is possible to obtain low-cost products that support sustainable agricultural production in full agreement with production development, environmental sustainability and technological innovation. The food scraps were treated with the aid of a patented compacting device which, through a thermo-mechanical process, led to the obtainment of a solid dry residue reduced, in volume and weight, from 70% to 90% % due to the different starting organic matrix. Each of the residues under study was used as a quality organo-mineral fertilizer, soil conditioner and compost, adding it to the growth substrate. In order to evaluate the effect of the residues obtained to support growth, in compliance with the environmental cultivation requirements of the species under study, growth trials were implemented in a protected environment. In accordance with the duration of the crop cycle of the species and in accordance with the phenological phases, all the morpho-physiological and agronomic parameters of interest were surveyed. Infection tests were also conducted, in order to evaluate the residues obtained as resistance inducers in a controlled environment, detecting and monitoring the progression of symptoms in planta. The re-use of residues obtained from food waste has therefore made it possible to demonstrate the support to growth and response to biotic stresses induced by the a forementioned residues in Solanum lycopersicum L. as a model crop for regional and national agriculture.

3. Results and Conclusion

The Company has divided the business processes into:
• Primary processes, which have a greater impact on the company's business results, are able to create value recognized by the customer and their operational performance, in terms of costs, quality and times, strongly influence the level of satisfaction of the end customer same; they are processes that directly produce a result for the outside.

• Support processes, necessary for company management but which contribute to the creation of value indirectly, playing a role of suppliers of primary processes, providing them with input and support, favoring their efficiency and effectiveness. They are strictly necessary for the functioning of the primary processes, even if they do not produce an output recognizable by the final customer. They are characterized by internal customers only.
This model envisages nine components, distinguished between infrastructural and "core business", i.e. linked to the characteristic processes of a given company, as previously described. Upstream of the model we find the constraints related to the environment and resources, while downstream the output that the end customer wants to receive is represented, the value he attributes to the result of the value chain.
The results obtained show that the waste residues, at the doses tested, show a potential to support the growth of Solanum lycopersicum L.,. In general, however, a slight improvement of the physiochemical and biometric parameters, and of the response to the infection with Botrytis cinerea is observed, mainly due to the effect of the residual waste. Further tests will be conducted to investigate the agronomic effect of the residues, at the tested doses, in the field conditions, more specifically agronomic.

References

[1] CRAN, 2017, Comprehensive R Archive Network. http://cran.r-project.org

[2] de Jong, S., 1993, SIMPLS: an alternative approach to partial least squares regression, Chemom.

[3] Intell. Lab. Syst. 18, 251e263CE, FMI, OCSE, ONU e Banca mondiale (2009), System of National Accounts, Nazioni Unite, New York.
https://unstats.un.org/unsd/nationalaccount/docs/sna2008.pdf

[4] Cfr. Bergman, E. & Haitani, R., Designing the PalmPilot: A Conversation with Rob Haitani, in E.Bergman, Information Appliances and Beyond, Morgan Kaufmann, 2000.

[5] Cfr. S.Houde, C.Hill, *What do Prototypes Prototype?* in *Handbook of Human - Computer Interaction* (2nd Ed.), M. Helander, T.E. Landauer, P. Prabhu (ed.), Elsevier Science, Amsterdam, 1997. Anche in
http://www.viktoria.se/fal/kurser/winograd-2004/Prototypes.pdf.

[6] ICSU e UNESCO (2002), Science, traditional knowledge and sustainable development, ICSU Series on Science for Sustainable development, no. 4, UNESCO, Parigi. http://unesdoc.UNESCO.org/images/0015/001505/150501eo.pdf

[7] Manuale di Frascati rev 2015.

[8] OCSE (2009), *Handbook on Deriving Capital Measures of Intellectual Property Products*, pubblicazione OCSE Parigi. http://dx.doi.org/10.1787/9789264079205-en

[9] OCSE (2015), *Making Open Science a Reality*, OCSE publishing, Parigi.

[10] OCSE/Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 3rd edition, The Measurement of Scientific and Technological Activities, pubblicazione OCSE, Parigi.
https://doi.org/10.1787/9789264013100-en

[11] Shelf life degli alimenti, Meccanismi Valutazione Previsione (2008) Sebastiano Poretta; Chiriotti editori.

[12] UNESCO (1978), *Recommendation concerning the International Standardization of Statistics on Science and Technology*, UNESCO, Parigi. *http://portal.UNESCO.org/en/ev.php-URl_ID=13135&URl_DO=DO_TOPIC&URl_SECTION=201.html*

[13] UNESCO (1984), *Guide to Statistics on Science and Technology*, division of Science and Technology – office of Statistics, ST/84/WS/19, UNESCO, Parigi. *www.uis.UNESCO.org/library/Documents/STSManual84_en.pdf*

[14] UNESCO-UIS (2014), *ISCED Fields of Education and Training 2013 (ISCED-F 2013)*, UNESCO, Parigi.
www.uis.UNESCO.org/Education/Documents/isced- elds-of-education-training-2013.pdf

Received: April 15, 2023; Published: May 5, 2023