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AGRICULTURAL ENGINEERING DEPARTMENT
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NATIONAL INSTITUTE FOR AGRICULTURAL MACHINERY,
INMA BUCHAREST
CROATIAN AGRICULTURAL ENGINEERING SOCIETY



PROCEEDINGS OF THE 49th INTERNATIONAL SYMPOSIUM

ACTUAL TASKS ON AGRICULTURAL ENGINEERING

OPATIJA, CROATIA, FEBRUARY 28th - MARCH 2nd 2023



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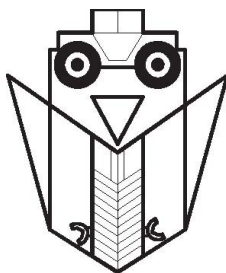
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PREFACE

Dear colleagues,
Dear readers,

I am very pleased to introduce the Proceedings of the 49th edition of Actual Tasks on Agricultural Engineering, with its unique and long tradition. Due to the worldwide Corona pandemic and last online symposium, this year's symposium is gathering us again in person in our beautiful Opatija from February 28 to March 2, 2023.

For the quality of the content of the Proceedings, the authors of 53 papers from 10 countries are meritorious, including: Austria 1, Croatia 10, Czech Republic 1, Germany 1, Hungary 1, Italy 3, Lithuania 5, Romania 20, Serbia 5, and Slovenia 6.

International professional associations as co-organizers of this year's Symposium are Croatian Soil Tillage Research Organization (CROSTRO (HDPOT)) International Commission of Agricultural and Biosystems Engineering (CIGR), and European Network for Advanced Engineering in Agriculture and Environment (EurAgEng).

The scientific importance of the ATAE symposium is assessed by the fact that papers from the Proceedings have been indexed since 1997 into databases: Clarivate Analytics: Web of Science Core Collection - Conference Proceedings Citation Index and CAB International - Agricultural Engineering Abstracts. Access to the web edition of the Proceedings is free of charge at the website <https://atae.agr.hr/proceedings.htm>.

I would like to thank all authors, reviewers and especially the members of the Organizing and Scientific Committees for their efforts in making this conference possible.

It is my pleasant duty to acknowledge the financial support from the POLJO-NOVA d.o.o.

I hope that at the next ATAE symposium in 2025, we will gather again in person and make a toast with a glass of wine for our 50th anniversary of ATAE symposium.

Zagreb, March 2023

Mateja Grubor, editor

CONTENTS

Anamarija BANAJ, Đuro BANAJ, Bojan STIPEŠEVIĆ, Dominik MIKOLČEVIĆ	11
Application of the newly designed seed eliminator for the vacuum sowing machine	
Giovanni CARABIN, Lorenzo BECCE, Andreas MANDLER, Fabrizio MAZZETTO	23
Integrated determination of tractor centre of gravity and lateral rollover angle	
Fredrik REGLER, Max KRUEGER, Heinz BERNHARDT	33
Using a digital maintenance assistant to independently maintain the PTO shaft	
Zita KRIAUCIŪNIENĖ, Lina SALDUKAITĖ, Sidona BURAGIENĖ, Aida ADAMAVIČIENĖ, Andrii ZABRODSKYI, Egidijus ŠARAUSKIS	41
Effect of strip tillage and direct seeding on winter wheat yield, diesel consumption and environment	
Nicolae LONTIS, Gabriel MALAIMARE, Dumitru TUCU	51
Stability analysis of a trailed farm sprayer aggregate by simulation model	
Lorenzo BECCE, Giovanni CARABIN, Fabrizio MAZZETTO	59
Evaluation of air flow influence on sprayer nozzle performance by shadowgraphy	
Jurica PLUKAVEC, Dubravko FILIPOVIĆ, Igor ĐUKIĆ, Krešimir ČOPEC, Igor KOVAČEV	69
Analysis and comparison of the noise of hand-held and back-pack type grass trimmers	
George IPATE, Cristian CIOBANU, Gheorghe VOICU, Filip ILIE, Madalina STEFAN, Paula TUDOR, Iuliana GAGEANU, Petru CARDEI, Dan CUJBESCU	79
Estimation of the parameters of the portland cement clinker grinding equation in the ball mill	
Kęstutis ROMANECKAS, Jovita BALANDAITĖ, Austėja ŠVEREIKAITĖ, Algirdas JASINSKAS, Ugnius GINELEVIČIUS, Deividas PAKALNIS	91
Impact of maize, hemp and faba bean intercropping on the soil properties	
Egidijus ŠARAUSKIS, Marius KAZLAUSKAS, Indrė BRUČIENĖ, Kęstutis ROMANECKAS, Vilma NAUJOKIENĖ, Sidona BURAGIENĖ, Dainius STEPONAVIČIUS, Abdul Mounem MOUAZEN	99
Winter wheat productivity and profitability at variable seeding rate and depth	

Jaroslav ČEPL, Pavel KASAL, Andrea SVOBODOVA.....	109
Influence of potato weed management on yield and quality of potato	
Zorica SRĐEVIĆ, Bojan SRĐEVIĆ, Senka ŽDERO, Milica ILIĆ, Laslo GALAMBOŠ, Tanja BOŠNJAK.....	119
Reducing drought risks in wetlands: analysis of causality relations between regulating measures using DEMATEL	
Bojan SRĐJEVIC, Zorica SRĐJEVIC	129
Multicriteria and social choice methods in agriculture, water management and forestry	
Vlad MĀRĀZAN, Alexandru ȚUCU, Hortensia RĂDULESCU, Rareș HĂLBAC-COTOARĂ-ZAMFIR	141
Squall phenomena in the Banat-Crișana plain of Romania and their impact on agriculture in a changing climate	
Vlad MĀRĀZAN, Codruța CHIȘ, Antoanela COZMA, Rareș HĂLBAC-COTOARĂ-ZAMFIR	151
Quantitative analysis of precipitation and the liaison with agriculture in western Romania	
Antoanela COZMA, Ariana VELCIOV, Iasmina Madalina ANGHEL, Bogdan COZMA, Vlad MĀRĀZAN.....	161
Development of chicken eggshells powder as agricultural fertilizer and soil conditioner	
Vladimir PEJAKOVIĆ, Andreas GRONAUER	173
Agricultural robots for the field operations	
Larisa Georgiana MATEI, Andrei-Alin VOINESCU, Alexandru SUCIU, Narcis GHITA, Marius FATU, Gabriel GARBAN, Titus SLAVICI.....	183
New system of manufacturing molds using Industry 4.0 for pellets and briquettes	
Ivan BRANDIĆ, Neven VOĆA, Josip LETO, Nikola BILANDŽIJA.....	193
Application of machine learning models in miscanthus x giganteus yield estimation	
Ante GALIĆ, Stjepan PLIESTIĆ	203
Technological innovations and new approaches in agricultural production	
Dumitru TUCU, Gabriel MALAIMARE, Vasile LEȘ, Nicolae LONTIS.....	213
Performance evaluation of photovoltaic system in conditions of independent farm	
Ariana-Bianca VELCIOV, Iasmina Madalina ANGHEL, Maria RADA, Vlad MĀRĀZAN, Antoanela COZMA.....	223
Valorification of the nettle plants from spontaneous flora as nettle powder – mineralizing potential in animal feed	
Vjekoslav TADIĆ, Davor PETROVIĆ, Petra MIŠKULIN, Goran PAČAREK, Ivan VIDAKOVIĆ, Željko BARAČ	233
Protection systems against late spring frosts in permanent crops	

Cătălina TUDORA, Cristina STROE, Floarea BURNICHI, Adriana MUSCALU, Valentin Nicolae VLĂDUȚ	245
Interactive, modulated system for the protection of vegetable crops	
Peter BERK, Andreja URBANEK KRAJNC, Mario LEŠNIK, Andrej PAUŠIČ, Denis STAJNKO, Peter VINDIŠ, Damijan KELC, Miran LAKOTA, Aleš BELŠAK, Tomaž POJE, Viktor JEJČIČ, Mojca MAVRIČ ŠTRUKELJ, Simona HAUPTMAN, Marko BREZNIK, Marko HOČEVAR, Matej SEČNIK	255
Automated spray mixture application process in the "Rebula" variety vineyard	
Damijan KELC, Denis STAJNKO, Miran LAKOTA, Peter VINDIŠ, Jurij RAKUN, Erik RIHTER, Peter BERK	267
Efficiency of alternative weed control with mechanical systems in the vineyard	
Erik RIHTER, Damijan KELC, Denis STAJNKO, Rajko BERNIK, Peter VINDIŠ, Vasilije FEMIĆ, Peter LEPEJ, Miran LAKOTA, Jurij RAKUN	275
An approach to save on plant protection products in cherry orchards	
Denis STAJNKO, Peter BERK, Damijan KELC, Miran LAKOTA, Jurij RAKUN	285
The effect of different led lighting on the growth of Eruca sativa (Mill.)	
Emilia DOBRIN, Nicușor-Alin SÎRBU, Gabriela-Victoria MNERIE	293
Research on the ultrasonic extraction of volatile sea buckthorn oils	
Matija BALALA, Igor KOVAČEV, Lepomir ČOGA, Sanja SLUNJSKI, Fabio CELLA, Željko JUKIĆ	303
Influence of nitrogen fertilization on the rupture force of maize kernels	
Augustina PRUTEANU, Mihaela NITU, Cristian SORICA	315
Research on the analysis of fruit and vegetable juice yield	
Mateja GRUBOR, Nikola BILANDŽIJA, Ana MATIN, Vanja JURIŠIĆ, Darija BILANDŽIJA, Tajana KRIČKA	325
The influence of precipitation on the energy properties of wheat biomass	
Božidar MATIN, Tajana KRIČKA, Alen ĐUROVIĆ, Mateja GRUBOR, Ana MATIN, Alan ANTONOVIĆ	331
Lignocellulosic composition and heating value of forest and agricultural biomass: A review	
Gvidas GRAMAUSKAS, Algirdas JASINSKAS, Ramūnas MIELDAŽYS	343
Evaluation of the processing and utilization of invasive herbaceous plants for the production of biofuel pellets	
Aleksandar NESTEROVIC, Djordje DJATKOV, Miodrag VISKOVIC, Milan MARTINOV	353
Sustainable crop residues potential for the production of lignocellulosic bioethanol in Serbia	

Zorana KOVAČEVIĆ, Anja ZERGOLLERN, Ksenija VIŠIĆ.....	363
Analysis of fibres extracted from corn husk	
Algirdas JASINSKAS, Rita PETLICKAITĖ, Edvardas VAICIUKEVIČIUS, Kęstutis ROMANECKAS	371
Processing and utilization of large-stemmed herbaceous plants for energy conversion	
Anamarija GUDELJ-VELAGA, Nikola BILANDŽIJA, Mateja GRUBOR, Ivana TOMIĆ, Zorana KOVAČEVIĆ, Tajana KRIČKA.....	381
Enzymes for lignocellulosic biomass degradation as an approach to green technology	
Viktor JEJČIČ, Tomaž POJE, Fouad AL-MANSOUR.....	389
Energy consumption for production rapeseed oil on family farms	
Cristian BEJERITA, Adriana-Carmen CAZAN, Nicoleta CONDESCU-ULARU, Liliana DORNEANU, Cristian COSARIU, Simina MARIS.....	399
Statistical methods and artificial neural networks in the optimization of heating pellets and briquettes	
Adriana-Carmen CAZAN, Cristian BEJERITA, Alexandra SUTA, Andrei-Alin VOINESCU, Larisa Georgiana MATEI, Simina MARIS, Daniel BOTEZ, Titus SLAVICI.....	409
Contemporary manufacturing techniques used in agricultural engineering	
László MAGÓ	419
Farmers cooperation in procurement and distribution of goods using online-marketplace	
Bogdan Raul MIRCEA, Rudolf MIRESCU, Dumitru TUCU	427
The use of gauge R&R method in manufacturing of agricultural machinery	
Djordje DJATKOV, Aleksandar NESTEROVIC, Miodrag VISKOVIC, Milan MARTINOV	437
Small biogas plants in Serbia- prerequisites for profitability	
Miodrag VISKOVIC, Djordje DJATKOV, Aleksandar NESTEROVIC, Milan MARTINOV	447
Possibilities for financing of new biogas plants in Serbia	
Rudolf MIRESCU, Alexandru TUCU, George Catalin CRISAN, Emil KAZOMIR, Dumitru TUCU.....	457
Causes and consequences of work events in the food industry enterprises from Timis county	
Rudolf MIRESCU, Alexandru TUCU, Bogdan Raul MIRCEA, Dumitru TUCU.....	467
Occupational risk management by systems ergonomics in manufacturing of ice cream sticks	

Alexandru TUCU, Anca-Alexandra PURCĂREA, George Catalin CRISAN, Vlad MĂRĂZAN, Dumitru TUCU	473
Perception of control in motivating compliance with ohs requirements in rural SMEs	
Emil Călin KAZOMIR, Dumitru ȚUCU.....	481
Safety improvement of integrated biomass combustion systems by simulation	
Ramona DZITAC, Ileana MOGOȘANU, Simina-Ștefania MARIȘ, Gabriela-Victoria MNERIE, Mihaela POPUȚA.....	489
Some particularities of telework activities practiced in agriculture	
Tomaž POJE.....	499
Analysis of registered tractors in Slovenia in the year 2021	
Gheorghe VOICU, Mircea-Bucur LAZEA, Paula TUDOR, Gabriel-Alexandru CONSTANTIN, Bianca-Stefania ZABAVA.....	507
Plastic waste behaviour during compaction in horizontal press with continuous feeding	
Pietro PICUNO, Roberto PUGLISI, George SPYROU, Evangelos DIMITRIOU, George PAPADAKIS, Maria SMYRNIOTAKI, Violetta OUTSOGIANNNOPOULOU, Christine STAVROPOULOU, Tina PAPASIDERI, Mercè BALCELLS, Lluís MARTIN CLOSAS, Luca BRONDELLI DI BRONDELLO, Cristina MATA, Anna FARRUS, Fátima BAPTISTA, Vasco FITAS DA CRUZ, Maria Elena MUR CACUHO, Teresa BATISTA, Firmino CORDEIRO, Zoe GODOSI, Delphine MARGOUT-JANTAC	517
Training farmers on circular economy implementation: The TANGO-circular project	
Commercial pages.....	527



TRAINING FARMERS ON CIRCULAR ECONOMY IMPLEMENTATION: THE TANGO-CIRCULAR PROJECT

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ABSTRACT

The volume of waste produced by agricultural activities is constantly rising, due to the continuous increase of crop and livestock production, aimed to cover the nutritional needs of the accreting population of the planet. This enormous mass of wastes has a significant environmental impact. A very promising way to reduce the environmental footprint of agriculture, passes through the valorization of agricultural co-products, by-products, residues and waste, as well as other materials - such as plastics - widely used for crop cultivation and animal production, after the end of their working life. In order to involve farmers to play an active role on this issue, contributing to transform what they currently consider as a "waste" into a new resource, under the perspective of a circular economy and for a more sustainable agriculture, the Project

TANGO-Circular has been financed by the EU Erasmus+ Programme. Aim of this Project is to contribute to the development of regional ecosystems, directly providing valuable economical inputs by integrating, through a Quadruple-Helix approach, innovative solutions, with a work-based learning. Core of the Project is the design, implementation and validation of some “Rural Labs”, in which farmers and other relevant stakeholders will be trained through a “knowledge-driven” approach. There, new ways of training will be explored, for the sake of a larger audience of trained people, working in the Project Countries as well as in the rest of Europe.

Keywords: Sustainable agriculture, waste valorization, Rural Labs, new entrepreneurship, Quadruple-Helix approach.

INTRODUCTION

It is well known that climate change is affected and affects to a large extent agriculture and animal husbandry. According to the current climate state, the need to transition to a more sustainable situation, mainly regarding the agricultural and livestock sector, is now almost inevitable. Also, the energy crisis that Europe is currently facing, reinforces the exigence to find new ways of producing energy. As agriculture and livestock activities produce a lot of unexploited remains, methods for utilizing these residues, industrial by-products and co-products, appear to be the key to this problem. The valorization of agro-livestock organic and non-organic wastes is a technique applied in rural areas for the production of energy and for manufacturing new value-added products such as soil improvers, animal feed, biofuels etc. (Yaashikaa et.al., 2022). Below, a graphical display of the fate of fruits and wastes is presented in figure 1.

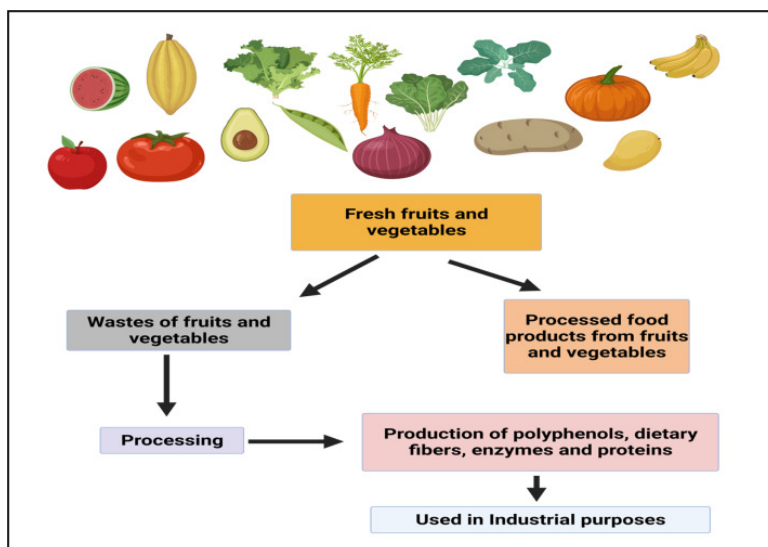


Figure 1 The fate of processed fruits and vegetables. (Source: Dey et.al., 2021, Valorization of agro-waste into value added products for sustainable development.)

Field and Industrial by-products of agricultural crops or animal by-products as well as plastics used in these sectors, can be classified into organic and non-organic wastes. The most common wastes are presented on Table 1.

Table 1 Classification Of Agricultural and Livestock wastes

Organic waste				Inorganic waste
Agricultural		Livestock		Agro-livestock by-products
Field plant by-products	Industrial Plant by-products	In farm animal by-products	Industrial animal by-products	Agro-livestock plastics
Herbaceous Crops straw, leaves, stems, husks, cane, flowers, scraps, no seed plant parts	Rice/sunflower etc. husks	Solid & liquid manure	Animal droppings	Plant Protect Product packages
	Peels	Animal bedding	Fat	Irrigation tubes
	Seeds	Damaged feeders	Skin	Crop protection plastics
Vegetable Crops leaves, stems, discarded fruits, bulbs, tubers, roots	Nut shells	Other remains	Hoofs	Fertilizer bags
	Pressed grape drags		Feathers	Plastic animal feed bags
	Pomaces		Hairs	Vineyard Nets
Orchard Crops tree prunings, leaves, discarded fruits or flowers	Press cake	Other remains	Eggshells	Mulching films
	Bagasse		Other remains	Landscape fabric
	Other remains			Other remains

Concerning the environmental, financial and energy issues that have arisen, appropriate education of the farmers appears to be necessary. Producers as well as society must be informed about the need to transition to a new sustainable model following the rules of the circular economy.

In the context of this necessity, Erasmus⁺ and EU funded the TANGO-Circular Project. The core of the project is to clarify to the producers and the relevant stakeholders, that utilization of the unusable remains of the crops or animal farms may enhance their financial input and simultaneously contribute to reducing the ecological footprint of their agro-livestock activities (Manniello et al., 2021).

Farmers constitute the main gear of food and economic chain, so their role on the adoption and implementation on new sustainable methods in the framework of circular economy is important (Picuno, 2016). Unfortunately, most usual methods farmers follow regarding agro-livestock wastes management, are burning or burial depending on the type of waste. This

strategy has been followed by farmers over the years and is still followed on a smaller scale, due to lack of legislation framework and to insufficient information about the impact such activities can cause. As farmer's and other stakeholder's activities affect in a great extent many sectors such as environmental, economic, food etc., they deserve a proper information about current environmental situation and a specific training in agricultural circular economy (Baptista et al., 2021).

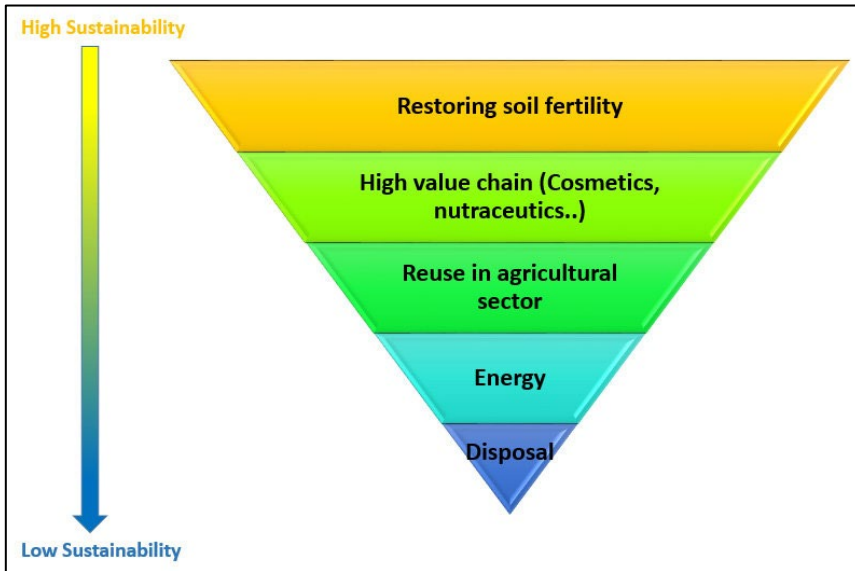


Figure 2 Agricultural by-product, co-product and waste management hierarchy (Statuto et al., 2019).

TANGO-Circular Project sets as a goal the collaboration of five (5) European Countries (France, Greece, Italy, Portugal and Spain) from Mediterranean Europe, for the development of an educational program that includes state-of-art technologies regarding collection, transportation, valorization of agricultural wastes, significant information about legislative, economic, social and technical sector, as well as many more topics, so the EU producers can acquire elementary and profound knowledge. The implementation of the project objectives is carried out according to a Quadruple-Helix approach, involving Public Authorities (Regional/Local Ministries/Agencies, etc.), RTD performers/ VET providers, Private stakeholders (Farmers Associations, Collectors/Recycling Firms/Associations, etc.) and the Civil Society (NGO, No-profit Associations, etc.). The pivotal venture conducted by the Project, is the modelling and implementation of some "Rural Labs" in which, under the coordination of the Partner Universities, expert in agricultural waste management, the farmers and other relevant stakeholders will be trained. The main view of these Rural Labs is the execution of new, interactive training models, combining an on-site training with the implementation of new ICT tools, to be produced for the sake of a larger audience of trained people, working in the Project Countries as well as in the rest of Europe.

OBJECTIVES

Currently in Europe, there is no such approach to the training of farmers, who very often find themselves managing waste plastic streams and agricultural residues without the right technical skills, without knowing the good practices that could lead to a proper exploitation of the streams themselves. The TANGO-*Circular* project is in line with the EU Common Agricultural Policy and needs a European approach in order to contribute to the achievement of the requirements a) to ensure the continued "greening" of this policy and b) to decrease any adverse effects of agriculture on the environment. Indeed, it aims at bringing together major stakeholders of the agricultural sector, including agricultural workers (farmers). The idea behind this approach is to ease the transfer of technological advancements of the agricultural sector from the laboratories directly to the people involved in the process. By creating a European consortium, the project aims at facilitating the transfer of advancements from every European country research institute to each farmer within the EU.

Furthermore, the direct communication between agricultural workers is a major advantage of the virtual environment that this project wishes to implement. The new strategy intends to take on the burden of managing waste from all major sectors; while recycling targets exist for some of them, for others (e.g., construction and agriculture) they are currently not defined, and separate legislation exists for the different waste typologies. Among others, it is interesting to focus on plastics used in the agricultural sector (Briassoulis et al., 2013; Picuno, 2014). Furthermore, the EU analysis specifies that a large proportion of this waste could be burnt or dumped in fields, as audits of collection systems have shown that none of them collects more than 70% of the agro-plastic (Briassoulis et al., 2010; Picuno C. et al., 2020). The objectives for the future will be to improve the collection and recycling rates of this waste and, where possible, to try to replace it in alternative ways.

For this to have an actual value, European cooperation is needed, in order to include agricultural workers from across Europe. In this way, they will be able to exchange opinions about by-products and waste, on the possible valorization process, on whether or not the process of valorizing a certain type of waste or agricultural residue is worthwhile, and other issues with colleagues from around Europe. Nowadays, agricultural workers have to be more creative in order to compete in a globally demanding market. Sustainable agriculture and use of environmental technologies are key elements to a successful agricultural business of tomorrow. Exchange of experiences about these issues with other agricultural workers across Europe that may have experimented in the past is significant for the success. The cooperation between various European partners will allow for the transparency, comparability, transferability and recognition of qualifications, between the participating countries and will lead to a joint training program that makes the various stakeholders aware of the good practices of exploitation of flows in the perspective of a circular economy. The project results will be in this way exploitable practically in every European country. Initially, stakeholders from the participating countries will be invited and afterwards the results will be disseminated to all major European associations and research institutes of agriculture.

The specific objectives that this hands-on training will try to achieve are numbered below:

- Training 1000 farmers (*i.e.*, 250 farmers in each one of the four Rural Labs) and a total of 200 stakeholders (*i.e.*, 50 stakeholders in each one of the four Rural Labs) in EU along the project

- Stimulate new entrepreneurship in the field of collecting, transporting and re-using biomass coming from agricultural co-products, by-products residues and waste, as well as in the field of agricultural plastic collection, transportation and mechanical recycling.
- Boosting innovation through developing and implementing new multidisciplinary approaches to teaching and learning.
- Developing a sense of initiative and entrepreneurial mind-sets, competences and skills, opening up new learning opportunities for farmers and stakeholders playing a key-role in waste management chain.
- Stimulating the flow and exchange of knowledge between higher education, VET, enterprises and research, in the framework of a Quadruple-Helix approach.
- Identifying resilience-related, market needs and emerging professions, including via the cooperation of HEIs and VET providers with national, regional and local authorities, as well as the private sector, to contribute to designing and implementing Smart Sustainable Specialization Strategies (S4) in their regions.
- Develop and implement new multidisciplinary curricula for the valorization of agricultural wastes in the framework of a Circular Economy, by implementing new digital skills.
- Test new learning tools for teaching and learning, learner-centred and customized on the requests coming from the people to be trained (*e.g.*, video tutorials, “didactic pills”, *etc.*). Along the whole Projects, at least 20 video-tutorials and 40 didactic pills, translated in all the languages of the participating Countries, will be produced;
- Development of a specific model of rural living labs – 4 Rural Labs - in the participating countries and to validate its replicability at EU level as an innovative organizational model to develop Sustainable Circular Business models in rural communities.
- Compilation, selection, and optimal configurations of state-of-the-art technologies.
- Political, Economic, Social and Technical (PEST) analysis.
- Training Needs Validation and Curriculum Design.
- Identification of new skills for future professionals.
- Identify alternative business models for waste collection and treatment based on farmer needs, as input to public policies.

METHODOLOGY

The TANGO-*Circular* Project follows a well-defined methodology for the preparation, design and delivery of the training program. The Workplan (figure 3) has been conceived to be lean and structured to accommodate as many users as possible and can be schematically described as follows:

- Analysis of the skills acquired by agricultural workers based on the latest research in the scientific bibliography, to provide a good scientific basis.
- Providing a training program that is comprehensive and detailed in all its parts.
- Strengthening of the users' curricula, and provide strong capacity to the user being trained.
- Development of smart skills so that they can be used by the final operator.

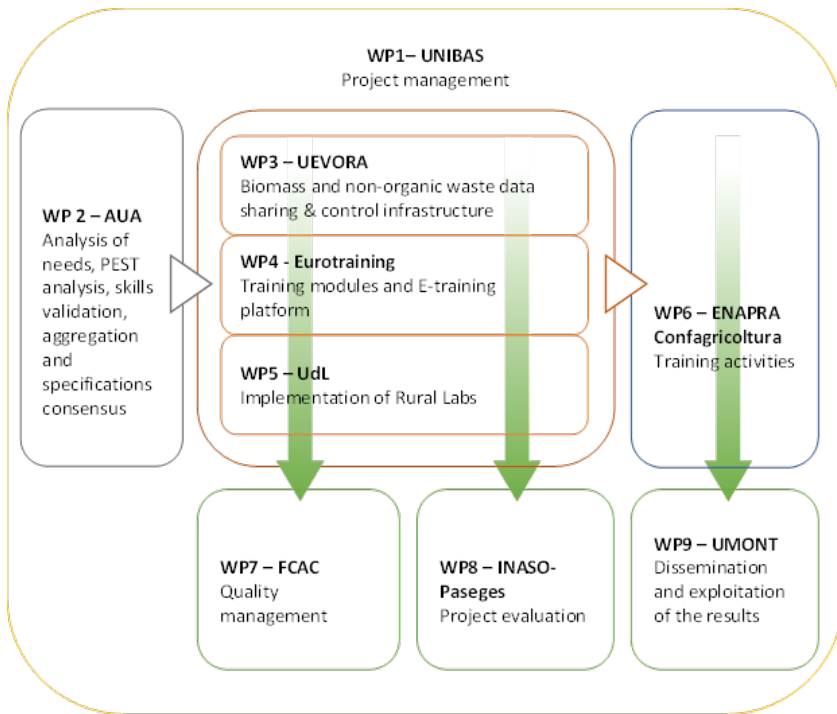


Figure 3 Overall Workplan structure.

TRAINING PROGRAM

The TANGO-*Circular* training program will be organized into the following nine (9) training modules:

1. Classification of agricultural biomass.
2. Valorization of agricultural biomass.
3. Valorization of agro-food co-products, byproducts and organic residuals.
4. Classification of agricultural plastic waste.
5. Collection, transportation and recycling of Agricultural Plastic Waste.
6. De-contamination and valorization of Agricultural Plastic Packaging Waste.
7. Waste/Biomass legislation.
8. Environmental, territorial and economic planning, associated with each form of valorization.
9. Advantages and disadvantages associated with each possible form of valorization.

Each module will have a duration of eight hours of blended learning, organized into:

- 2 hours of face-to-face lessons
- 2 hours of demonstration at the Rural Lab
- 2 practical training at the Rural Lab
- 2 hours of online learning.

Each module will enable to be credited for 0.5 ECTS/ECVET points.

CONCLUSIONS

Trainees in the field of agriculture and youth farmers, as well as relevant stakeholders and enterprises involved in the specific sector's activities, will benefit from the short, medium and long-term effects of the Project. Taking into consideration that in the EU Mediterranean Countries the agriculture sector has a significant representation in the labor market, it is recognizable that the acquisition of digital and green skills for the youth, who intend to work in that field, are fundamental prerequisites. Indeed, the implementation of the project's activities shapes great potential to offer tailor-made opportunities in youth trainees - farmers and employees in the agricultural sector - to obtain competencies and skills according to the existing and emerging needs in that field. The coherent set of activities included in the Project will therefore have a significant socio-economic impact, since it will capitalize the potential of young people to tackle the challenges and initiatives in the agriculture sector. It is important to refer to the impact of the project in the labor market and the long-term effects. Specifically, enterprises and stakeholders in the field would have the opportunity to upgrade their efforts to minimize the agricultural waste. The harmonization with the rules of circular economy stresses the crucial importance of implementing new multidisciplinary approaches to teaching and learning, fostering education programs and activities within agricultural enterprises.

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REFERENCES

- Baptista F., Lourenço P., Fitas da Cruz V., Silva L.L., Silva J.R., Correia M., Picuno P., Dimitriou E., Papadakis G. (2021). Which are the best practices for MSc programmes in sustainable agriculture? *Journal of Cleaner Production*, 303, 126914, pp. 1-10.
- Briassoulis D., Hiskakis M., Scarascia Mugnozza G., Picuno P., Delgado C., Dejean C. (2010). Labelling Scheme for Agricultural Plastic Wastes in Europe. *Quality Assurance and Safety of Crops & Foods*, (2), 93-104.
- Briassoulis, D., Babou, E., Hiskakis, M., Scarascia-Mugnozza G., Picuno P., Guarde, D., Dejean, C. (2013). Review, mapping and analysis of the agricultural plastic waste generation and consolidation in Europe. *Waste Management and Research*, 31 (12): 1262-1278.
- Dey, T., Bhattacharjee, T., Nag, P., Ritika, Ghati, A., Kuila, A. (2021) Valorization of agro-waste into value added products for sustainable development, *Bioresource Technology Reports*, 16, 100834, ISSN 2589-014X.
- Manniello C., Statuto D., Di Pasquale A., Picuno P. (2021). Planning the Integrated Management of Organic Waste Flows and Agricultural Residues for a Circular Economy. *Proceedings of the European Conference on Agricultural Engineering - AgEng2021*, 4 – 8 July 2021, Evora (Portugal), Vol. 1, pp. 137-145.
- Picuno P. (2014). Innovative Material and Improved Technical Design for a Sustainable Exploitation of Agricultural Plastic Film, *Polymer - Plastics Technology and Engineering*, 53:10, 1000-1011.
- Picuno P. (2016). Use of traditional material in farm buildings for a sustainable rural environment. *International Journal of Sustainable Built Environment*. 5 (2): 451-460.

- Picuno C., Alassali A., Sundermann M., Godosi Z., Picuno P. & Kuchta K. (2020). Decontamination and recycling of agrochemical plastic packaging waste. *Journal of Hazardous Materials*, Vol. 381, 5 January 2020, Article number 120965.
- Statuto D., Frederiksen P. & Picuno P. (2019). Valorization of Agricultural by-products within the "Energyscapes": Renewable energy as driving force in modeling rural landscape. *Natural Resources Research*, Vol. 28, No. SI, August 2019, S111- S124. <https://doi.org/10.1007/s11053-018-9408-1>.
- Yaashikaa P.R., Senthil Kumar P., Varjani S. (2022). Valorization of agro-industrial wastes for biorefinery process and circular bioeconomy: A critical review, *Bioresource Technology*, 343, 126126, ISSN 0960-8524.

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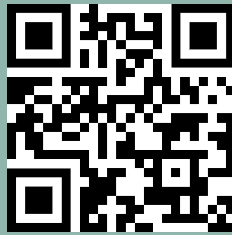


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