ORGANIC, FARMING, ECOMARKET AND THEIR CAPITALIZATION THROUGH THE ENTREPRENEURIAL INITIATIVE

Course for Trainers

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Course for trainers: Organic farming, eco-market and their capitalization through the entrepreneurial initiative
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Fourth section: Business and economic development

Fifth section: Innovation

Presentation

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The AGROECOINN project aims to implement within the curricula of the partner universities a content that generates interdisciplinary competences, bringing together the expertise of specialists in agrifood economy, environmental economics, biologists and entrepreneurs, and exchanging good practices and the knowledge of the specialists among partners, represented by universities and research institutes. The implementation of the AGROECOINN project, having as its main objective to improve curricula to meet student learning needs in line with labour market requirements, in economic, biological and agricultural fields will help to fulfill the specific objective of the Erasmus+ Programme in the field of education - improve the level of key competences and skills, with particular regard to their relevance for the labour market and their contribution to a cohesive society. The project is mainly addressed to the specific priority in the field of higher education - tackling skills gaps and mismatches; the learning-outcomes and curricula must meet the needs of students, whilst also being relevant to the labour market and societal needs, including through better use of open, online, mixed work-based and multidisciplinary learning.

The AGROECOINN project will generate two types of results - some tangible, represented by the intellectual products made in the project and some intangible, represented by the new skills and abilities acquired by both the trainers, teachers and by the students form key target group. The first intellectual output O1 -"Organic farming, eco-market and their capitalization through the entrepreneurial initiative" is a data collection of the situation of organic farming, the organic products market related to the possibility of integration of these aspects in educational curricula in the involved partners. Information from different fields of knowledge - organic farming, agri-food, biochemistry, eco-biology, agro-marketing, consumer behavior, and innovative entrepreneurship are integrated, thus achieving an interdisciplinary review on a subject that is part of the major European strategies.

This intellectual product can be transferred to EU universities interested in harmonizing the curriculum in accordance with the protocol to be proposed by this project.

The partners involved in the project have developed solid scientific and teaching backgrounds in natural capital management, principles of systemic ecology and sustainable development, food biochemistry, agri-food, and environmental economics. The target group will be represented by professors, researchers and students (undergraduate students, master and doctoral students) from partner institutions.

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Introduction

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There is no doubt that food could be freely added to the list of natural elements necessary for the survival of human population. Although at current level of civilization development produced quantities of food and providing of global food security have been still very important, during the previous several decades it comes to slight shifting of the overall focus to the agro-food products primarily characterised by good quality, even more produced in harmony with nature.

Therefore, complying to new market requirements, one group of producers involved in sector of agriculture has been started to frankly support the concept of full sustainability of food production (economic, social and environmental), by introduction of techniques that are enabling the access to relatively high and stable yields of safe and health crop and animal food-products without jeopardizing the natural ambient to persons who live and work in it.

So, everything could start with presentation of one among many globally used definitions that determines the term of organic agriculture. Organic agriculture could be considered as ecological production management system that boost up and advance available biodiversity, biological cycles, and soil biological activity. It is driven by the maximal leaning on internal farm's inputs and management methods which restore, maintain, or increase ecological balance, i.e. that harmonizes the wellbeing and productivity of interdependent communities of soil life, plants, animals, and human population.

What is the key result of described agricultural practice, before all organic food products, i.e. products that do not benefit just to direct producers and consumers, but also to entire society and available life-support systems of the planet Earth. Why? Simply because they improve both the human and environment health, primarily as in their production there is no use of synthetic fertilizers, pesticides, growth regulators and hormones, biocides, antibiotics, bio-engineered genes, etc.

Is there future for organic production? Surely there is respectable level of its prosperity and long-term sustainability. Nowadays, in current extremely dynamic society, entrepreneurial chances for success in dealing with organic agriculture are really high. This could be based on the facts that generally organic production shows continuously upward trend in all aspects, according to expansion of used production capacities, growth in reached yields or produced volume of agro-food products, and before all towards to significant increase in market value of this segment of agricultural production. On the other side, mentioned is enabled by ascending demand for almost each kind of organic food products.

With such a defined background, although there are many published or e-sources focused to the certain segment of organic agriculture always exists the need for at least refreshed knowledge offered by some new publication. Main expectation from such this publication is to offer proper knowledge transfer to all current and future entrepreneurs willing to stay or to enrol the sector of organic production, in order to successfully implement and manage their businesses with organic food-products.

Publication "Course for trainers: Organic farming, eco-market and their capitalization through the entrepreneurial initiative" is one of the results that derives from the Erasmus + project "Evaluation of agro-ecological development potential through transnational cooperation and entrepreneurial innovation" granted under the contract no. 219-1-RO01-KA203--063939. Publication is a joint product of all scientific institutions involved in project realization (University of Alexandru Ioan Cuza – Iasi, Romania; University of Catania, Italy; Bucharest University of Economics Studies, Romania; ISCTE University Institute of Lisbon, Portugal; Institute of Agricultural Economics – Belgrade, Serbia; and University of Bucharest, Romania).

Main mission of the publication is to bring closer the idea, principles, general facts and regulation, certain production, standardization and analytical techniques and tools, etc. primarily to postgraduate students as potential entrepreneurs that would like to try in upcoming future to prove themselves within the sector of organic agriculture. Of course, the publication is also in the service of the existing producers of organic products as certain link to the updated knowledge, as well as to all stakeholders involved in agribusiness (policy makers and planners, extension officers, scientific audience, input suppliers, traders, processors, etc.).

By their character and way of presentation, written chapters are offering fundamental scientific or purely practical message. Publication could be simultaneously considered as an educational and professional tool created for personal development of future readers, or simplified the primer for beginners and hand book for real agricultural professionals active within the sector of organic agriculture.

In line to publications' title and its main scope, publication involves 14 chapters, grouped around following thematic fields: Descriptive data related organic farming; Quality provided by organic agriculture; Sustainability of organic farming, Business activities and economic development of organic agriculture; and Organic agriculture based on innovation.

Chapters provide a brief but sufficiently detailed description of formal logic and crucial principles that guide the system of organic farming, as well as general facts that determine the global and regional production capacities used in organic agriculture, achieved production and market results, and challenges and opportunities with whom the consumers and producers are facing. Publication explains essential differences between organic and conventional food-products, and offers a list of beliefs and health-related effects linked to the consumption of organic food. In one part, organic agriculture is reconsidered as adequate quality standard that has to serve as unique guarantee for the quality of all organic products. According to that current system for production and import control established in EU is also presented. Certain focus is turned to the issues of the sustainability of this business model, primarily from the aspect of learning and knowledge transfer, available models and tools for support, level of official financial support directed to organic agriculture in EU, or sector's contribution to the sustainable development of rural territories. For entrepreneurs that want to enrol the certain line of organic production publication offers the concise methodological approach for evaluation of economic efficiency of planed investment. Besides, as sustainability of any segment of economy is driven by innovations, some contemporary methods for the evaluation of agro-ecological potential and plants behaviour towards the organic farming optimization have been also considered.

We hope you will enjoy the reading.

Authors, May 2020.

FIRST SECTION: Descriptive Data

- Organic Agriculture in European Union
- Challenges and opportunities
  in the Romanian organic food market
  considering youth preferences

1.1. Organic agriculture in European Union

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Abstract: Organic agriculture is a model of agricultural production that supports and promotes the well-being of the soil, the ecosystem and people. It is oriented towards the principles of use of the internal resources of the natural system through the reduction of the impacts on health and environment.
In recent years the consumption of organic products has increased, also driven by the increased demand for sustainable and healthy products. European market trends are highly debated because, although they represent a small percentage of total agricultural production, they are rather prominent in public discussions.
The aim of this chapter is to describe the current state of organic production in the European Union, highlighting its contribution to world production and also showing the current characteristics and dimensions of this sector.
The current state of distribution will also be investigated, in addition to production data, which are very important to understand the possible growth margins of the market at a European level.

Keywords: organic agriculture; European Union; market characteristics.

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1. Introduction

Organic farming is an agricultural method aimed at producing food with natural substances and processes. This means that it tends to have a limited environmental impact, as it encourages the responsible use of natural resources in order to maintain biodiversity and ecological balance (ATTRA, 1995).

In addition, animal welfare is sustained also through the satisfaction of the specific behavioural needs of animals (Bellon & Penvern, 2014).

The protection and enhancement of natural resources, promotion of animal welfare, quality, transparency and food safety are the principles on which organic agriculture is based (Niggli, 2015).

A sustainable agricultural production model does not just offer food products with specific characteristics and different from those commonly on the market; it also proposes a development that protects and enhances the environment, biodiversity and the landscape (Paoletti et al. 1992). Besides, many authors (Lockeretz, 2007; Freyer and Bingen, 2014; Darnhofer et al., 2019) think that organic agriculture is also useful for the modernisation of agriculture and the promotion of fairness in producer-consumer relationships and of a greater autonomy for farmers.

In recent decades, organic agriculture has experienced growing expansion all over the world, both in the most industrialised and advanced countries and in emerging countries, establishing itself as one of the strongest sectors of the agricultural landscape (Bengtsson et al., 2005).

In recent years, consumer interest in organic products has grown (Boobalan and Nachimuthu, 2020). This interest is linked to the growing health concern. The modern consumer is increasingly attentive regarding health considerations and this attention is also directed towards food products (Asif et al., 2018). In addition to health, another important issue for consumers is that of the environment. Organic products also respond to this concern (Laureti and Benedetti, 2018). This interest in the attributes of organic products has increased demand, and consequently this has led farmers to work more on production (Nair and Nair, 2019).

Among the associations that have played a driving role and have been promoters of the organic approach is the International Federation of Organic Agriculture Movements (IFOAM), which in 1980 published the first international standards for the production and processing of organic products.

These were based on four ethical principles (health, ecology, fairness and care) which were used as a basis for drafting national and international regulations. These principles concern the way in which human beings interact with the environment and with each other, helping to create a legacy for future generations.

- Health: Organic Agriculture must support and promote the well-being of the soil, plants, animals, humans and the earth, as a single and indivisible whole, by eliminating fertilizers, plant protection products and food additives from production;
- Ecology: Organic production must respect the ecological cycles and nature balances, taking into account the characteristics of each territory, with the aim of maintaining and improving the quality of the environment;
- Fairness: Organic Agriculture must guarantee fairness with respect to common environment and life opportunities. It must ensure social justice at all levels and among all the parties involved;
- Care: The management of Organic Agriculture must be in a provident and responsible in order to protect the health and well-being of present and future generations as well as the environment.

From its earliest stages, organic farming has been co-developed by the farmers who have practised it and by researchers who have put their scientific knowledge at the service of further development (Watson et al., 2008).

According to Darnhofer et al. (2019) various factors have influenced the development of organic agriculture. First of all, some studies highlighted the role of agri-environmental programmes, which have been implemented differently from country to country and have convinced farmers to convert to organic farming by focusing on economic attractiveness (e.g. Offermann et al., 2009; Stolze and Lampkin, 2009; Läpple, 2010; Sanders et al., 2011). A second body of literature examined how institutions defined the organic sector through legislation, highlighting the strengths but also the disadvantages of setting legally binding standards (Klein and Winickoff, 2011; Seufert et al., 2017). A third body of publications highlighted the importance that has been given to organic agriculture with respect to the increase in productivity per worker, plant and animal, through the specialisation and professionalisation of farms (Weis, 2010; Grin, 2012). Finally, a fourth group of publications stressed the role of consumer purchasing behaviour in shaping the dynamics of the organic sector (Lobley et al., 2013; Thorsøe and Noe, 2015).

The development of organic agriculture has gone through several stages, which have been defined by borrowing the terminology derived from computer science. Organic agriculture 1.0 indicates the pioneering phase. The second phase, referred to as organic agriculture 2.0, is characterised by the vast growth of the organic sector in terms of cultivated areas and market value. In this phase, which dates back to the 1990s, in many parts of the globe - Europe first and foremost - we observe the transformation of organic agriculture from a niche form to a fully fledged agri-food sector. Finally, the current phase of the sector is characterised by the ambition to become the reference global agricultural model and is known as organic agriculture 3.0 (Arbenz et al., 2015).

The European Union (EU) has clearly regulated the production and trade of organic products in order to satisfy the demand for reliable organic products from consumers at the same time creating a fair market for producers, distributors and retailers.

In order for farmers to benefit from organic production methods, consumers must have confidence in organic production. Therefore, the EU maintains a strict control system (which is also an accreditation system) to ensure that the rules and regulations for organic products are respected. The control rules also apply to the transformation, distribution and retail sector. Imported organic food is subject to control procedures to ensure that it has been produced and transported in accordance with organic production principles.

The aim of this chapter is to describe organic agriculture in the EU, analysing the characteristics of production, and its role in the world market. From the methodological point of view Eurostat and some specialised reports such as FiBL-IFOAM (Willer et al., 2020) will be used for the sector analysis.

The chapter is divided into four sections. In the first section some information will be given regarding organic production worldwide, which helps to understand the mechanisms of this market. In the second section EU organic production and its market will be dealt with. The third section will concentrate on the characteristics of EU organic farming and finally in the fourth section some information on retail will be given.

2. EU Organic farming legislation

Organic farming was regulated for the first time in Europe with EU regulation no. 2092 of 1991.

At that time, the European Community was called upon to manage the problem of production surpluses. Therefore a regulated organic market could be supportive of the food market.

However, this EC Regulation indicated the method for organic production of agricultural products only, excluding the livestock sector and the production of wine and oil, included in the subsequent regulations. However, the procedure and rules for the labelling and control of organic products were already indicated.

With reg. (CE) n. 834/2007, organic production extended its spaces of relevance. New requests for environmental and biodiversity protection introduce new issues.

The objectives were not only to provide a specific market that could respond to consumer demand for organic products but also to provide public goods which would contribute to environmental protection, animal welfare and rural development.

The comparison of the objectives of 2007 with those set out in 1991 clearly shows that organic agriculture had by then made a great deal of progress. Organic agriculture was no longer instrumental to the conventional food market; it had become autonomous with its own proper functions. In this new identity, environmental protection played a central role.

This Regulation governed the entire organic agriculture supply chain, including all stages of production, preparation and distribution of organic products. The general principles and objectives of organic farming set by this Regulation were complemented by Regulation (EC) no. 889/2008 which established specific rules regarding organic production, labelling and control of products in the vegetable and animal sectors.

In 2018, the European Commission approved a proposal for a new regulation, which would replace the 2007 text and enter into force in 2021. This is Regulation no. 848 approved on May 30, 2018.

The text of regulation 848/2018 is centred on the objective of strengthening consumer confidence in the product, focusing on its quality.

The reasons for the intervention of the EU legislator are articulated along two main guidelines:

• Economic development: organic agriculture is one of the sectors that has expanded most in the last decade;

• Adaptation to the regulatory environment: in fact, the Europe 2020 strategy gives priority to sustainable growth and the promotion of a more efficient, greener and more competitive economy. Organic production is perfectly integrated.

In the new regulation, which will come into force in 2021, the objectives will be the following:

• Respect natural systems and cycles in order to maintain the balance between the state of the soil, water, air, plants and animals;
• Keep the natural heritage unchanged;
• Use energy and natural resources responsibly;
• Produce high quality food;
Guarantee the integrity of organic production;
• Use living organisms and mechanical production methods;
• Exclude the use of GMOs and the products obtained from them;
• Adapt the production process taking into account health, climatic conditions and regional differences;

3. Outlook on the organic production at world level

In the world there are 2.8 million farmers (especially in India, Uganda and Ethiopia) who produce 71.5 million hectares of organic crops (+ 2.9% on 2017), or 1.5% of the total area cultivated, and the market is worth 97 billion euros per year.

Concerning the number of farmers, doubts remain regarding the under-sizing of the data available worldwide, already highlighted in the past. However, there is a positive change in the overall number of producers which in 2019 increased by 13% (compared to 2018), mostly in developing countries and emerging markets.

Oceania is the area with the most organic agricultural land (table 1) (36 million hectares), followed by Europe (15.6 million), Latin America (8 million), Asia (6.5 million), North America (3.3 million), and Africa (2.0 million) (Willer et al., 2020).

At global level in the last years there has been an increase in organic agricultural land in all regions. Most of the increase was in Europe (almost 1.25 million hectares, 8.7% increase), in Asia, (almost 8.9% or an additional 0.54 million hectares) and in North America by more than 3.5% or almost 0.1 million additional hectares (Willer et al., 2020).

Wild collection and beekeeping are the other activities for the organic land. The areas of non-agricultural land, such as aquaculture, forests, and grazing areas on non-agricultural land, constitute more than 35.7 million hectares (Willer et al., 2020).

Australia (35, 7 million ha) is the country with the largest organic cultivated area in the world followed by Argentina (3.6 million hectares), and China (3.1 million ha) (table 2).

As for processors and importers, whose major share is recognised in Europe, it should be noted that the data of some important countries, like the USA, are not available.

In 2019 the consumption of organic products and drinks has grown again worldwide, in line with the positive trend that has characterized the last few years . Regarding the market share, the demand for organic foods is concentrated in North America and Europe. Although the share of these two regions is declining, they still comprise a large part of global sales.

However, the domestic market for organic products and drinks is expanding in India, China and Australia. In the case of China, this depends above all on the numerous food scandals that have characterised it in recent years, so that the population is gaining increasing awareness of the importance of consuming healthy food.

In any case, the first market is the North American one (43 billion) while the second is the Europe market (+ 8% compared to 2017) reaching a value of 40.7 billion euros (Willer et al., 2020).

It is interesting to note that the US market for drinks and organic products - including fruit and vegetables, followed by milk and derivatives -, although it is the largest in the world, is guaranteed by imports (coming in particular from Switzerland, Canada, South Korea, Japan, Taiwan and the European Union). The positive trend in demand, in fact, does not seem to have yet managed to stimulate an adequate reaction from the supply, through an increase in the area invested in organic agriculture (Bio report 2017-2018).

Table 1. World: Organic agricultural land (including in-conversion areas) and regions' shares of the global organic agricultural land 2018

Region	Organic agricultural land (hectares)	Regions' shares of the global organic agricultural land (%)
Africa	2,003,976	3
Asia	6,537,226	9
Europe	15,635,505	22
Latin America	8,008,581	11
North America	3,335,002	5
Oceania	35,999,373	50
World*	71,514,583	100

Source: Willer et al. (2020). Note: Agricultural land includes in-conversion areas and excludes wild collection, aquaculture, forest, and non-agricultural grazing areas. *Includes correction value for French overseas departments.

Table 2 - Organic Agriculture: Key Indicators and Top Countries

Indicator	World	Top countries
countries with organic activities	2018: 186 countries	
Organic agricultural land	2018: 71.5 million hectares (1999: 11 million hectares)	Australia (35.7 million hectares) Argentina (3.6 million hectares) China (3.1 million hectares)
Organic share of total agricultural land	2018: 1.5%	Liechtenstein (38.5%) Samoa (34.5%) Austria (24.7%)
Wild collection and further non-agricultural areas	2018: 35.7 million hectares (1999: 4.1 million hectares)	Finland (11.3 million hectares) Zambia (3.2 million hectares) Tanzania (2.4 million hectares)
Producers	2018: 2.8 million producers (1999: 200'000 producers)	India (1,149,371) Uganda (210,352) Ethiopia (203,602)
Organic market	2018: 96.7 billion euros (2000: 15.1 billion euros)	US (40.6 billion euros) Germany (10.9 billion euros) France (9.1 billion euros)
Per capita consumption	2018: 12.8 euros	Switzerland (312 euros) Denmark (312 euros) Sweden (231 euros)
Number of countries with organic regulations	2018: 103 countries	
Number of affiliates of IFOAM – Organics International	2018: 779 affiliates from 110 countries	Germany - 79 affiliates India - 55 affiliates China - 45 affiliates United States - 48 affiliates

Source: Willer et al. (2020)

Regarding the producers, there were at least 2.8 million organic producers in 2018, especially in Asia (47%) followed by Africa (28%), Europe (15%) and Latin America (8%).

The countries with the most producers are India (1,149,371), Uganda (210,352), and Ethiopia (203,602).

Although organic food sales are growing at a healthy rate, there are still persistent challenges. For example, it has been challenging for strong local markets to develop in Asian, Latin American and African countries.

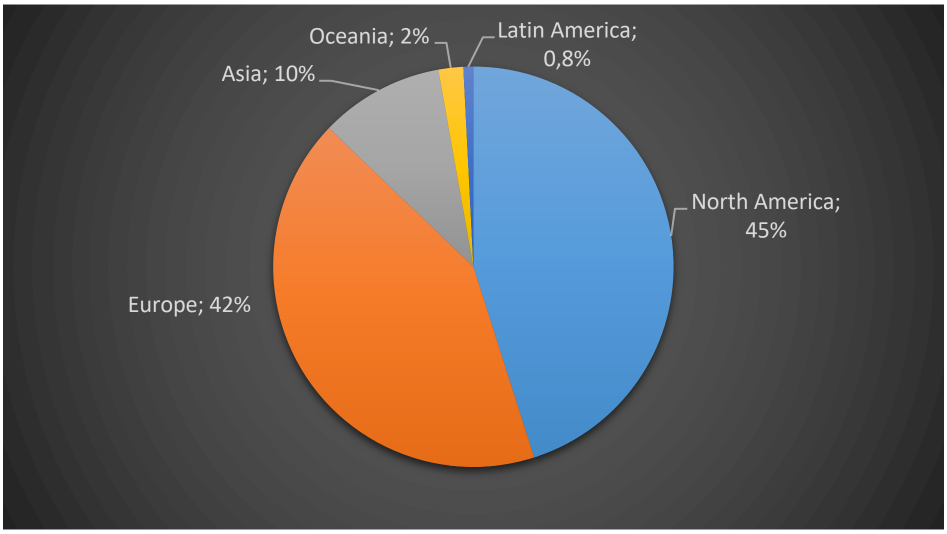
In 2018, the countries with the largest organic markets were the United States (40.6 billion euros), Germany (10.9 billion euros), and France (9.1 billion euros). If we consider the single markets at world level, the first was the United States (42% of the global market), followed by the European Union (38.5%), and China (8.3%). Switzerland and Denmark registered the highest per-capita consumption in 2018 (312 euros). The highest organic market shares were reached in Denmark (11.5%), the first country to reach an organic market share of over 10%, Switzerland (9.9%) and Sweden (9.6%).

The data regarding the distribution of retail sales at global level show on the supply side an overall and fairly widespread growth in production, while on the demand side there is a strong concentration on the countries where the purchasing power is highest (figure 1). These countries are therefore unable to cope with the growing demand for organic products by means of internal production and, to satisfy the requests, they resort to imports.

There is therefore an asymmetry between the places of production and those of consumption, with the creation of a large distinction within the various producing nations between producer countries and consumers of organic products.

Organic agriculture plays a fundamental role in developing countries especially in areas characterised by scarcity of resources where small family units are linked to traditional land management. In these areas, organic agriculture is more efficient not only for the lower costs determined by the reuse of seeds and the non-use of chemical fertilizers and pesticides, but also for performance equal and superior to conventional agriculture in the long term. Many farmers have never converted to modern farming methods and have often continued to use the old hardy strains and still know how to minimise insect attacks and enrich the soil using natural means (De Vylder et al., 2007). These reasons help to understand the increase of organic farming in these areas.

Figure 1. Global market for organic food: Distribution of retail sales by region 2018



Source: our elaboration on Willer et al. (2020)

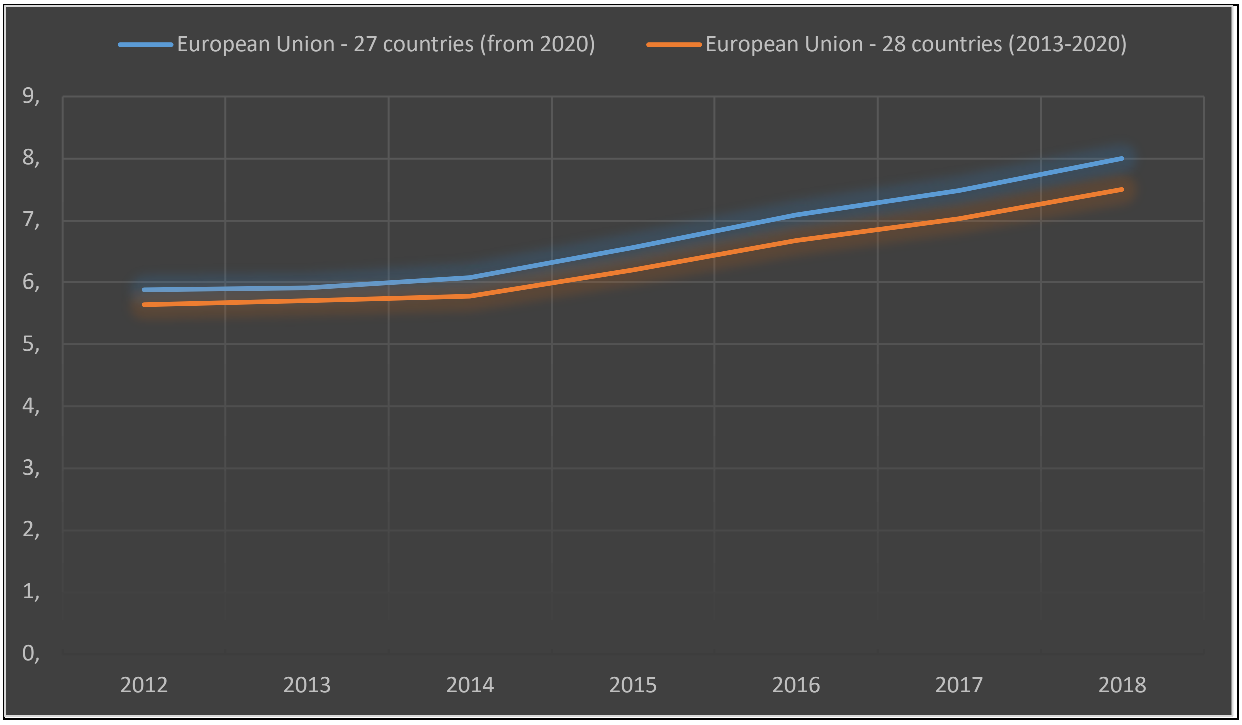
4. Organic production in the EU

4.1 Organic agricultural land

The organic products sector in the EU is characterised by high dynamism. Over the past ten years growth has been exponential (over 70%) and in 2017 it reached 12.6 million hectares, representing 18% of the global biological area.

In 2012 the percentage of area used for organic farming did not reach 6%, while in 2018 it was close to 8% (Figure 2).

Figure 2. Evolution of area under organic farming (% of total utilized agricultural area)



Source: Authors' elaboration according Eurostat (2020). The indicator measures the share of total utilised agricultural area (UAA) occupied by organic farming (existing organically-farmed areas and areas in process of conversion).

The countries where the percentage of the area destined for organic agriculture was above 14% were Italy (15.24), Switzerland (15.39), Austria (24.08), Sweden (20.29), the Czech Republic (14.76), Estonia (20.57) , Latvia (14.47) (figure 3).

In absolute terms, the Member States with the largest areas in 2018 were Spain (almost 2 million ha), France, Italy (about 2 million ha) and Germany (almost 1 million ha), which together accounted for around 52% of the EU-28 total organic area.

The Czech Republic in which 519,910 ha were dedicated to organic farming was the leading EU-n13 Member State in terms of surface.

Liechtenstein was the leading Member State in terms of share of organic area in the UAA, (38.5%), followed by Austria (24.7%), Estonia (21.6%), and Sweden (19.9%). Liechtenstein was the country with the highest organic farmland share in the world.

The evolution of the total certified organic farming area should be considered together with the increase in the number of organic producers (figure 5).

In 2018, there were more than 327,000 in the EU. The country with the largest number of producers was Italy (more than 69,000).

From 2009 to 2018 the number of producers in the EU increased by 56%. Figure 5 shows the trend in the number of organic producers over the period being studied.

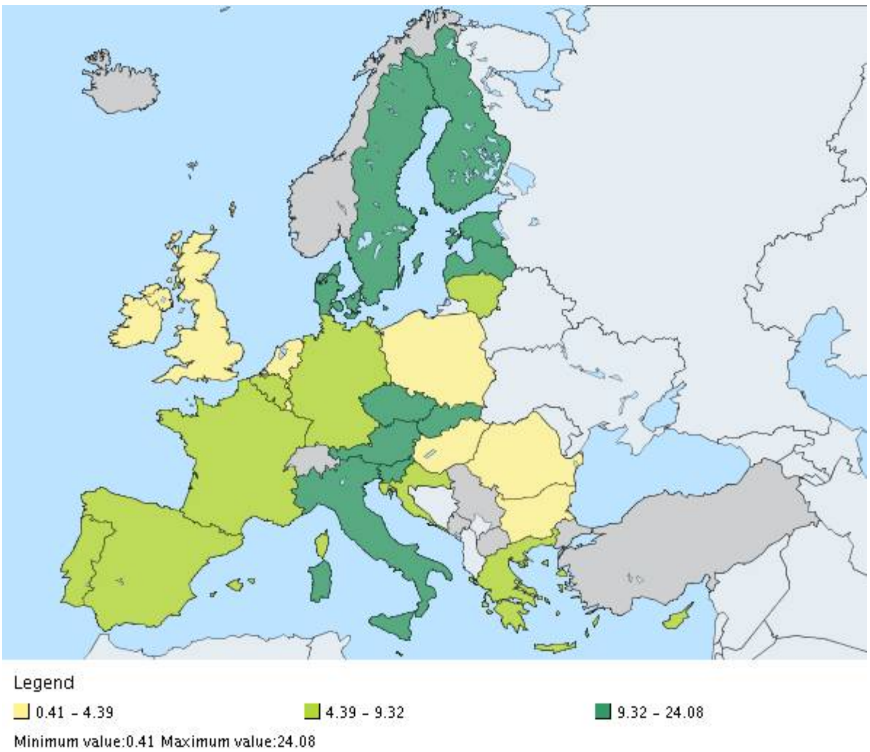


Figure 3. European Union. Area under organic farming - % of utilised agricultural area (UAA) in 2018

Source: Eurostat (2020)

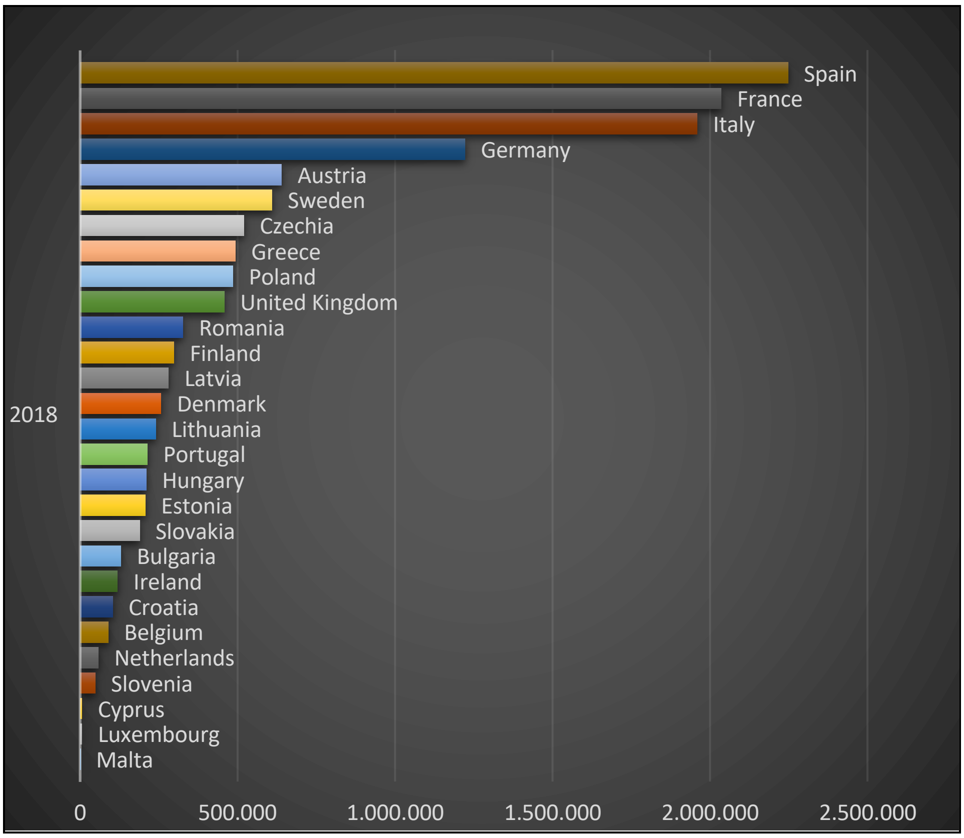


Figure 4. European Union. Organic crop area for country at 2018 (hectares)

Source: Authors' elaboration according Eurostat (2020). Utilised agricultural area excluding kitchen gardens; Total fully converted and under conversion to organic farming.

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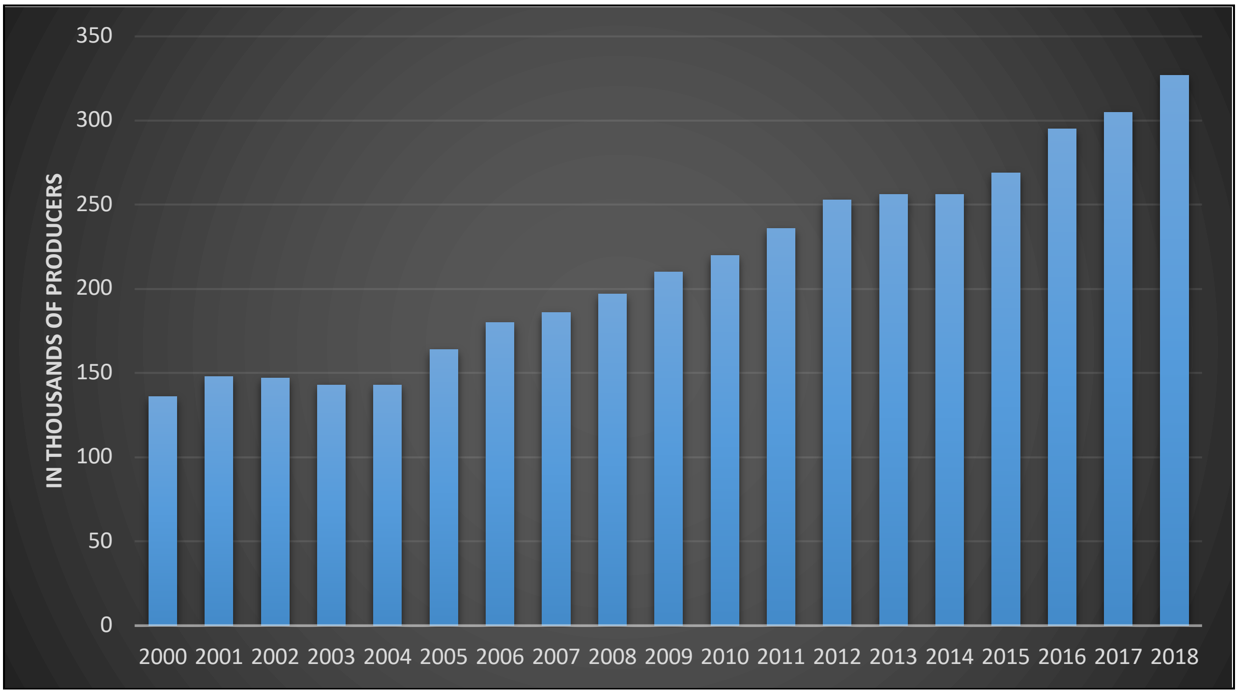
Figure 5. European Union: Development of the number of organic producers in 2000-2018



Source: Authors' elaboration according Willer et al. (2020)

4.2 Land use in EU organic agriculture

With regard to EU land use, there are no substantial changes compared to the past. The land is in fact divided between permanent grassland (45%) and arable land (45%), while a residual part is cultivated with permanent crops. The proportions vary from country to country, with the predominance of arable land in some cases (Scandinavian countries in the lead) and grassland in others (figure 6). Arable land constitutes a large part of organic farmland, with 6.1 million hectares. Permanent crops constitute 11% of organic farmland with 1.5 million hectares. Shares of a certain importance (biological surface greater than 20%) are recorded in Bulgaria, Spain and Italy, with peaks in Cyprus and Malta (over 45%).

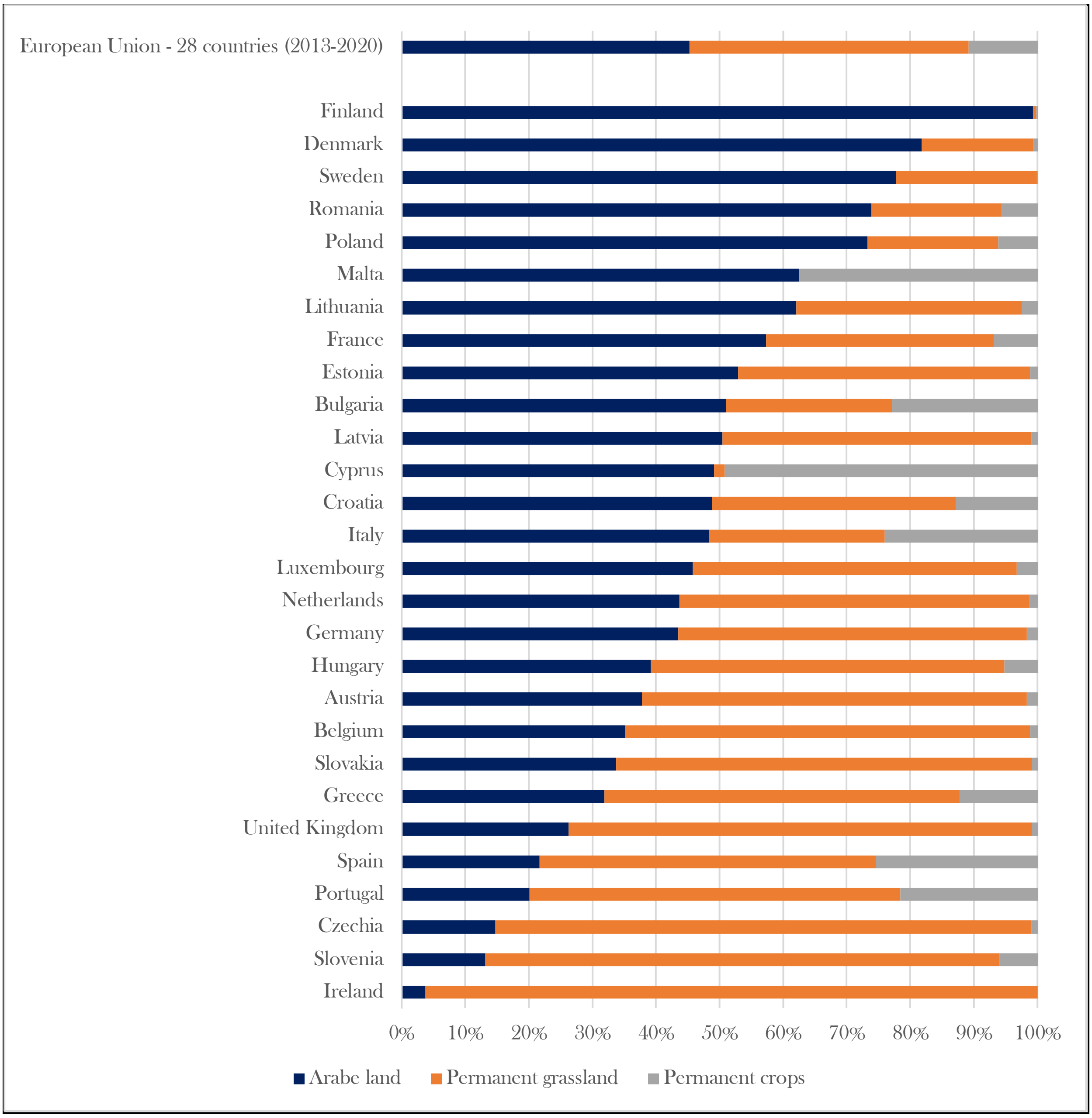
In the period 2009-2018 arable and permanent crops doubled showing a greater increase than permanent grassland (that increased by about 50%) (Willer et al., 2020) (figure 6).

Regarding the type of production on organic farms, it differs among regions and Member States and depends on various factors (technical and economic aspects, also linked to the market demand).

The data in table 4 show that all key arable and permanent crop groups growth in the European Union except for citrus fruit (decline in Italy). In the European Union, organic arable crops are very important in that they represent 5% of the total cultivated area. Cereals and green fodder from arable land represent about two thirds of organic arable land (table 4).

Regarding the organic share, in the EU dry pulses are the most successful crop. Their importance is considerable given that they represent almost a fifth of the total area of dry pulses. It should be considered that they are important for crop rotation and animal feeding, while they have disappeared in conventional agriculture since protein crops for animal feed are imported and crop rotation has been replaced by fertilizer. Among the main groups, cereals and green fodder showed the highest increase in the earth's surface. (Willer et al., 2020).

Figure 6: European Union. Arable land crops, permanent grassland (pastures and meadows) and permanent crops, by country, 2018 (% of total organic area — fully converted and under conversion) (data refer to 2017).

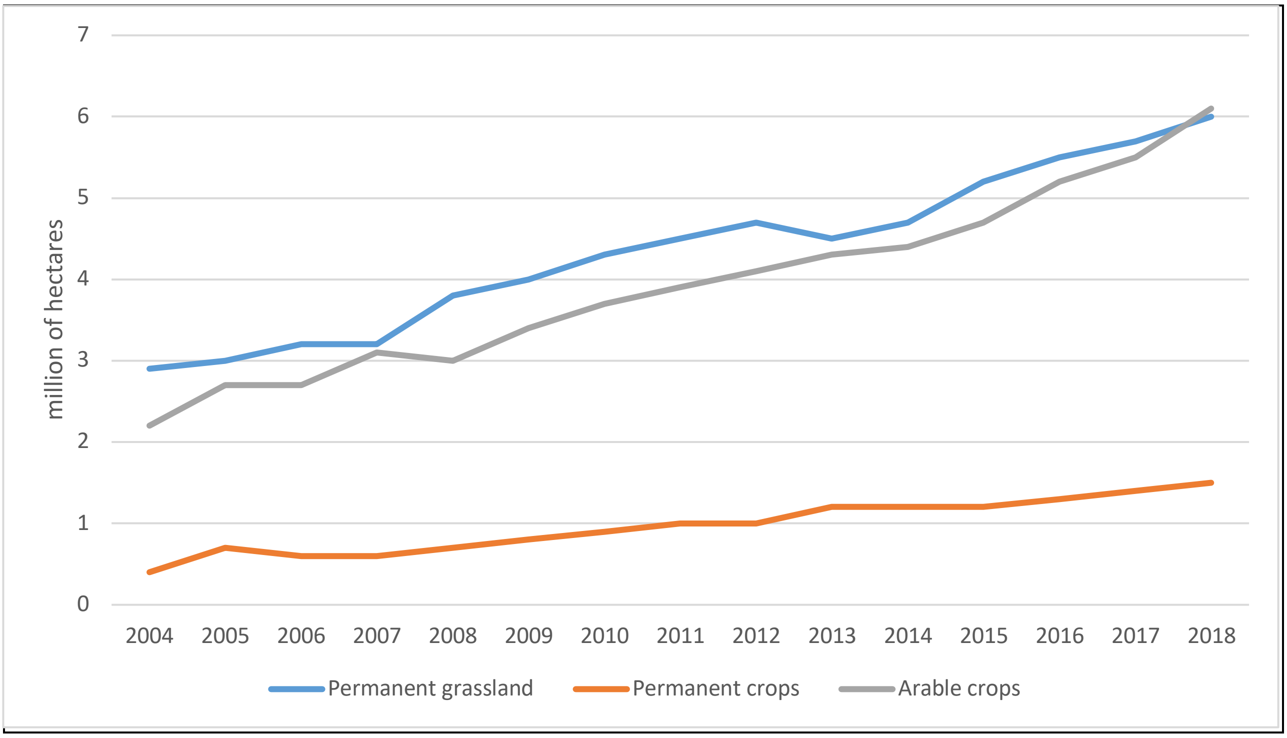


Source: Authors' elaboration according Eurostat (2020)

The share of permanent crops is high in the organic sector (15%). This is probably related to the fact that in the organic market the demand for fruit and vegetables is among the highest.

Considering the permanent grassland category, it represents over 50% of the whole organic area. In contrast, cereals cover more than 30% of the EU's total UAA, but a smaller percentage of the organic UAA. This characteristic is accounted for by the fact that organic production systems are more extensive than conventional agriculture (i.e. there is greater dependence on grazing on permanent pastures).

Figure 7. European Union: Growth in organic agricultural land by land use type 2004-2018



Source: Authors' elaboration according to Willer et al. (2020)

Table 4. European Union: key crops/crop group

	Crop group	Area (ha)	Organic share	Change 2017-2018	Change 2009-2018
Arable crops	Cereals	2,179,519	3.9	9.0	50.0
	Dry Pulses	442,829	18.5	15.0	233.0
	Green Fodder	2,333,638	NA	6.0	85.0
	Oilseeds	307,725	2.5	14.0	191.0
	Robot Crops	42,425	1.2	10.0	41.0
	Vegetables	170,909	7.2	8.0	81.0
Permanent crops	Berries	37,588	22.2	2.0	101.0
	Citrus Fruit	52,354	10.2	- 4.0	73.0
	Grapes	349,036	11.1	8.0	125.0
	Nuts	279,559	26.0	6.0	93.0
	Olives	516,918	10.0	1.0	50.0
	Temperate Fruit	111,006	8.5	9.0	93.0
	(Sub) Tropical Fruit	16,207	11.4	16.0	132.0

Source: Authors' elaboration according to Willer et al. (2020).

4.3 Organic livestock

Regarding the animal sector, it is developing at a fast speed in the EU. As shown in Table 5, sheep and bovine animals are the most important, after poultry.

The share of organic production depends on the different animal sectors. The pork sector has the lowest weight. This is partly due to the difficulties faced in providing organic animal feed (compound feed) and the consequent high price for consumers.

Conversely the highest shares are found in the sheep sector. The ruminant sector tend to develop faster than other livestock sectors.

Table 5. European Union: organic livestock 2018

	Animal (head)	Organic share of total (%)
Bovine Animals	4,603.380	5.2
Sheep	5,685.771	5.0
Pigs*	1,321.170	0.7
Poultry*	53,615.279	3.3

Source: Authors' elaboration according to Willer et al. (2020).
* Please note there is no consistent reporting in the official statistics, no clear distinction is made between the number of animals slaughtered, the places or average numbers of stock. Therefore, the data should be treated with caution.

Organic milk production has almost doubled since 2007. The current production is around 5.3 million metric tons, thus reaching 3.4% of the total milk production within the European Union.

According to statistics produced by Willer et al (2019), the largest producers of organic cattle are Germany (771,320), France (751,382), Austria (421,234), Italy (375,414) and Sweden (332,294). Austria, Germany, the United Kingdom and France are those with the highest number of organic dairy cows.

Organic pig production is mainly in Denmark (488,886), France (317,295) and Germany (178,200). Finally, the organic poultry sector is currently led by France with more than 20 million animals, followed by Germany (almost 10 million).

5. Organic retail sales and export

At the end of this chapter, it is worth focusing on a few data regarding the retail system in order to better understand the sector characteristics. In 2018, the EU organic market confirmed its particular dynamism, growing to 37.3 billion euros. It is not easy to quantify the real market as the statistics are not reliable. However, according to several studies (Willer et al., 2020) it can be assumed that the market is larger than the one indicated by the figures in table 6.

Table 6. European Union. Organic retail sales 2018: Key data

Retail sales (Million €)	Per capita consumption (€)	Growth 2017-2018 (%)	Growth 2009-2018 (%)
37,412	76.2	7.7	121

Source: Authors' elaboration according to Willer et al. (2020).

Regarding the size of the organic market, Germany is the largest market in the EU (10.9 billion euros) and, after the United States, it is the second biggest organic market in the world. France comes in second place in Europe with 9.1 billion euros.

The sustained increase in French consumption caused an increase in imports, which in 2017 covered 29% of the organic products consumed (Abitabile et al., 2019). In this country the biological surface alternates periods of growth with periods of stagnation, strongly dependent on the activation of different public support tools; however, French domestic production cannot compensate for the greater market demands.

The expansion of organised and specialised distribution in the French organic product market could lead, on the one hand, to a weakening of the cornerstones of organic agriculture, such as reduced environmental impact, social roots and balanced redistribution of the value produced, also resorting to the short chain and, on the other hand, to a reduction in producer prices (Abitabile et al., 2019).

6. Conclusions

Organic agriculture represents a cultural evolution that has its origin in an environmental culture that has spread and consolidated in the common perception of the community in the last twenty years (Gregori, 2006). However, attention to these products is also connected with the profound renewal of the demand for safe food from the health and hygiene points of view in that they have higher quality standards and are less harmful to health due to a more limited use of chemicals.

According to Schifferstein and Oude Ophuis (1998) there are two main reasons for the expansion of organic agriculture. The first is related to government measures taken against the use of polluting technologies. These measures have also increased due to the general concern for the environment. The second reason is connected to the possibility of higher financial returns which makes organic agriculture an interesting option. This aspect is even more interesting for small farmers for whom the production of organic food is a market niche. In fact, they suffer economically due to their small size and cannot benefit from the effects of the economies of scale of technologically advanced agricultural production. According to Brzezina et al (2017) the main risks to the growth and sustainability of organic production in the European Union lies on the one hand in the market dynamics or the decline in environmental motivation, on the other hand the organic farming system in the EU can become dependent on third countries and undermine its own sustainability.

In a recent publication on the agricultural perspectives 2019-2030, further growth in organic demand is expected which will in turn cause an increase in supply at a rapid pace until 2030.

However, according to the Commission, it will not be easy to respond to the demand for organic products as farmers have to apply very different production techniques, in which dependence on work is greater. They must also comply with stricter animal welfare and drug rules. In the face of these higher costs, production prices cannot compensate.

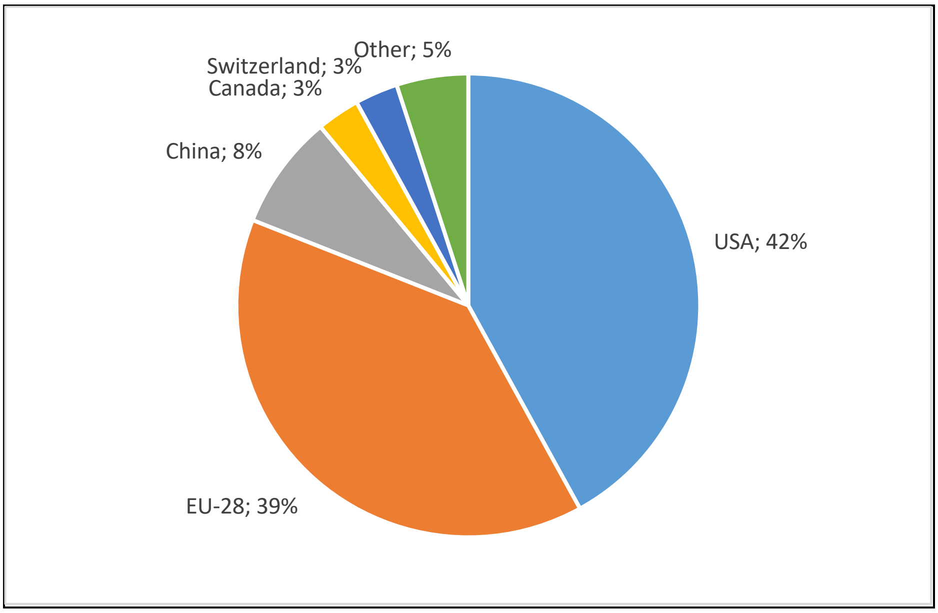
Organic production will also have to face some important challenges, such as conversion. Market differentiation, e.g. zero labelling of pesticides, could also weigh on the growth of the organic market.

According to the Commission, the EU biological area could reach 18 million hectares by 2030, or 10% of the total agricultural area, which represents a 3% increase in land use per year. The slowest development is expected for permanent grassland and permanent crops, where organic products have already reached significant altitudes.

Despite significant production growth, import dependence may remain high as demand increases, says the European Commission. Imports of organic products that are not produced or manufactured in small quantities in the EU (e.g. coffee, tea, tropical fruit and nuts) should also increase.

The tools to accompany and encourage the growth of the internal market are different and concern different aspects: constant quality improvement, research and development in order to respond to and anticipate consumer demand, consolidation of the control system due to the introduction of new technological tools, such as platforms for traceability of transactions, and common standards. (Bostan et al., 2019). However, updating information on the various aspects should be a constant effort.

Figure 8. Distribution of retail sales by single market worldwide 2018



Source: Willer et al. (2020).

The European regulation recognizes that organic production has a dual social function, not only by responding to consumer demand for natural, genuine and reliable products, but also by providing public goods that contribute to environmental protection, animal welfare and rural development.

The organic sector is a fast-growing sector of EU agriculture, thanks to the development of a sustainable lifestyle and the many consequent business opportunities offered by consumer society. The growth in the demand for organic products is considered, by many authors, as an indicator of the growing need of consumers to adopt sustainable lifestyles and eating habits (Yiridoe et al., 2005).

Just to respond to the challenges posed by this rapid expansion and to provide an effective legal framework for industry, the EU has approved new legislation which will enter into force on 1 January 2021 (Regulation (EU) 2018/848).

The main novel objectives of this legislation are to strengthen the control system, boost consumer confidence, facilitate the conversion of small traditional farms to organic ones and to introduce new regulations on imported organic products to ensure that all organic products sold in the European Union respect the same standards (Tittarelli, 2020).

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Appendix 1 – Definitions of key terms

accreditation system – each country has an official accreditation body which exerts independent authority within its territory. The concept of international accreditation systems means that an accreditation body operates internationally in a particular sector.

agricultural biodiversity – farmers play an important role in preserving biodiversity thanks to good practices. Organic farms have greater diversity due to mandatory crop rotations and preference for seeds and breeds with high tolerance to complex abiotic and biotic factors such as climate extremes, pests and diseases. Although some organic systems can be relatively genetically limited, diversity is an economic strategy to control pests and diseases.

animal feed – quantities of product used for animal feed and/or for the manufacture of foodstuffs for animals.

animal welfare – refers to the well-being and treatment of nonhuman animals by humans. Animals are raised with techniques that respect their well-being: they have access to pastures and open spaces every day and their density (in terms of numbers in proportion to the size of pastures) is limited. The animal welfare conception tries to improve treatment of animals, but it does not object to the use of animals generally in pursuit of human goals.

arable land – in agricultural statistics, it is land worked (ploughed or tilled) regularly, generally under a system of crop rotation.

crop rotation – crop rotation is an agronomic technique adopted in agriculture. It provides for the variation of the agricultural species cultivated in the same field, in order to improve or maintain the soil fertility, interrupt weed and disease cycle and maintain or improve the content of organic substance.

ecological balance – a state of dynamic equilibrium within a community of organisms in which genetic, species and ecosystem diversity remain relatively stable, subject to gradual changes through natural succession.

EU 28 – this term is used to refer to the dimension of the European Union. The dimension of the EU has not always been as it is today. In 1951, when European countries started to cooperate only Belgium, Germany, France, Italy, Luxembourg and the Netherlands participated. Over time, more and more countries decided to join. The Union currently counts 27 EU countries. The United Kingdom withdrew from the European Union on 31 January 2020. Countries in EU 28 classification: Austria, Italy, Belgium, Latvia, Bulgaria, Lithuania, Croatia, Luxembourg, Cyprus, Malta, Czechia, the Netherlands, Denmark, Poland, Estonia, Portugal, Finland, Romania, France, Slovakia, Germany, Slovenia, Greece, Spain, Hungary, Sweden, Ireland.

EU 27 – it is EU 28 without the United Kingdom which withdrew from the European Union on 31 January 2020.

international Federation of Organic Agriculture Movements (IFOAM) – IFOAM's mission is to lead, unite, and assist the organic movement in its full diversity. The goal of IFOAM is the worldwide adoption of ecologically, socially, and economically sound systems that are based on the principles of organic agriculture.

permanent crops. –they are plants and trees planted in a regular or systematic manner.

permanent grassland – it is land used permanently (for several consecutive years, normally 5 years or more) to grow herbaceous fodder, forage or energy purpose crops, through cultivation (sown) or naturally (self-seeded), and which is not included in the crop rotation on the holding.

pesticides – products intended to destroy or control any harmful organism (including microorganisms and weeds). More specific terms include the following: "Insecticide," a substance that kills insects; "herbicide," a substance that kills plants/weeds; "fungicide," a substance that kills fungi; "fumigant," a substance that kills all organisms in the soil - a soil sterilizer; and "rodenticide," a substance that kills rodents.

UAA (utilized agricultural area) – all the area of arable land, permanent meadow and pasture, and land devoted to permanent crops and kitchen gardens.

Ch. 1.1.

ORGANIC AGRICULTURE IN EUROPEAN UNION

Data, key and figures around the organic agriculture production in EU

OBJECTIVES:

- The chapter aims at presenting the principal characteristics of the organic sector in the EU.

SKILLS:

- After the study, students will have more skills as to the dimension, principal trends, strengths and weaknesses of the organic sector.

QUESTION 1

What are the four ethical principles of IFOAM.

- ☐ Well-being, ecology, fairness and care
- ☐ Health, ecology, fairness and care
- ☐ Health, ecology, fairness and trust
- ☐ Well-being, ecology, fairness and trust

QUESTION 2

What is the correct definition of organic agriculture 2.0

- ☐ It tries to satisfy the need for radical change.
- ☐ It is characterised by the great growth of the organic sector in terms of cultivated areas and market value
- ☐ It tries to solve the enormous challenges facing our planet and our species.
- ☐ It is characterised by a wide utilization of technology

QUESTION 3

Regarding the extension of organic agriculture in the EU, what is the country with the largest area (in absolute terms)?

- ☐ Italy
- ☐ Germay
- ☐ Spain
- ☐ France

QUESTION 4

Regarding the size of the organic market, what is the largest market in the EU

- ☐ Italy
- ☐ Germany
- ☐ Spain
- ☐ France

QUESTION 5 (open ended question)

Why is organic food more expensive than conventional food? Please write your answer also using the information that you can collect on this website: https://www.ifoam.bio/en

PRACTICAL APPLICATION RELATED TO THE CHAPTER.

Using the data reported in the followed table, calculate the area (in hectare) of each region in 2008. Using this value and the value reported for 2018 in the same table, draw a graphic with a tendency line. Comment these results.

Organic agricultural land by region: growth 2017-2018 and 10 years growth

Region	Organic agr. land 2017 [ha]	Organic agr. land 2018 [ha]	1 year growth [ha]	1 year growth [%]	10 years growth [ha]	10 years growth [%]
Africa	1'999'846	2'003'976	+4'130	+0.2%	+1'003'847	+100.4%
Asia	6'002'017	6'537'226	+535'209	+8.9%	+2'956'766	+82.6%
Europe	14'382'480	15'635'505	+1'253'025	+8.7%	+6'406'273	+69.4%
Latin America	7'995'447	8'008'581	+13'134	+0.2%	+348'989	+4.6%
North America	3'223'057	3'335'002	+111'945	+3.5%	+682'377	+25.7%
Oceania	35'894'365	35'999'373	+105'008	+0.3%	+23'847'268	+196.2%
World*	**69'492'495**	**71'514'583**	**+2'022'327**	**+2.9%**	**+35'243'503**	**+97.2%**

Source: Willer et al., 2020

1.2. Challenges and opportunities in the Romanian organic food market considering youth preferences

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Abstract: Due to the human health concerns regarding soil, water and air pollution, the organic food are gaining more popularity among consumers, determining an increase in demand. The possibilities of offering this type of food to a large segment of the consumers should be considered an important opportunity by the producers. How fast the producers prepare themselves to answer to the consumers' demand of organic products differs due to national regulations and consumers' purchasing power. Yet, the market of organic food products is at the beginning of its time, as the food and health research, together with policy makers and the media (classic and social), constantly influence and shapes the consumers' demand for this type of products. The following chapter presents a brief analysis of the current status of the organic food market in Romania compared to the European Union (EU) by considering the main aspects, challenges and opportunities in the future of this market from the perspective of the Romanian youth.

Keywords: organic food, supply, demand, challenges, opportunities, willingness to pay, youth consumers, Romanian organic food market.

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1. Introduction

Organic food seems to be a new favorite and trending concept, being used by people with more or less knowledge on the topic, such as professionals (doctors, researchers) or groups of people with an interest in the influence of food in their life (mothers, for example).

But what does organic food really mean?

According to the scientific literature, there is no common accepted definition of organic food, but several studies consider the perceived health benefits understood by the consumers, the improved taste, the natural components or the ethical aspects of these products (Magkos et al., 2006; Vega Zamora et al., 2013; Scalvedi, Saba, 2018; Kushwah et al., 2019), while other studies reveal the barriers in consuming organic products, such as higher prices, low variety and little availability in stores (Lillywhite et al., 2013; Kushwah et al., 2019).

For a better understanding of the different factors that influence the definition of organic food in scientific papers, 221 articles were used, available on Web of Science (retrieved with the organic food and definition query).

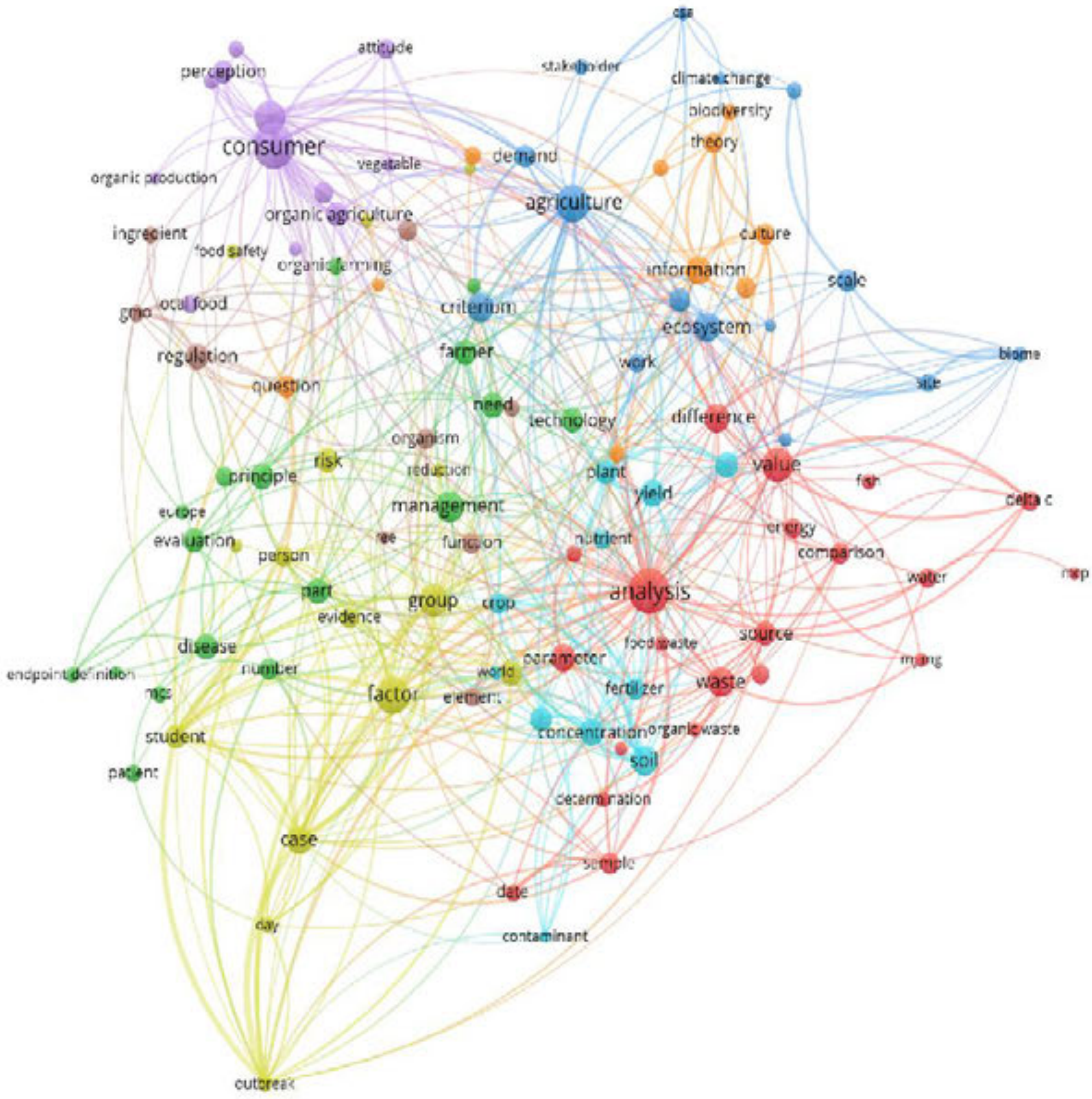
In Figure A1 the focal points considered by the researchers when speaking of organic food, are shown. Considering this figure, it seems that defining organic food is based on the results of knowledge, analyses and differences between various groups of products, mostly organic and conventional food products. Also, there are three main groups that influence the market of organic food: the producers (who use organic agriculture/ farming/ production criteria), the authorities (who are responsible for the regulations in the organic food production) and the consumers (through their attitude and perception of organic food, as well as their demand of organic products). The focal points for each category of actors in developing a common understanding of the organic food system, according to Figure A1, are:

1. Consumers:
    - perception (including health, taste and environmental expectations);
    - attitude (related to or opposed to the perceptions);
    - demand;
    - organic production/agriculture;
    - ingredient;
    - food safety.
2. Production (agriculture):
    - farmers (as prime food producers);
    - ecosystem;
    - biodiversity;
    - yield reduction;
    - management (cost of production, regulations, supply and marketing chain);
    - differences;
    - comparison to conventional agriculture;
    - climate change;
    - stakeholder;
    - local food;
    - principle;
    - criteria;
    - evaluation;
    - information.
3. Authorities (analysis):
    - comparison;
    - difference;
    - parameter;
    - sample;
    - determination;
    - source;
    - value;
    - disease;
    - information;
    - regulations (on production, labelling, subsidies for organic producers).

The common topic for all categories is “information”. This can be understood as a nudge towards emphasizing the need for constant studies on the topic of organic food, studies capable of generating knowledge on improvement options and uses of a large-scale organic agriculture system and common understanding on the organic food topic.

According to international organizations such as Food and Agriculture Organization (FAO), International Federation of Organic Agriculture Movements (IFOAM), and European Union, organic food products (both raw and those which went through a processing technique) are provided by the use of organic/ecologic agricultural methods. In the legislation of the European Union, this was revealed initially in the regulation EC 2092/91 in 1991, and, currently, through EC 834/2007.

Figure A1. Focal points in defining organic food



Source: Authors' own abstracting using the VosViewer software

The current EU Regulation on organic food (EC 834/2007) considers that organic production should simultaneously include the following principles:

- rely on the best environmental practices;
- have a high level of biodiversity;
- preserve natural resources;

- apply high standards of animal welfare;
- consider the consumer preferences for products using natural ingredients and processing methods.

The organic food production rules refer to production of plant, livestock and aquaculture, collection of wild plants and seaweeds, the conversion to organic farming, food processing (including wine, animal feed and organic yeasts), while considering all the food operators (producers, processors and traders) in this matter.

According to the current European Regulation (EC 834/2007), which was adopted also by Romania, the organic food should be prepared only through methods that do not interfere in the integrity and the vital quality of the product in all stages of production and distribution.

The same Regulation (EC 834/2007) mentions that an organic food product should be made integrally or almost integrally from organic raw ingredients, with the lowest presence of GMOs, but not excluding these components. For example, Gonzalez et al. (2019) prove in their study that, contrary to the popular belief, the organic food products may contain chemical compounds, just like the conventional food products.

In Romania, there are nine regulations related to organic agriculture regarding the production, imports and labelling of organic food. As a synthesis, the organic food production should lack chemical pesticides, synthetic fertilizers and genetically modified organisms (GMOs) as much as possible, it should follow the ecological production principles and it should be certified by an authorized body (Emergency Ordinance 34/2000). Besides offering safe and nutritious food, the organic production is considered sustainable and protective with natural resources and consumers' health (Emergency Ordinance 34/2000). In this case, it is natural for the consumers to search for organic food products available on the market in order to increase or secure their health.

In this context, the main goal of the current chapter is analyzing the current status of the organic food market in Romania compared to the European Union (EU) by considering the main market aspects (demand and supply) for emphasizing its challenges and opportunities, by considering an experimental research on Romanian youth perspectives.

What are the organic food market components?

The economy and its functioning laws have preoccupied philosophers since the oldest times, as Platon (422-347 B.C.) was considering the possibilities of ensuring human needs in his papers, while Aristotle (384-322 B.C) was considering the basic trade activities in his work. Later, David Ricardo (1817) and Adam Smith (1937) were considering the laws behind the countries' wealth distribution. Yet, the notion 'economy' is considered by Alain Samuelson (1985) as the generalization of all trade relations, as the confronting place of market demand and supply.

The market economy is, then, defined as all human activities related to the production, distribution, and consumption of certain goods (Larousse, 2020).

Alain Gilpin (1966) explains that between the demand and the supply of a product or category of products, certain priority principles interfere, so specific organizing methods of production and inputs combination emerge, while prime access to these products is given by the price level. Hence, there are people willing to pay more for specific products than others, according to theirs believes, perceptions, knowledge, and, of course, income level.

As Herbst (2019) observes, there are producers or distributors willing to provide the product requested by their consumers, determining niche markets. In this case, the organic food market might be considered a niche market, since few people currently demand organic food products (Stampa et al., 2020).

As Kim et al. (2018) explain the organic food market, it presents growing opportunities derived from the different motivations or characteristics of organic consumers.

Concluding, the organic food market is the confronting place of demand - the consumers of organic food products-, and supply - the organic food operators (producers, processors, importers/exporters and distributors of organic food).

2. Materials and methods

In order to determine the supply and demand of organic food, secondary data provided by Eurostat – Organic farming (2020) and by the Research Institute of Organic Agriculture (FiBL, 2020) regarding the organic areas, producers, operators and consumers were used.

Further on, in order to determine the challenges and opportunities on the organic food market, a quantitative analysis was conducted using an online questionnaire directed towards the Romanian youth. Since the method is an experimental one, the results cannot be extrapolated to a larger population segment, but offer a glimpse on the understandings and priorities that the young Romanian population has regarding buying organic food.

The questionnaire has 16 questions aimed at determining the current understanding of the Romanian youth on organic food, the willingness to pay for this type of food and the socio-demographic questions. The experiment was conducted on the students of The Bucharest University of Economic Studies, Faculty of Agri-food and Environmental Economics, by considering various factors, like education and possible existing knowledge of consumers, validated by previous studies (Dimitri, Dettmann, 2012; Paul, Rana, 2012; Wee et al., 2014; Suh et al., 2015).

The choice of this specific generation is determined by the differences between generations (Wiedmer, 2015; Reisenwitz, Iyer, 2009), revealing the fact that younger generations (born after 1980's) are more concerned by the global context, reducing their environmental impact, reducing social inequalities and making choices that express their thoughts. Also, there are studies (Hughner et al., 2007) showing that the youth has a more positive attitude towards organic food, while the older category purchases most of the organic food, due to the higher incomes. Yet, the current research focuses on the intention to purchase, a fact that implies knowledge on the topic from the respondents and an evaluation of the attitudes towards organic food purchasing.

The objectives of this study are:

O1. Determining the number of respondents with minimum knowledge on organic food products

O2. Determining the importance of healthy eating in the respondents' lifestyle.

O3. Determining the association made by the respondents between organic food and health.

O4. Determining the purchasing frequency of food products of the respondents.

O5. Determining the influencing factors of choosing food products and organic food products.

O6. Determining the willingness to pay for organic food products of the respondents.

O7. Determining the level of trust in the certification authorities of organic food products.

The hypotheses of this study are:

H1. We presume that 80% of the respondents have a minimum knowledge on organic food products and 20% do not have it.

H2. 60% consider that healthy eating is important and 40% do not consider this.

H3. 60% associate organic food with health, while 40% do not.

H4. 80% shop for food weekly or more frequently, while 20% shop less frequently.

H5. 80% consider that price is the most important factor, while 20% consider the quality of the product. For organic food products 40% consider the proximity of the products, 30% consider the quality and 30% would try an organic food product out of curiosity.

H6. 40% of the respondents are willing to pay 50% more for organic food products than on regular products, while 60% are not.

H7. 40% of the respondents trust the certification authorities, while 60% do not.

The questionnaire was filled by 203 students during 17th and 20th March 2020.

Finally, a SWOT analysis on the challenges and opportunities of the Romanian organic food market, based on youth perspectives, as they are revealed by the questionnaire results and the secondary data analysis has been presented as conclusion.

3. Organic food market components

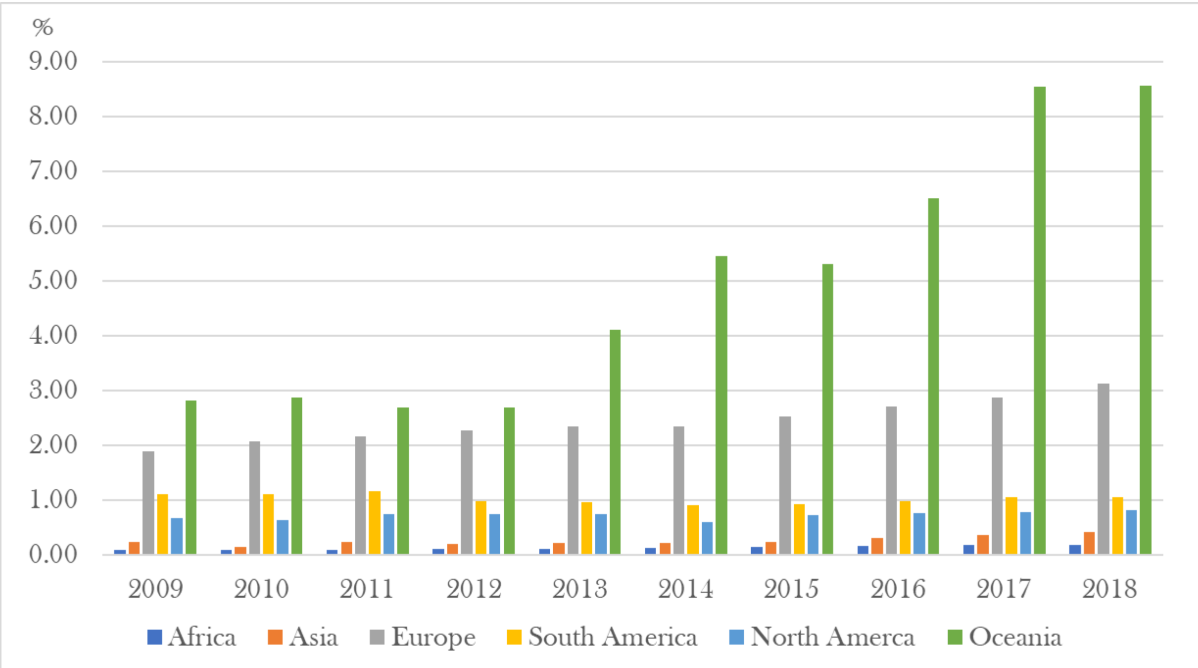
3.1. Organic farming - cultivated area and number of animals

The availability of organic food must be analyzed initially for a better understanding of the current system of organic food, through the following indicators:

- agricultural area under organic farming;
- dynamics of conversion to organic farming;
- organic areas in Romania;
- organic grown livestock;
- organic productions:
    - cereals;
    - fresh vegetables;
    - grapes;
    - meat;
    - fresh milk;
    - aquaculture.
- number of operators in the organic food system;
- dynamics of organic food retail:
    - sales of organic food;
    - amounts spent on organic food per capita.

The tendency of producing more organic food is not resumed to a particular area of the world, but it is starting to be available all around the world.

Figure A2. The percentage of organic and under conversion farming area

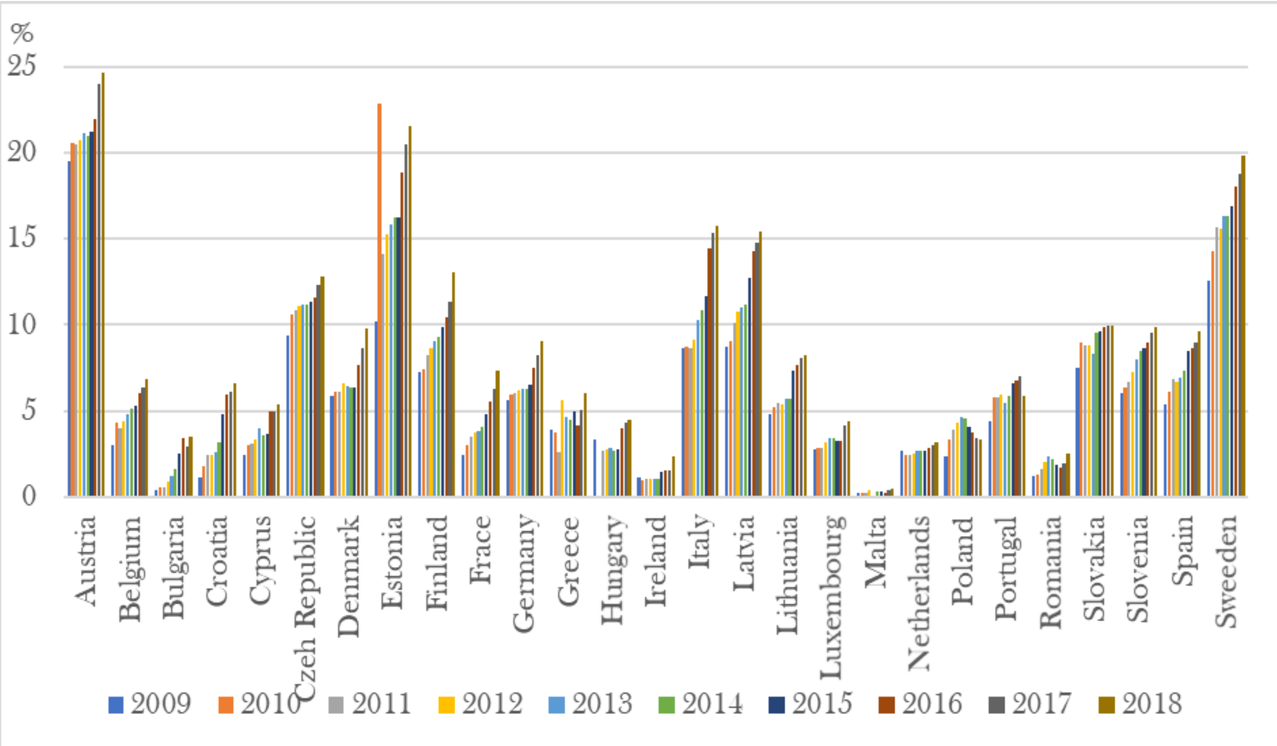


Source: FiBL, 2020.

According to the Research Institute of Organic Agriculture (FiBL, 2020), the organic agriculture area and the areas under conversion are on the rise at global level, as seen on Figure A3. Oceania and Europe are the continents with the largest organic farming area while large continents, like Asia or Africa, are only at the beginning of their experience with organic farming, as these continents are more consumed by prolonged crisis, such as extreme poverty and wars.

As one of the most active supporters of turning to a more sustainable consumption and production pattern, the European Union (EU) provides specific financing instruments for its members, so they can have a higher rate of conversion to organic agriculture. The data of all 27 EU members on organic and under conversion farming areas may be seen in Figure A4.

Figure A3. The percentage of organic and under conversion farming area in the EU



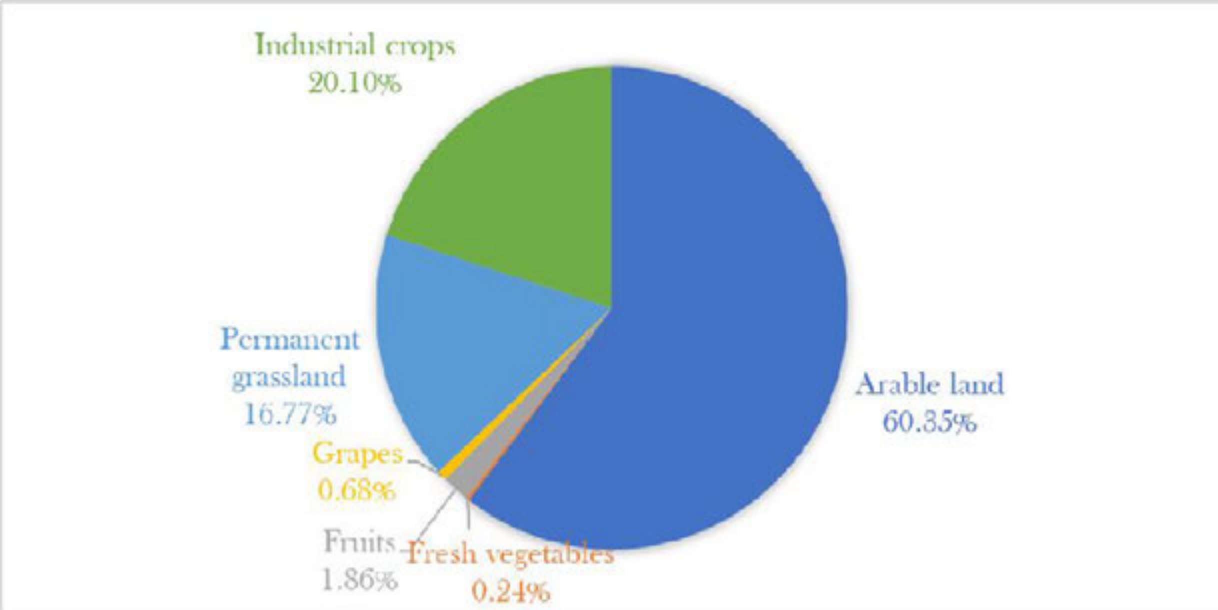
Source: FiBL, 2020.

Even if the total trend is an increasing one, there are different rates of accepting the change to organic farming and being an active actor of this change across the EU member states. In 2009, only three countries had a percentage higher than 10% of area under organic farming, while, in 2018, there were seven countries registering values above 10%. Even if these countries recorded a significant growth rate, almost doubling their organic areas in 10 years, the other EU countries recorded low increase rates. In 2018, eight countries had a percentage lower than 5%, and three countries were below 2.5%. Romania was included in the latter category.

In what concerns Romania, the total utilized agricultural area under organic farming excluding kitchen gardens in 2018 was of 326,260 hectares (Eurostat, 2020). Yet, the surface occupied by the main categories of agricultural land use (arable, fruits and grapes, permanent grassland and industrial crops) is higher, approximately 400,000 hectares out of the total 14.5 million hectares of agricultural area (NSI, 2020), as it may be seen in figure A5. In general, the agricultural land used for organic farming is short, and may be included in the category of kitchen gardens in the statistical data.

The main use of organic land in Romania is as arable land, mostly used for producing grains (240,800 hectares), followed by industrial crops (80,193 hectares), and by permanent grassland with 66,890 hectares, while the products with a higher value, such as vegetables, fruits and grapes sum up an area of only 11,093 hectares.

Figure A4. The main use of the organic agricultural land in Romania in 2018



Source: Eurostat, 2020.

The main use of organic land in Romania is as arable land, mostly used for producing grains (240,800 hectares), followed by industrial crops (80,193 hectares), and by permanent grassland with 66,890 hectares, while the products with a higher value, such as vegetables, fruits and grapes sum up an area of only 11,093 hectares.

In this case, we may conclude that the organic farming is in the trial stage for many Romanian farmers, most of them using small areas for this type of production, while directing to the market even a smaller share of the production obtained.

The organic production, as part of the health improving concept, is still a personal activity, not one to be conducted and shared on a large scale.

According to Eurostat (2020), the number of animals grown under organic agriculture principles is incredibly low compared to the total number of animals grown for food. Only the live poultry grown under organic principles is above 1 million in countries such as Germany or France (Eurostat, 2020). In table B1, the number of live animals grown by organic farming principles may be seen for Romania and the EU27.

Table B1. Organic livestock in EU27 and Romania

Element		2014	2015	2016	2017	2018
EU27	Poultry	*	*	39,839,728	*	*
	Bovines	3,326,183	3,342,953	3,700,694	4,014,568	4,281,542
	Swine	884,892	949,388	993,610	1,163,677	1,323,511
	Sheep	3,408,523	3,616,521	3,654,951	4,058,773	4,891,632
Romania	Poultry	57,797	107,639	63,254	*	83,859
	Bovines	33,782	29,313	20,093	19,339	16,890
	Swine	126	86	20	20	9
	Sheep	114,843	85,419	66,401	55,483	32,579

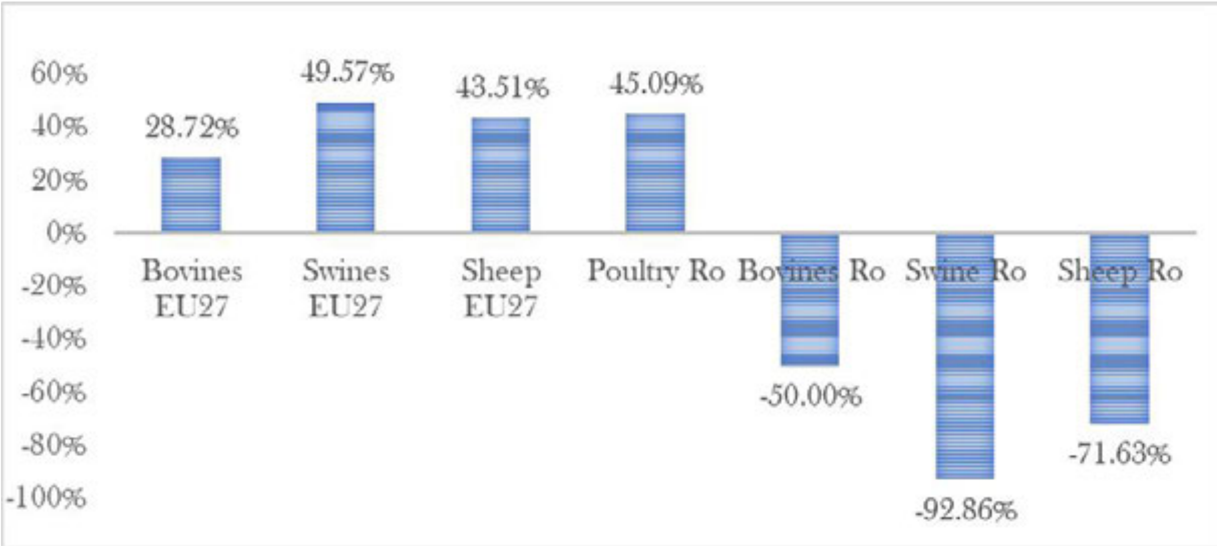
Source: Eurostat, 2020.

The available data on organic grown livestock is not yet detailed. A possible explanation for this might rely on the recommendations of lowering the consumption of meat, while another one may consider the natural process of obtaining organic livestock production, which starts from the feeding of the animals with organic feed. However, at the EU27 level, a growing tendency may be observed for live bovines, swine and sheep.

In Romania, only the poultry growing follows the European tendency, while the larger animals see a decreasing trend, some of them lowering with more than 50%, as it is the case of sheep. As percentage, Romania registered less than 1% of the EU27 organic livestock in 2018, against all the spoken potential of livestock production (NRDP 2014-2020).

Figure A6 shows the differences between the EU27 and the Romanian tendencies regarding growing organic livestock between 2014 and 2018.

Figure A5. The tendencies of organic livestock growth in EU27 and Romania



Source: Eurostat, 2020.

As it may be seen, if the organic swine growing has the highest increase in the analyzed period for the EU27, Romania has a totally opposite tendency, as the number of swine, which is already small, dropped from 126 animals in 2014 to 9 animals in 2018. This kind of numbers, even if it is registered, cannot be considered as possible market resources. The situation does not differ by much in the case of bovines or sheep growing.

3.2. Organic production

The organic food is largely understood as the food that comes from the organic farming systems (USDA, 2020; NASAA, 2020). Further, the main organic products will be considered in terms of available quantity (cereals, fruits, vegetables, grapes, meat, and milk). For Romania, the evolution of organic production between 2014-2018 is described in table B2.

Table B2. Evolution of the organic production in Romania (tons)

Year	Cereal for grains	Dry pulses	Root crops	Industrial crops	Fresh vegetables	Fruits	Grapes
2014	290,081	3,659	6,571	88,463	2,315	8,277	2,368
2015	254,867	2,276	7,766	83,043	3,639	6,434	6,405
2016	192,439	2,009	9,936	81,174	3,321	11,695	2,904
2017	198,044	6,879	6,349	96,469	3,189	12,108	7,672
2018	240,534	8,288	4,862	96,228	1,968	11,080	14,155

Source: Eurostat, 2020.

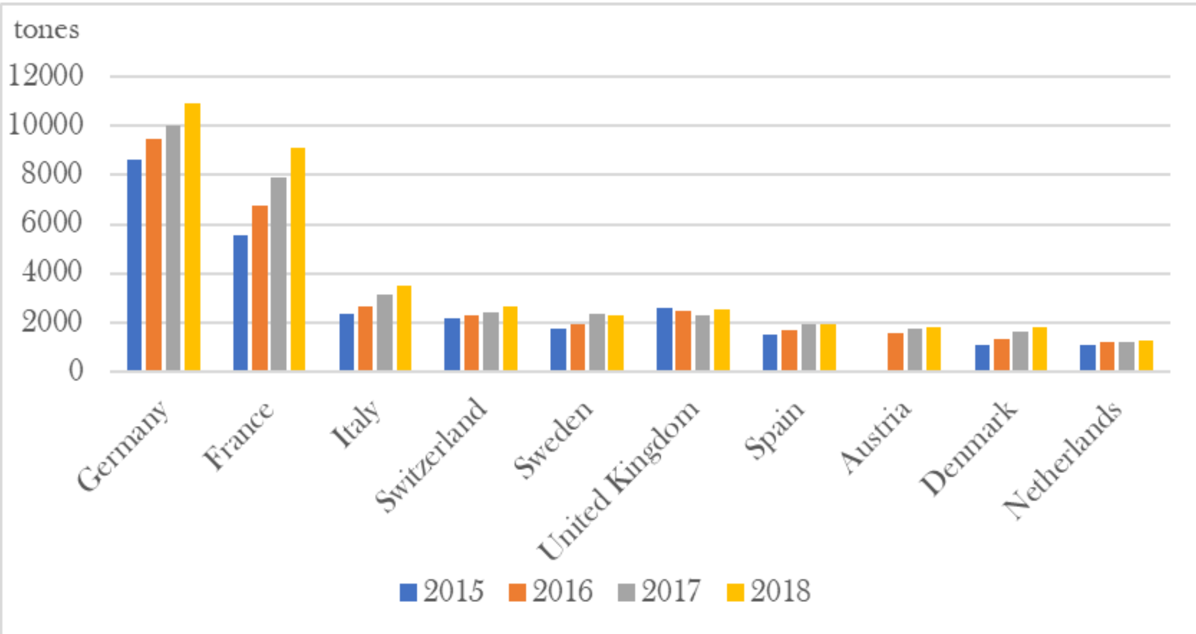
Even if a considerable growth would be expected when considering the organic production in Romania, there is a decrease of organic cultivated areas. The production of cereals, root crops and fresh vegetables registered decreases between 2014 and 2018. Yet, there are some categories of plant products that register small production increases, such as dry pulses, industrial crops, fruits and grapes. The most significant increase is registered for grape production.

The main categories of plant organic production in Romania, in 2018, are:

- cereals for grains;
- industrial crops;
- grapes;
- fruits;
- dry pulses;
- root crops;
- fresh vegetables.

Because an unified database considering the EU27 organic livestock production is not yet available, Romania will be further compared to other EU countries with available data between 2014 and 2018 on this matter, as illustrated in figure A7.

Figure A6. Evolution of the organic cereals production in EU countries



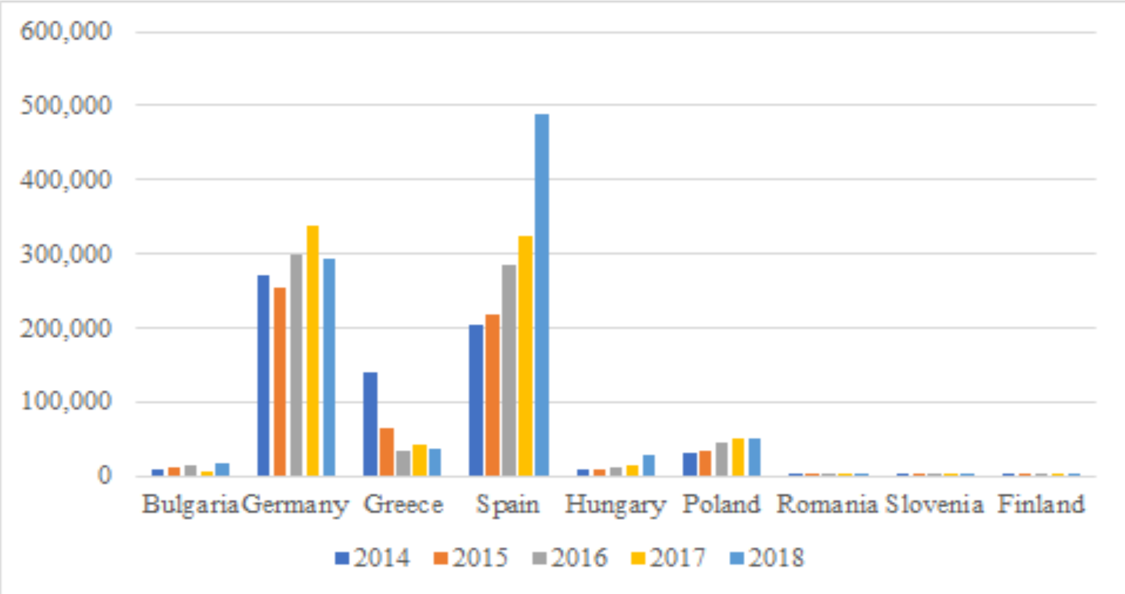
Source: Eurostat, 2020.

The Romanian organic cereal production suffered a significant decrease between 2014 and 2016. The production started to rise after 2016. In 2018, Romania had one of the highest organic productions of cereals among the EU member states.

Figure A8 presents the evolution of organic fresh vegetables production, the countries with less than 1,000 tons of production and those with no data being eliminated from the comparison.

The country with the highest production of organic fresh vegetables was Spain, with a constant growth between 2014 and 2018. Countries such as Poland, Hungary and Bulgaria turn out to be focused on the organic production of fresh vegetables, as they present a rising tendency, while their neighbor country, Romania, does not share the same trend. In Romania, the organic vegetable productions are decreasing over the analyzed period.

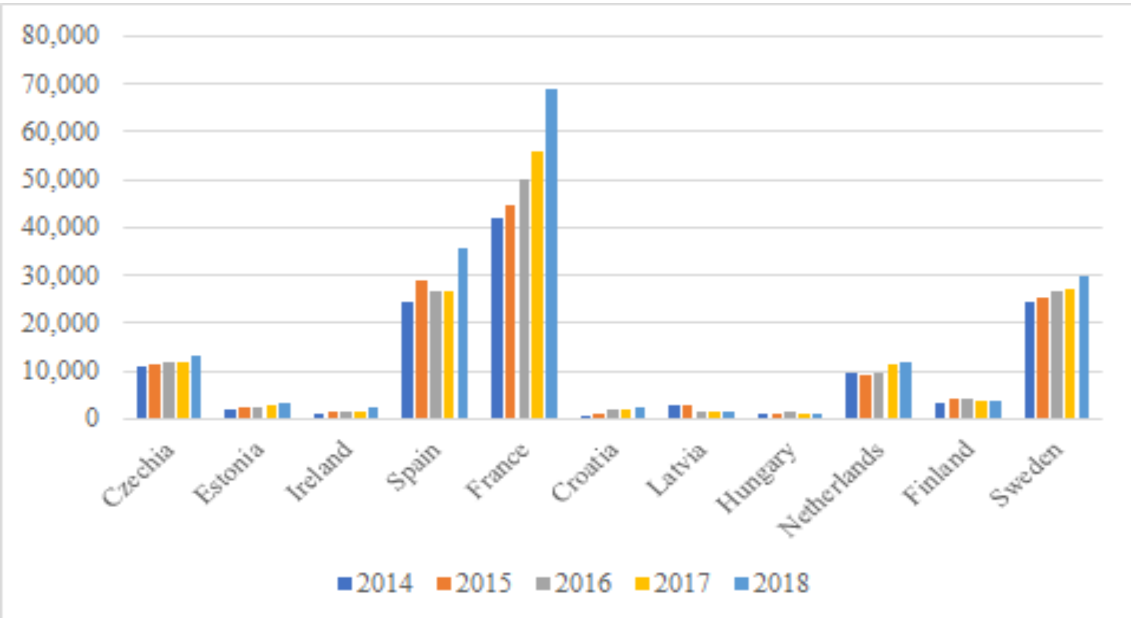
Figure A7. Evolution of the organic fresh vegetables production in EU countries (tones)



Source: Eurostat, 2020.

Regarding the organic livestock production, Romania has a very low production, reaching in 2018 only 8 tons of organic meat, 28,062 tons of fresh milk and 1,619 tons of fish and sea fruits, while other EU members show an increasing interest in the organic production from livestock (Figure A9).

Figure A8. Evolution of the organic meat production in EU countries (tones)



Source: Eurostat, 2020.

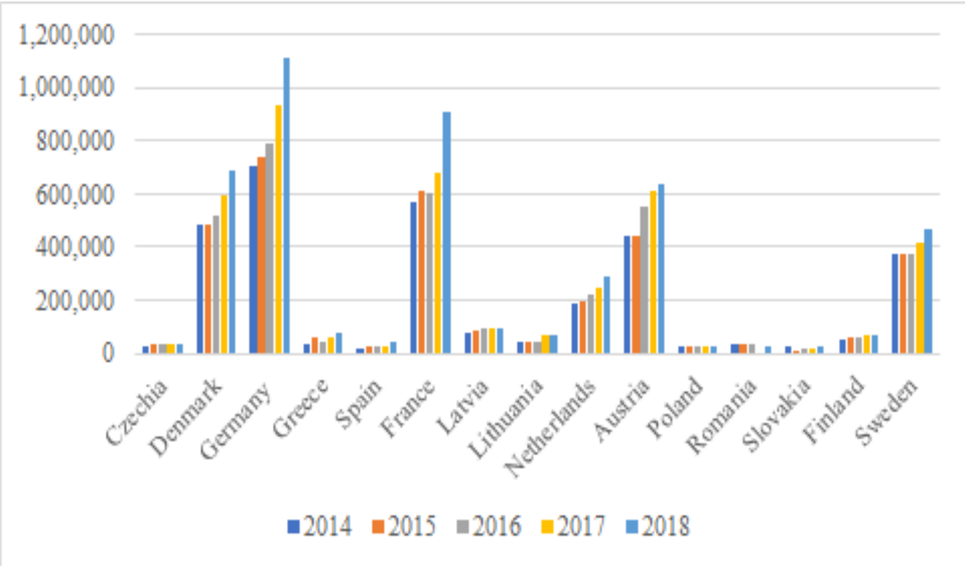
France, which showed no interest in the production of organic cereals or vegetables, has the highest production of organic meat in the EU. Meat has a higher value than the vegetable products, a fact that may turn out to be an interesting market decision.

Even if Romania has the same increasing trend as other EU members, its increase was only from 1 to 8 tons of meat per year. So, a yearly production of 8 tons in 2018 cannot be taken into consideration in a comparison between countries.

The organic fresh milk production is another important segment of the organic food market. In this case, considering that milk is a traditional product in Romania, we could expect to have an important share of production converted to the organic area.

Figure A10 illustrates the amounts of organic fresh milk produced by some of the EU members with registered productions higher than 10,000 tons since 2014.

Figure A9. Evolution of the organic fresh milk production in EU countries (tons)



Source: Eurostat, 2020.

The countries with the highest production of fresh milk (more than 500,000 tons in 2018) were Germany, France, Denmark and Austria. While, Romania registered a milk production of only 28,062 tons.

Aquaculture represents the production of fish and sea fruits and other water organisms grown for human consumption and it is an important type of production due to the health benefits given by the consumption of fish. Figure A11 presents the aquaculture production in tons of live organisms.

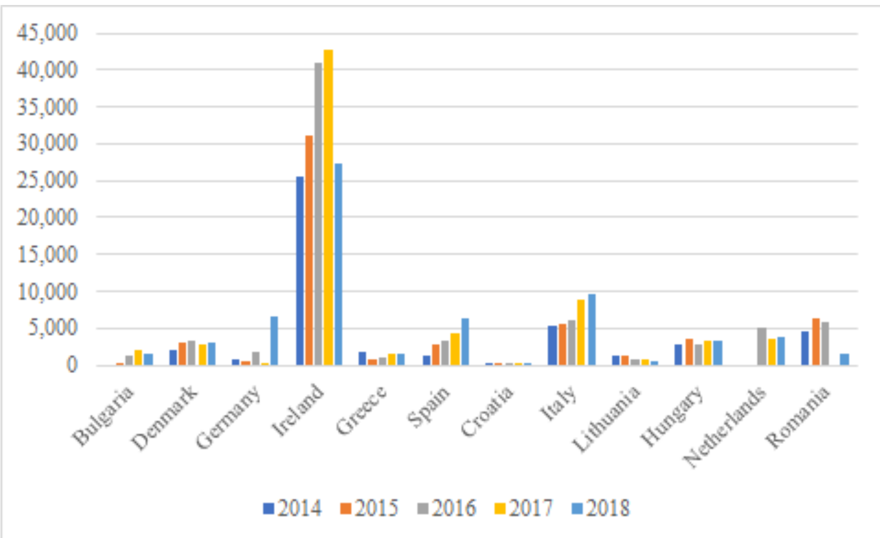


Figure A10. Evolution of the organic aquaculture production in EU countries (tons)

Source: Eurostat, 2020.

The EU member states do not follow an ascending trend in the case of aquaculture production, the only country with more than 10,000 tons/year in 2018 was Ireland. Yet, this is also a country with a considerable decrease in production. Romania suffered a significant decrease in the analyzed period, dropping from 4,542 tons in 2014 to 1,619 tons of aquaculture production in 2018.

Even so, the offer of organic food available on the market in Romania and in other EU countries is influenced by the economic operations of production, processing, exporting, and importing of organic food. So, the dynamics of organic food operators in the EU are an important aspect in prospecting the opportunities of the organic food market.

3.3. Organic food operators

The food market operators are formed by:

- the food producers;
- the food processors;
- the importers and exporters of food products.

Since the organic food market is a niche, the organic food operators may be seen as pioneers in their fields, subjecting themselves to constantly changing regulations and trying to sell products with higher prices to people with already created preferences and tastes. Yet, their number is expected to rise in the future, based on the increased publicity and of consumer demand for these food products. For now, the organic food operators are few, as it is possible to see in table B3. So, there is an opportunity of development for other interested producers.

Table B3. The number of organic food operators in EU27 and Romania

Element		2014	2015	2016	2017	2018
EU27	Agricultural producers	254,115	267,915	292,175	*	*
	Aquaculture producers	511	456	449	*	*
	Processors	49,664	55,358	59,697	*	*
	Importers	2,828	3,505	3,941	*	*
	Exporters	*	*	*	*	*
Romania	Agricultural producers	14,151	11,812	10,083	7,908	8,518
	Aquaculture producers	29	22	18	17	14
	Processors	124	142	150	161	175
	Importers	3	6	5	9	18
	Exporters	1	3	5	6	11

Source: Eurostat, 2020.

In the EU27, the trend revealed by the available data regarding organic food operators is increasing for all categories, except aquaculture producers. The agricultural producers increased their numbers by almost 40,000 between 2014 and 2018. The organic food processors grew in number with approximately 10,000, while the importers increased by more than 1,000.

In Romania, the number of producers both in agriculture and aquaculture decreased, while the number of processors, importers and exporters shyly increased. In 2016, the percentage of Romanian organic agriculture producers was only 3.45% of the total EU27 number. The Romanian aquaculture producers represented 4.00% of the total EU27, while the processors and importers in Romania represented less than 1% of the total EU27 numbers.

3.4 Retail of organic food

According to the Research Institute of Organic Agriculture (FiBL, 2020), in 2018, the total retail sales (products sold in small quantities, purchased mostly for personal consumption and not for other resale activities, as opposed to wholesales, regularly large quantity sales intended to be resold) summed up to 97 billion euro. It is important to mention that the value of the total retail sales was available for 56 countries (30% of the total countries with organic data), which means that the data utilized in the next pages are referring to a sample and are not expanded at world level. Table B4 presents their evolution.

Table B4. The evolution of retail sales in the 2015-2018 period (million euro)

Year	2015	2016	2017	2018
Africa	17	16	16	17
Asia	6,255	7,343	9,601	10,071
Europe	29,781	33,526	37,351	40,729
Latin America	31	810	810	811
North America	38,540	41,939	43,003	43,677
Oceania	1.085	1,065	1,293	1,378
Total	75,709	84,699	92,074	96,683

Source: FiBL, 2020.

Since the production of organic food is rather small compared to the amounts of conventional food produced around the world, the number of operators on this niche market is also small. Thus, the wholesale would not be a good option for selling organic food.

It can be observed that the total retail sales increased with 27.70%. All the continents (except for Africa, which maintains the same level of sales) registered the same rising trend:

- Latin America (↗ 2,516.12%);
- Asia (↗ 61.00%);
- Europe (↗ 36.76%);
- Oceania (↗ 27.00%);
- North America (↗ 13.32%).

In 2018, the country with the largest market for organic food was the United States (40,559 million euro), followed by Germany (10,910 million euro), France (9,139 million euro) and China (8,087 million euro). It is important to emphasize that all countries (56) registered an increase in sales, with the highest value in France (15.4%).

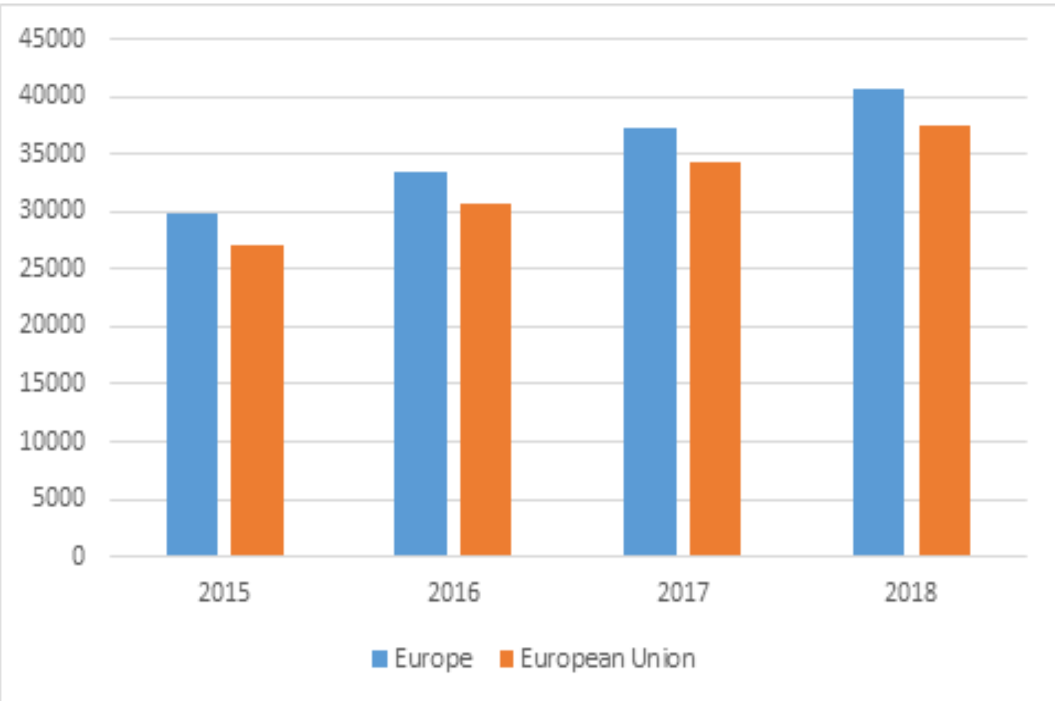


Figure A11. The evolution of retail sales in the 2015-2018 period (million euro)

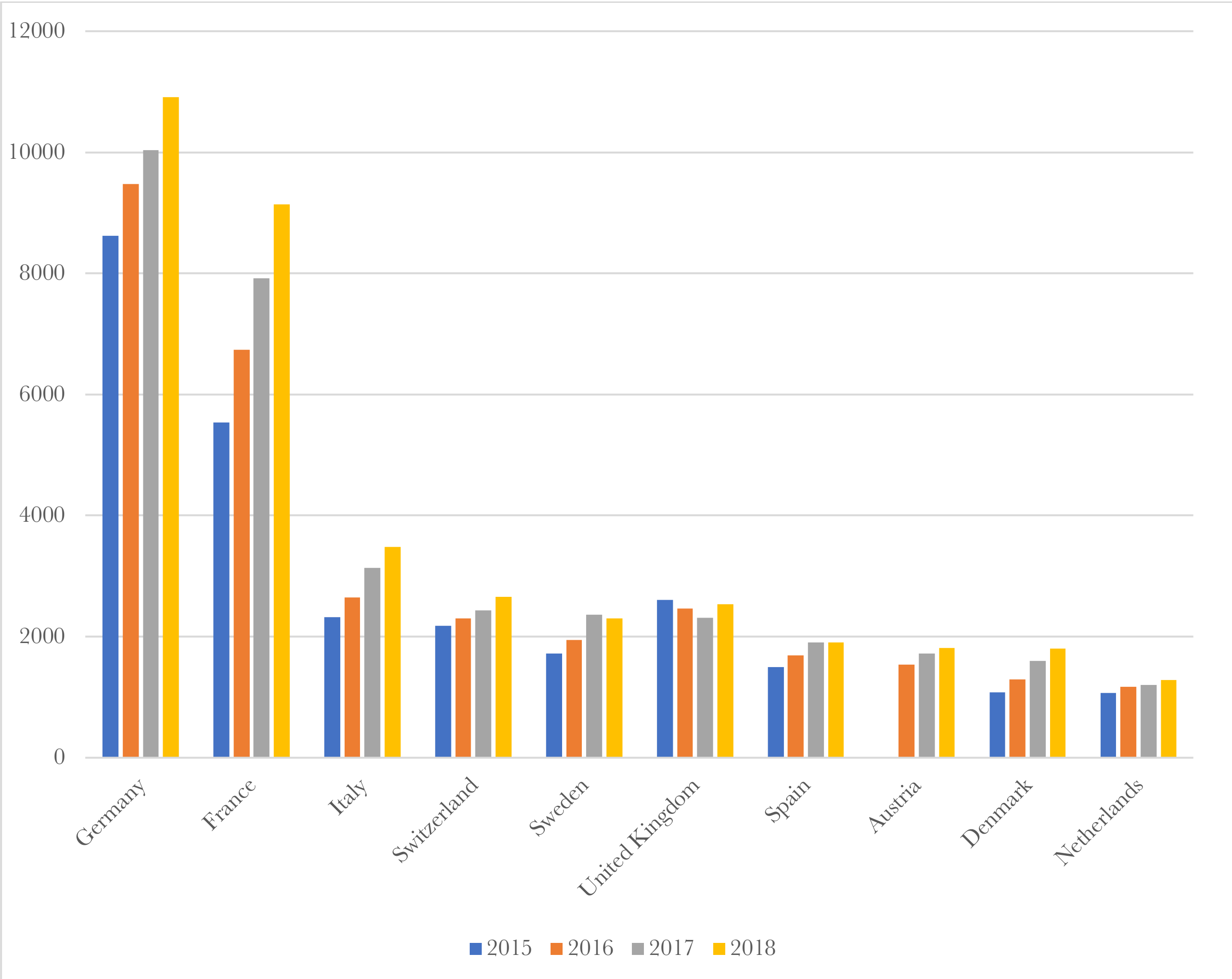
Source: FiBL, 2020.

The total European Union contribution was around 91%, as it is presented in figure A12.

During 2015-2018 period, the organic market grew by 36.76% in Europe and 38.01% in the European Union.

In top 10 European countries by retail sales, Germany was first during the analyzed period, as it is presented in figure A13, with the highest value of organic food sales. The most significant increase is registered in Denmark (67.46%), followed by France (65.14%) and Italy (50.32%). In Romania, the retail sales were 41 million euro in 2016.

Figure A12. The evolution of retail sales in the 2015-2018 period (million euro)



* value for 2011, Source: FiBL, 2020.

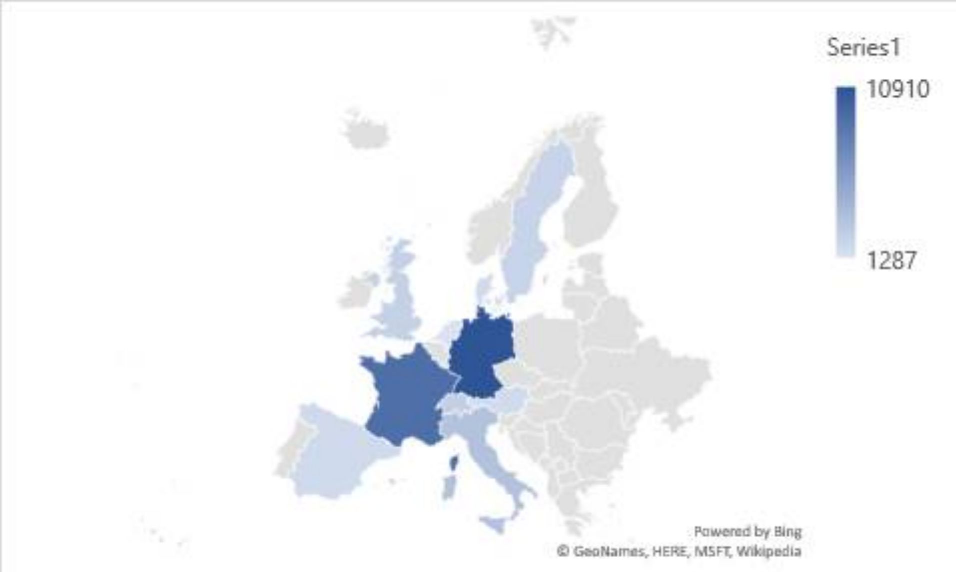
The top three retail sales evolution in the EU countries is formed by:

- Germany;
- France;
- Italy.

The situation of organic food products retail sales in 2018 is illustrated as a map in figure A14. From light blue to dark blue, the map indicates the ten main retail markets in Europe for organic food.

Germany sets the highest score with 10,910 million euro, followed by France with 9,139 million euro, while Netherlands completes the top ten ranking with a retail market of 1,287 million euro.

Figure A13. European map of the retail sales of organic food products in 2018



Source: FiBL, 2020

4. Demand for organic food products

The request from the consumers is the first one to change the way a market works or even determines the appearance of new markets. Being encouraged by the studies in the field of organic food, but also, on a larger scale, by the new trend of food TV shows, by the influencers on both classic media and social media or by the advice received from doctors and nutritionists, consumers have started to search for the organic food products in local shops or supermarkets and hypermarkets.

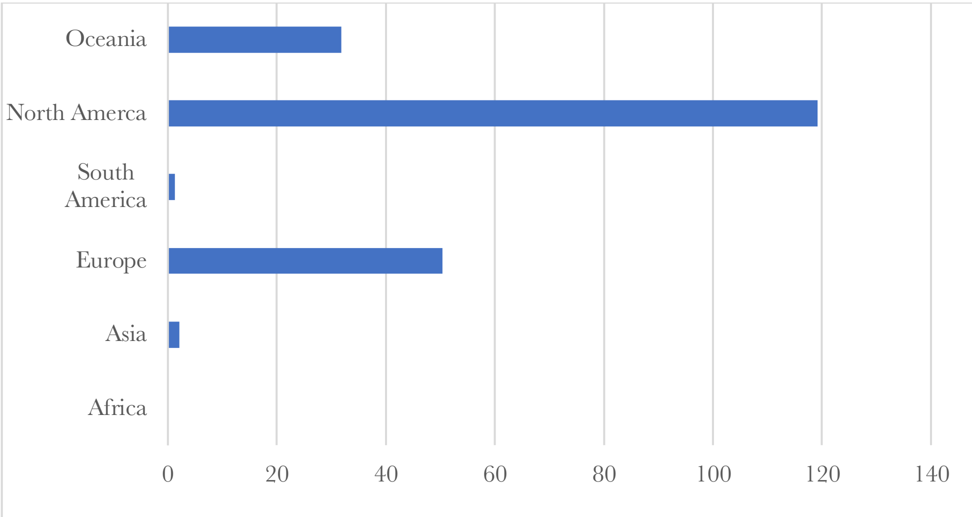
The literature regarding the consumer behavior towards organic food products is mostly exploratory, focusing on the factors that could influence the purchasing decisions taken by consumers, by considering the local culture, the education, the available information on organic food and the purchasing power in a region. For example, the results of one study (Dimitri, Dettmann, 2012) indicate that a higher level of education could generate a stronger possibility of buying organic products, while factors such as the marital status, the available income, and the availability of organic food products are recurrent across models. They also suggest that ethnicity might have a powerful influence on the consumption of organic food.

Another study (Paul, Rana, 2012) finds that "health, availability and education from demographic factors positively influence the consumer's attitude towards buying organic food". The study of Wee et al. (2014) indicates that the consumers' intention "to purchase organic food is significantly influenced by the perception of safety, health, environmental factors and animal welfare" of these products. Yet, there was "no significant effect of consumers' perceived quality of organic food products on their intention to purchase the products". By comparing the purchase intention and the real purchase behavior towards organic food, Suh et al. (2015) found that the main influencing factors were, in descending order, the "experience, attitude, the subjective norm, trust, and perceived behavioral control" of consumers. While, the actual purchase behavior was influenced by "unexpected circumstances, living circumstances, and price".

Even more, the difference between generations was considered by previous studies, such as the one conducted by Sa'ari & Koe (2014), who revealed the fact that, among millennials, three factors – "perceived quality, environmental concern and trust" - pose a significant and positive influence on the consuming organic food intention. Also, the perceived cost and health issues were not significant for the intention of consuming organic food predictions for this generation.

In order to create a picture of the organic food demand around the world, the sample data of the Research Institute of Organic Agriculture (FiBL, 2020) will be further used. Figure A15 presents the yearly amount spent on organic food around the globe in 2017.

Figure A14. The amount spent per capita on organic food on each continent in 2017 (euro)

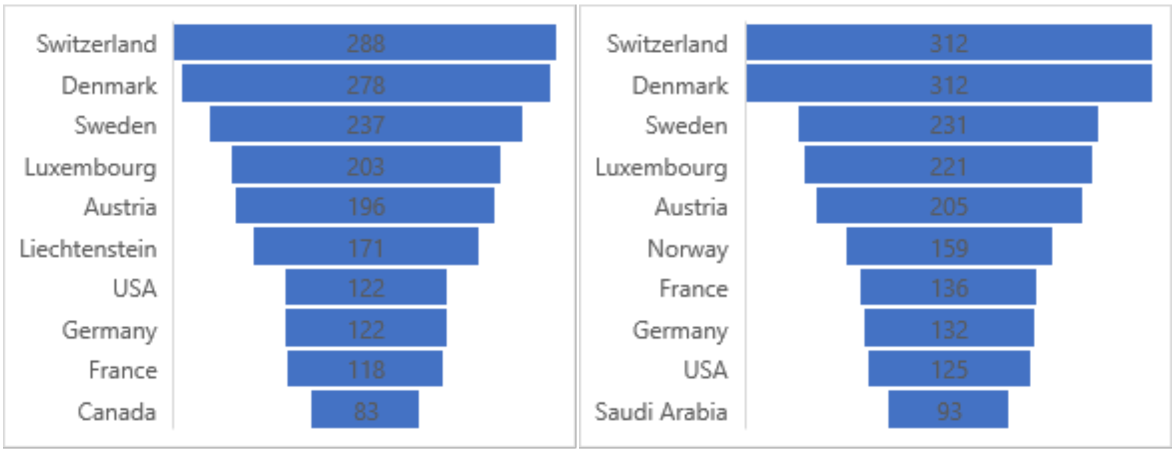


Source: FiBL, 2020

The Northern part of the American continent spent the highest amount on organic food products in 2017, an average of 119.1 euro/ capita, more than double from the second position, Europe, with 50.3 euro/capita. Oceania spent no more than 31.8 euro/capita, while the other three regions have less than 2.5 euro/year/capita spent. Even more, in Africa 0 euro were spent for this type of products in 2017.

The top ten countries regarding the amount spent on organic food products in 2017 and 2018 may be observed in figure A16.

Figure A15. Top ten consumption/ capita of organic food in 2017 and 2018



Source: FiBL, 2020.

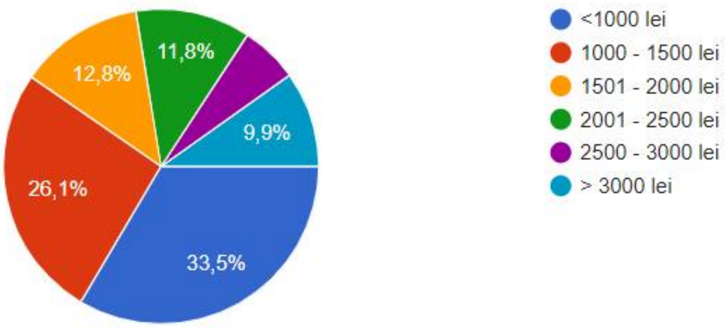
Switzerland has the highest amount spent on organic food products, with an increase of 24 euro/capita between 2017 and 2018. The following place, Denmark, has an increase of 34 euro/capita in the considered period. During the two analyzed years, the first five places remain the same, while in the second part of the ranking there are switches between the USA, Germany and France, and even new entries from the Asian part of the world, Saudi Arabia with 93 euro/capita in 2018. Romania has not collected any statistical data regarding the spending on organic food.

4.1 Questionnaire results

Based on the responses of the 203 students of the Agri-food and Environmental Economics Faculty of the Bucharest University of Economic Studies, the results are presented further.

From the total number of respondents, 96% are young adults, between 18 and 25 years old, 70 % of the respondents are girls and 30% are boys. Regarding their provenience, 58% are from urban areas, while 42% are from rural areas. The income categories, in which the respondents are included in, are presented in Figure A2.

Figure A16. Income categories of the questionnaire respondents



The respondents have small average incomes, as approximately 60% have less than 2,000 lei/month to spend, which represents around 416.67 euro/month (considering an exchange rate of 4.8 lei/euro). In this case, the possibility of spending a significant amount on organic food products is jeopardized.

Most of the respondents considered that they are familiar with the "organic agriculture" concept and they recognize the visual symbol of it, 97%. Yet, only 55.7% of them chose the right visual symbol of organic agriculture in Romania and 81.1% chose the right visual symbol for the European organic agriculture. In this case, first hypothesis is confirmed for the European logo and infirmed for the Romanian logo.

Most respondents associate organic food products with health, with "cleaner" production practices, natural, with less chemicals or pesticides. Biological, ecological, green and natural are seen as synonyms for organic food products. It is important that the respondents consider both the production and the processing practices for obtaining organic food products.

The most important aspects considered by the respondents in defining an organic product are:

- a product without additives, preservatives, added colors;
- a product that comes from an agriculture without fertilizers; pesticides; chemicals;
- a product that is "bio", "eco";
- natural;
- healthy;
- good for the environment.

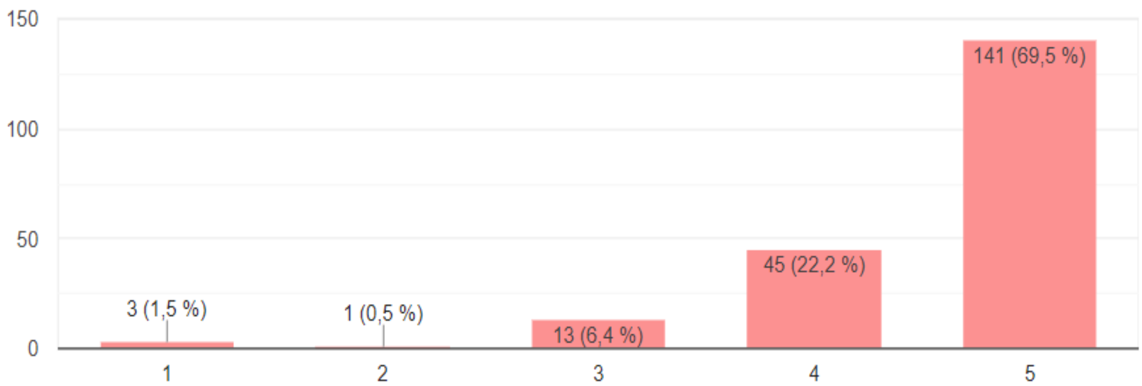
Other less considered aspects, but that need to be mentioned since they offer interesting perspectives on organic food products are:

- of good quality;
- "clean";
- fresh;
- obtained without pollution;
- safe product;
- ensures food security;

- that care for animal welfare and human health;
- expensive.

Regarding the role of healthy eating in the respondents' lifestyle, 69.5 % of them claim that they consider eating healthy as being particularly important in their lives, while only 1.5 % of the respondents consider it has no importance. The detailed scale of responses is represented in figure A17.

Figure A17. The importance of healthy eating

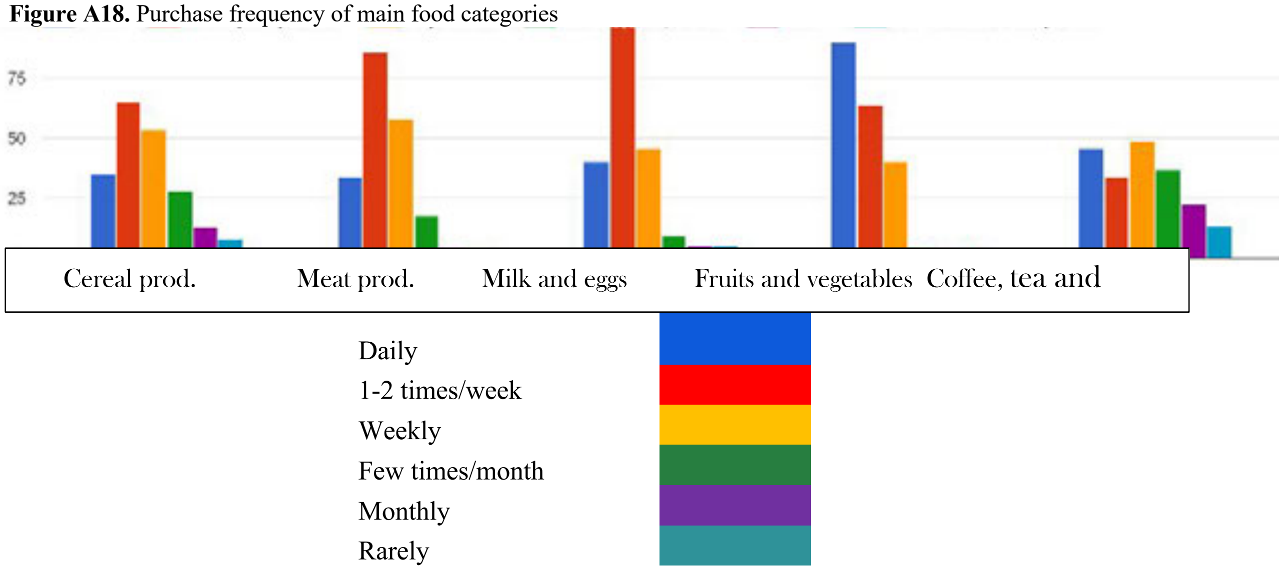


Source: authors' processing based on questionnaire results

In this case, the second hypothesis is confirmed by the responses of the students who participated in the study. Even more, the following question highlights the association made by the respondents between the organic food and the health benefits, as 99% of the respondents consider that organic food has more health benefits than conventional food. So, the third hypothesis may be considered as confirmed.

Further, the purchasing frequency of the main food categories was illustrated in figure A18.

Figure A18. Purchase frequency of main food categories

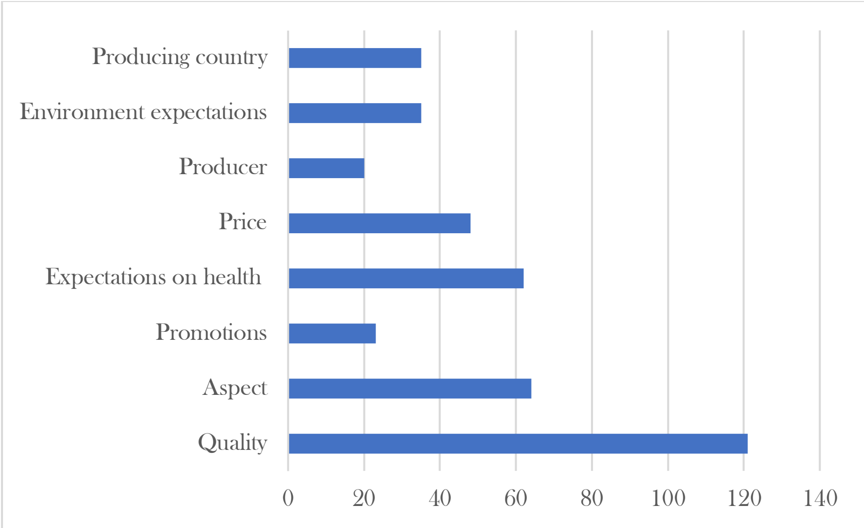


Source: authors' processing based on questionnaire results

Regarding the purchasing frequency, the respondents prefer to shop more often for their food products. The preferred periods being daily, 1-2 times/week and weekly, as it was assumed in the fourth hypothesis.

The factors that matter most in the regular food choice made by the respondents are presented in figure A19.

Figure A19. Influencing factors of conventional food choice



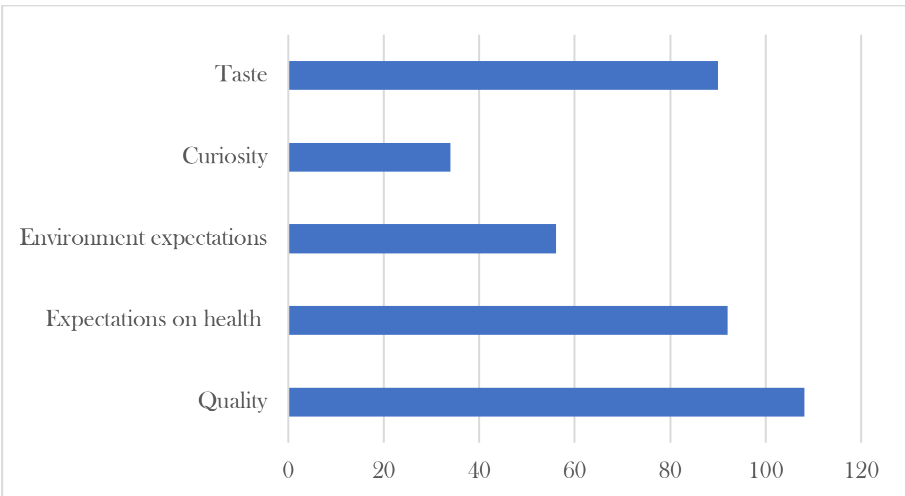
Source: authors' processing based on questionnaire results

As the young respondents claim, the quality of the product is more important than its price for the regular food purchasing, infirming the fifth hypothesis. The aspect and health benefits expected to be provided by the purchased food product are also important influencing factors. It is important to mention that the environmental expectation from the purchased product is starting to be considered by the respondents.

When asked to consider the factors that would mostly influence them in the purchase of organic food products, the respondents considered quality, again, as the most important one. 108 students think quality would be the prime factor of influence if they were to buy organic food products.

The quality is followed by the health expectations on this type of products, as it can be seen in figure A20.

Figure A20. Influencing factors of organic food choice



Source: authors' processing based on questionnaire results

The third factor of importance in the presumed choice of organic food products is the taste. In this case, the respondents expect the food products to have a significant better taste than the conventional ones, a fact that might deliver singular purchases and not a regular purchase pattern. Also, the environmental expectations are higher for these products than for the regular ones.

An important aspect is the placement of curiosity on the fifth position, a fact that might be interpreted as buying organic food products as a thoughtful decision and not an impulsive act.

The list of factors that influence the young Romanians who responded to this study in the possible choice of organic food are, from the most important to the least important:

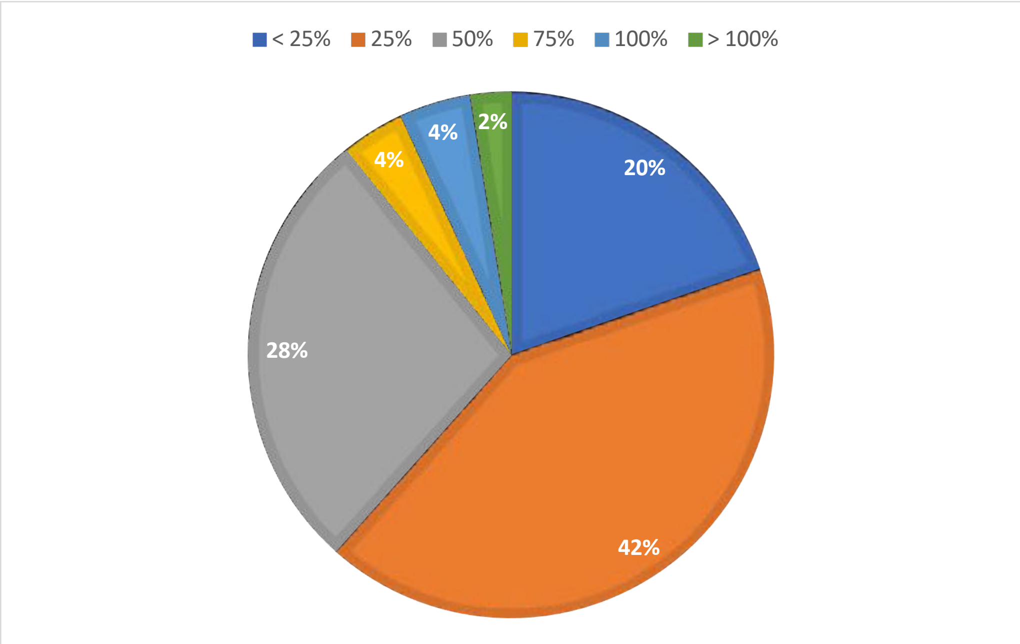
- Quality of the product;
- Taste of the product;
- Expectations of health benefits due to the choice of the product;
- Expectations of environmental improvements due to the choice of the product;
- Curiosity towards the product.

When considering the preferred place for purchasing organic food products, the respondents chose the supermarkets and hypermarkets as the first choice, with more than 69%, followed by farmers' markets with 14.3% and specialty stores with 10.8%. The last places the respondents would buy organic products from would be proximity stores (4.9%) and online stores (0.5%). Therefore, the fifth hypothesis is again infirmed.

When considering how much they would pay more for organic food products than for the conventional food they regularly buy, considering the smaller yields, the respondents showed more reluctancy. Less than 10% of the respondents were willing to pay 75% or more. Figure A21 illustrates the spread of choices.

The highest percentage consists of respondents who would pay maximum 25% more for organic food prices, turning out that price is, actually, an important aspect in the purchasing pattern.

Figure A21. Willingness to pay more for organic food products

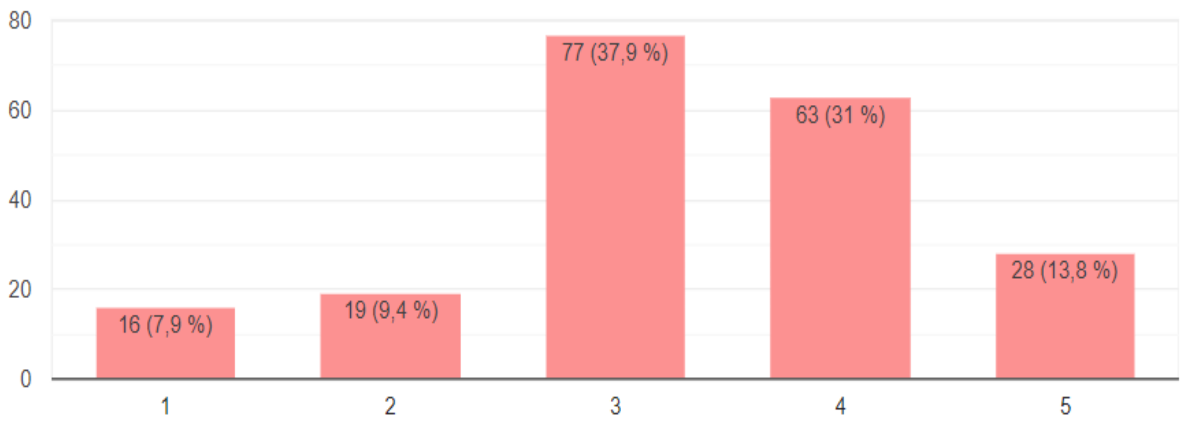


Source: authors' processing based on questionnaire results

When considering the trust in the certifying authorities in Romania, the initial assumption was that few respondents trust that the certification authorities do a good job and they can be trusted. Figure A22 illustrates the level of trust in Romanian certification authorities by young consumers who responded to the study.

The results show that most of the respondents have a neutral position regarding this matter. However, 43% of the respondents have a positive attitude towards the certification authorities.

Figure A22. The level of trust in Romanian certification authorities



Source: authors' processing based on questionnaire results

5. Conclusion

Because the analysis of the organic food market in Romania, compared to other world regions has pointed a few interesting things, both positive and negative, the concluding remarks will be expressed through a SWOT analysis.

The analysis will highlight the opportunities and challenges expected in the near future for the Romanian market of organic food.

Strengths

- The agricultural land used for organic agriculture and under conversion is rising, Romania is part of this trend, having large agricultural areas to offer;
- The young generation is aware of the benefits on personal health and on the environment that can be brought by consuming more organic food and less conventional one, as it is revealed by international studies and confirmed by the results of the present study on 203 Romanian young people;
- The available information on organic food reaches the respondents of this study, the visual images of organic agriculture in EU and Romania being recognized by the majority of the respondents.

Weaknesses

- The production of organic food is little in Romania, so the current producers are not able to deliver consistent quantities to the supermarkets and hypermarkets;
- The respondents to this study understand the difficulties of producing organic food, but their incomes would not allow them to pay considerably more on these products than they pay for conventional produced ones;
- A large part of the respondents considers that the certification authorities of organic food in Romania do not do a proper job in controlling and monitoring the truthfulness of the certified produce, and that generated trust issues.

Opportunities

- More and more research indicates the benefits of organic food on health and on environment;
- Consumers represented by the respondents to this study easily recognize the organic food products in stores;

- There is room for more organic certifications, so the products can be easily recognized in the stores;
- The Romanian young people which responded to the study recognizes the logo of EU certification of Organic agriculture faster than the Romanian logo, so there can be room for EU imports of organic products in Romania;
- Young respondents are more willing to search for qualitative products rather than only consider the price;
- The number of operators in the organic food system (producers, processors, importers and exporters) is still very small, especially in Romania, so new operators would have a high potential for gaining clients;
- The freshness of the product is important for the young respondents, a fact that can be translated in a preference for local food, which does not have the time to wilt. This might be an opportunity for the local organic farmers;
- Many of the respondents to this study would prefer the large retail stores for buying organic food products, so high quantities might be sold through these channels.

Threats

- The respondents to this study, potential consumers of organic food products, have high expectations regarding these products in terms of taste, health benefits and environmental benefits, so a lack of significant improvement on the three areas on short term might determine losing them as consumers;
- The number of organic food operator is higher in countries close to Romania, so they could cover the market before the Romanian operators;
- The respondents to this study are aware of the yield differences between organic and conventional food production, but are not willing to pay more than 25 % for organic food products;
- The certification authorities have a problem in gaining the trust of the young respondents regarding the truthfulness of their verifications;
- The online stores are not in the preferences of the young Romanian respondents for buying organic food.

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Appendix 1 – Definitions of key terms

organic food: food that should be prepared only through methods that do not interfere in the integrity and vital quality of the product, in all stages of production and distribution and should be made integrally or almost integrally from organic raw ingredients, with the lowest presence of GMOs, but not excluding these components.

organic food market: the confronting place of demand and supply, the consumers of organic food products and the organic food operators (producers, processors, importers/exporters and distributors of organic food).

willingness to pay: the predisposition of a specific category of people sharing similar characteristics (such as age, location, income level, education level etc.), which in certain conditions would pay more in order to purchase products that may satisfy other needs than the basic ones. In our case, the willingness to pay for organic products, considering the possible health and environmental benefits they might have.

organic food operators: the people that work in the supply chain of organic food. This category includes farmers or producers of organic food, processors of organic food, sellers, exporters and importers of organic food.

retail sales: sales of products sold in small quantities, purchased mostly with the purpose of personal/final consumption and not for other resale activities, as opposed to wholesales, regularly large quantity sales intended to be resold.

Appendix 2 – Questionnaire

Title: The availability to pay for organic food products among youth

Q1: Are you familiar with the phrase "organic agriculture"?
Yes / No

Q2: Which of the following represents the official logo of "organic agriculture" in Romania?

Q3: Which of the following represents the official logo of "organic agriculture" in the European Union?

Q4: Shortly describe what do you understand by "organic food product":...

Q5: Evaluate how important is a healthy diet for you on a scale from 1 to 5 (where 1 is the least important and 5 is the most important):

a) 1
b) 2
c) 3
d) 4
e) 5

Q6: Evaluate the following sentence "Organic agrifood products are heathier than conventional obtained agrifood products" on a scale from 1 to 5 (where 1 is the least important and 5 is the most important):

a) 1
b) 2

c) 3
d) 4
e) 5

Q7: How often do you purchase the following categories of food products?

Element	Daily	1-2 times per week	Weekly	Few times per month	Monthly	More rare than once per month
Cereal products						
Meat products						
Dairy and egg products						
Fruits and vegetables						
Coffee and tea						

Q8: Rank the following factors considering their highest influence in your food purchasing decision (where 1 is the least important and 8 is the most important):

1) Quality
2) Aspect
3) Promotions
4) Expected health benefits
5) Price
6) Producer
7) Environmental benefits from the production process of the product
8) Producing country

Q9: How much more would you be willing to pay for organic food products, considering the yield differences:

a) <25%
b) 25%
c) 50%
d) 75%
e) 100%
f) >100%

Q10: From which of the following options would you prefer to purchase organic food products?

a) Hypermarkets and supermarkets
b) Proximity stores
c) Specialty stores
d) Food markets and dedicated fairs
e) Online stores

Q11: What would convince you to choose organic food products instead of the conventional ones?

a) Quality
b) Health benefits
c) Environmental benefits
d) Curiosity

Q12: Evaluate your trust level in the fact that the authorities fulfill their duties of certification and monitoring in the agrifood sector on a scale from 1 to 5 (where 1 is the least important and 5 is the most important):

a) 1
b) 2
c) 3
d) 4
e) 5

Q13: In what age category do you find yourself?

a) <18
b) 18-25
c) >25

Q14: What is your gender?

a) Female
b) Male

Q15: In what area of residency do you live in?

a) Rural
b) Urban

Q16: In what category of monthly net income do you find yourself?

a) <1,000 lei
b) 1,000-1,500 lei
c) 1,501-2,000 lei
d) 2,001-2,500 lei
e) 2,501-3,000 lei
f) >3,000 lei

Ch. 1.2.

CHALLENGES AND OPPORTUNITIES IN THE ROMANIAN ORGANIC FOOD MARKET CONSIDERING YOUTH PREFERENCES

Organic food market investigation

OBJECTIVES:

- The students will be able to analyses the organic food market considering the Romanian case;
- The students will be able to identify the main challenges in the Romanian organic food market;
- The students will be able to identify the main opportunities in the Romanian organic food market.

SKILLS:

- Characterize the organic food market in Romania;
- Design a market survey on food issues;
- Critical thinking on organic food issues;
- Challenge the arguments of other peers on organic food topics;
- Managing information on organic food issues.

QUESTION 1 WHAT TYPE OF ORGANIC FOOD OPERATOR IS THE MOST PRESENT ON THE ORGANIC FOOD MARKET? (PLEASE CHECK THE CORRECT ANSWER)

Please, enter the proper question related to specific content of the previous chapter.

- ☐ Processors
- ☐ Agricultural producers
- ☐ Importers
- ☐ Aquaculture producers

QUESTION 2 WHAT AFFIRMATION COULD BE CONSIDERED AN OPPORTUNITY FOR THE ORGANIC FOOD MARKET? (PLEASE CHECK THE CORRECT ANSWER)

Please, enter the proper question related to specific content of the previous chapter.

- ☐ The consumers have high expectations for the organic food products in terms of health and environmental benefits
- ☐ The consumers are not willing to pay by more than 25% for organic food products
- ☐ More and more research show the benefits of organic food on health and on environment
- ☐ Important parts of the world are still too poor to participate in the organic food market

QUESTION 3 WHAT AFFIRMATION COULD BE CONSIDERED A CHALLENGE FOR THE ORGANIC FOOD MARKET? (PLEASE CHECK THE CORRECT ANSWER)

Please, enter the proper question related to specific content of the previous chapter.

- The regulations are constantly changing
- The yearly amount spent on organic food products is on a rising trend
- The tendencies at world level show increases in all the organic food market components
- Consumers easily recognize the organic food products in stores

QUESTION 4 IS THE PRESENCE OF CHEMICAL COMPOUNDS PERMITTED IN THE ORGANIC FOOD PRODUCTS?

Please, enter the proper question related to specific content of the previous chapter.

- It is strictly forbidden
- It is permitted
- It should be kept to the minimal presence possible
- The EU Regulations do not specify this

QUESTION 5 PLEASE DESCRIBE THREE INFLUENCING FACTORS OF ORGANIC FOOD PURCHASES (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

Please, enter the proper question related to specific content of the previous chapter.

PRACTICAL APPLICATION. PLEASE DISCUSS THE RESULTS OF THE WILLINGNESS TO PAY FOR ORGANIC FOOD SURVEY WITH YOUR PEERS THROUGH THE DEBATE TECHNIQUE

SECOND SECTION: The Quality of Organic Agriculture

- The control system for organic products manufactured or imported into the EU - guarantee for consumers
- Biochemical difference between organic and conventional foods. A comparative study
- Organic agricultural production as a quality standard
- Beliefs and health-related effects of organic food consumption

2.1. The control system for organic products obtained or imported into the EU - guarantee for consumers

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Abstract: Organic production at EU level is influenced by the consumer interests protection, ensuring an unbiased rivalry between producers and facilitating the free circulation of organic produce in the EU. The consumer of organic produce must have the guarantee of a control system at each stage of the supply chain, regardless of whether the goods are made in the EU or they are made outside the EU. The chapter aims to analyse the control structure that legislates the production, processing, dispersion and imports of organic products at the level of EU member countries. Starting from the fact that there is no systematic approach to determine if a produce is environmentally friendly, maintaining and legitimizing buyers' assurance in goods marked as ecological builds on the strength of the control and certification scheme to reduce the tendency of operators failing to meet relevant standards. The analysis will also reveal the monitoring activity carried out by the European Commission on the control structures of the Member States, the oversight of the control entities by the Member States and the trade of data existing between the different entities and authorities. The chapter will present an exercise in traceability of organic products in Romania.

Keywords: traceability, organic products, transaction certificates, control bodies.

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1. Introduction

Organic production represents "a global system of agricultural management and food production that combines best environmental and climate action practices, a high level of biodiversity, the conservation of natural resources and the application of high animal welfare standards and high production standards that meet the requirements of more and more consumers, who want products obtained with the help of natural substances and processes", according to the Recital 1 of Regulation (EU) 2018/848. The sector of organic production includes the producers, suppliers and distributors of food products form aquaculture and agricultural sectors, therefore the organic products include, besides unprocessed and processed food products, as well the animal feed, beverages and seeds.

A frame of reference for organic production jointly with a structure of control and certification at EU level was introduced by a Council regulation in 1991, the main objectives being to ease the free dynamism of organic products in the EU, to better protect the interests of consumers, and to ensure fair competition between producers.

The 2007 Council Regulation on organic production and labelling of organic products covers all stages of the organic supply chain (aquaculture and zootechnical sectors), such as retailing, distribution and food processing, as well as two implementing regulations contain more detailed rules.

The Commission presented a legislative project for a new set of principles of behaviour on organic production and a new EU action plan on organic production in March 2014. In June 2018 was published the new Council Regulation (EU) no. 2018/848 on organic production and labelling of organic products and it will be applied from January 2021. Until then, the implementing regulations and delegated acts will be finalized and published.

In addition to the specific legislation on organic production, organic foods must comply with the general food law, namely Regulation (EC) no. 178/2002. Organic production falls within the scope of Regulation no. 882/2004 regarding official controls, which was recently amended by the Regulation (EU) no. 2017/625, with the application of these provisions from December 14, 2019.

For reaching the main goal of the chapter, namely the analysis of the control structure that legislates the production, processing, dispersion and imports of organic products at the level of EU member countries, the chapter is structured on 4 subheadings, whose titles describe the purpose of those sections:

- subheading no. 2 - The monitoring activity carried out by the European Commission on the control systems of the Member States;
- subheading no. 3 - The supervision of control bodies by Member States;
- subheading no. 4 – Swap of data between dissimilar entities and authorities;
- subheading no. 5 - Traceability exercise of the organic products in Romania.

The chapter is completed with conclusions, references and an appendix regarding the definitions of key terms.

The documentation realized on the subject *The control system for organic products obtained or imported into the EU - guarantee for consumers* was a bibliographic one, in this way being clarified the concepts and notions used and the methods of collecting and processing of information being deepened, supplemented with the direct documentation, in the purpose of knowing the specifics of the phenomena and activities of the current practice, by gathering information regarding the entities that are the object of the research. Thus, the data in this chapter was obtained through quantitative and qualitative methods, as a result of the study of the Community legislation on food, organic products and their control system, completed with official data on European key indicators (organic area and organic retail sale), having as source of information FiBL (2020), as well as data obtained from the MARD (2020), Ministry of Agriculture and Rural Development in Romania, regarding the information on transaction certificates issued by the control bodies in Romania, between January to August 2019.

2. The monitoring activity carried out by the European Commission on the control systems of the Member States

There is no test discovered through experimentation to conclude if a produce is an organic product. "Maintaining and justifying consumer confidence in products labelled as organic" (Recital 3 of Regulation (EC) No. 834/2007) "depends on the ability of the control and certification system to reduce the probability of operators failing to meet relevant standards" (The ECA special report no. 4/2019).

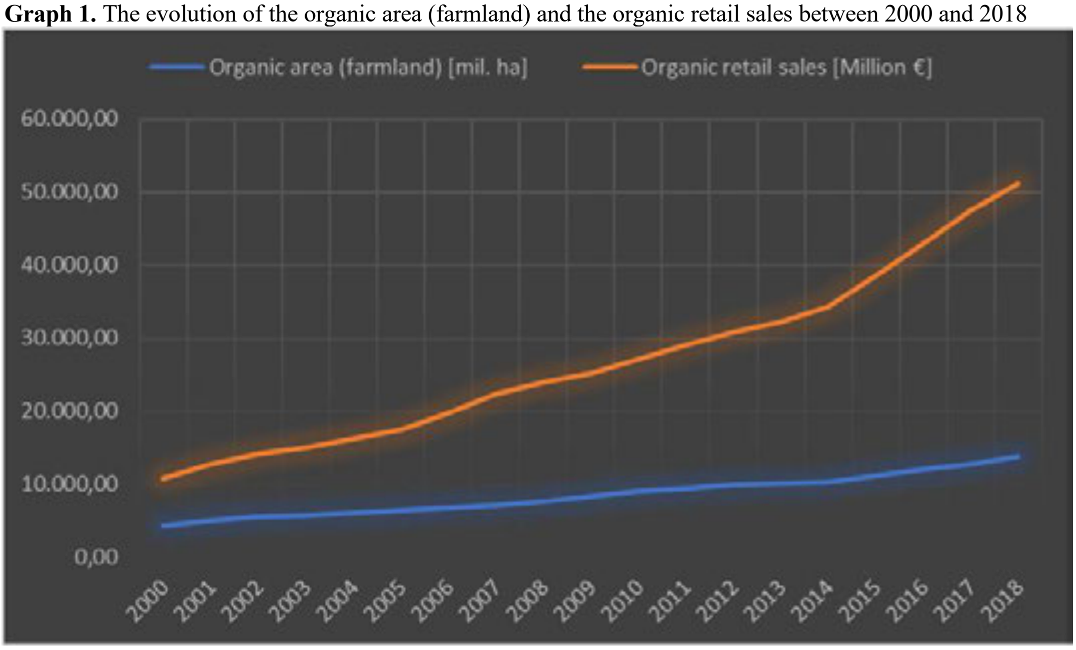
The EU logo indicates that the product was subjected to a control and certification system and, thus checking whether it was obtained in accordance with the relevant EU standards. This means that "at least 95% of the agricultural ingredients are organic, in the case of processed products" (European Commission 2020). Thus, for the safety of this, one of the basic elements is the fact that specific operators, at various stages of the supply chain, have to set up their own processes for the organic goods, shifting from clean controls to very complicated methods.

The EU has set up a control scheme, meaning that the single operators are being verified by particular entities, that are a main essential feature of all ecological control and certification systems, and these controls include checking the accounting documents, physical inspections performed at the production or processing units and taking samples of finished goods, of harvested products, of leaves or of soil fragments for examination to determine if there were used, or not, unauthorized substances. The operators have to compensate for the certificates issued by the control entities.

For the imported products are being enforced different control systems regarding those applied to the products obtained in EU. In all these systems, the central role is played by the Commission, overseeing both the control systems of the Member States and the actors involved in the different import regimes.

The EU ecological sector has grown rapidly in recent years, in terms of the agricultural area involved, its market share and number of operators. The total area of agricultural land used for organic farming in the EU expanded with 52% in the 2010 – 2018 period, from 9.1 million hectares in 2010 to 13.79 million hectares in 2018. During the same period, the value of retail sales of organic products increased with 107.51%, from 18.03 billion euros to 37.41 billion euros. In order to have an overview of the evolution of the value of agricultural areas, as well as of the retail sales of organic products, from 2000 to 2018, the graph no. 1 was created, with the help of the data obtained from the FiBL (2020) site.

Graph 1. The evolution of the organic area (farmland) and the organic retail sales between 2000 and 2018



Source: created by the author based on information from FiBL (2020) site

Like Falguera et al. (2012) said, people started to have concerns about the impact of the consumed food on their own health, as well as the social and environmental consequences that it entails. As the consumers interest in organic foods is increasing, so does the need for a robust analytical tool for their authentication (Capuano et al. 2012). Consumers pay a higher price, sometimes even significantly higher, for organic products than the price paid for conventional products. The price difference is influenced both by the differences related to the processing and distribution costs, as well as the demand from the consumers. Reported price premiums vary significantly from one study to another and from one food product to another, and the producers are receiving only a part of these premiums (Marian et al. 2014).

Considering that, at the time of the publication of the 2012 audit report of the European Court of Auditors, “the Commission had not carried out any audit on organic farming in the Member States since 2004” (The ECA special report no. 9/2012), one of the recommendations in the report was to strengthen its monitoring activity of the control systems in the Member States by carrying out audit missions and by collecting and using the necessary data and information. Thus, following the Court's report, the Commission restarted its audit visits to the Member States. According to the special report no. 4/2019 of the European Court of Auditors (follow-up audit), between 2012 and the end of 2018, “the Commission's Directorate-General for Health and Food Safety (DG SANTE) conducted 63 audits related to organic farming, of which 28 were conducted in the EU Member States and the general conclusion of this audits was, in most Member States, that despite the deficiencies identified in the supervision of control bodies and at the level of individual inspections, the control systems were well organized. The Court confirmed the relevance of the Commission's findings, after the two visits made to the Member States that the Commission had verified in 2014 and 2015 (Czech Republic and Bulgaria)”.

The Commission may initiate a procedure for failure to fulfil some obligations if the EU ruling on organic goods has not been accordingly enforced. There are also EU Pilot procedures (the Commission can send to the Member States concerned letters, prior to the finding of non-compliance with the obligations, if EU ruling on organic goods has not been accordingly enforced), which are beneficial instruments for starting a talk with the Member States. According to the special report no. 4/2019 of the European Court of Auditors (ECA), since 2012, the Commission has sent 41 letters prior to the finding of non-compliance with the obligations to 22 different Member States. Through EU Pilot procedures, the Commission was able to avoid initiating longer procedures, even if these lasted on average nine months.

In addition, the Commission uses fruitfully the gatherings of the Committee on Organic Production (COP), compounded of representatives of the Member States, thereby this COP is coming together of five to seven times a year. The measures taken as a result of irregularities and suspected fraud is one of the persistent subject matter at these gatherings. Last but not least, the Commission has taken initiatives regarding the coordination with the control bodies and competent authorities, private sector organizations and anti-fraud authorities, as well as regarding their formation. Some examples regarding the types of fraud, also critiqued in the study realized by the Manning & Monaghan 2019, include substitution, mislabelling or misrepresentation of origin (regional location or country), incorrect varietal declaration or method of production (conventional or organic).

3. The supervision of control bodies by Member States

Monitoring the control scheme for organic goods in the EU is highly valued, as most of the organic goods used in the EU are produced in the Union. According to the special report no. 9/2012 of the European Court of Auditors, in addition to reinforcing the Commission's monitoring control systems in the Member States, the Court expected from the competent authorities of the Member States to strengthen the supervisory role of control bodies, including harmonizing the definition of nonconformity types and the related measures to ensure compliance with the regulations. Following this report, the Member States are beginning to have documented and proper steps for approving and supervising of control entities, in this way the oversight of the control structure for organic goods produces in the Union is being enhanced.

In 2013, the European Commission amended the Regulation (EC) no. 889/2008 by supplementing with a chapter, no. 9, regarding the supervision realised by the competent authorities of the Member States, specifying in this way the legal framework. In this regard, for example, are detailed the types of supervisory activities that the competent authorities should carry out with respect to the control bodies and is set out their obligation to organize an annual inspection at the control bodies.

Following the audit conducted in 2012, according to the ECA special report no. 4/2019, “the competent authorities from the Member States that have been subject to the follow-up audit, have taken numerous measures to improve the supervisory activity of the control bodies, for example:

- improved guidelines and procedures (Spain, Ireland, United Kingdom and France);
- made changes in the legal framework (Spain, Germany and Italy);
- the competent authorities have to verify if the control bodies have established risk analysis procedures for the rotation of the designated inspectors and for the inspections they carry out;
- a better coordination with the accreditation bodies (France, Ireland, Germany and United Kingdom)".

Despite the above improvements, the Court has identified in these Member States a number of deficiencies related to its previous findings, including the following:

- in Bulgaria, for the two control bodies visited by the Court, some deficiencies were not identified during the annual inspections of the competent authority and, thus as provided in the regulation, no evidence was identified regarding the performing of a risk analysis on the selection of operators where the goods were to be tested for unapproved substances;
- the Court found that the two control bodies, audited in Italy, made most of the check-ups close to end of the year, during which time they are not so effective, especially in the case of cultivators;
- in France, some of the control bodies did not publish online the updated lists of operators, as well as their ecological certificates, in this way slowing down the traceability checks and reducing transparency;
- in the Court's point of view, after the visit in Spain (Andalusia), the competent authority did not carry out sufficiently documented checks.

Starting with 2013, according to article no. 92d of Regulation (EC) no. 889/2008, the competent authorities have the obligation to adopt a catalogue with non-conformity types and to send it to the control bodies in order to be applied. The Commission has recently begun working with the Member States to supplement the legal provisions with the obligation to develop a catalogue of measures to ensure compliance with the rules, including sanctions, harmonized at EU level.

Also, starting with 2013, the article no. 65 paragraph (2) of Regulation (EC) no. 889/2008 specifies that "the minimum number of samples to be taken and be analysed by the control body should correspond to a percentage of 5% of the number of operators under the control of that control body". For the future, article no. 29 of the new regulation on organic production, Regulation (EU) 2018/848, requires the control bodies or competent authorities to "carry out an investigation to determine the cause and source of the presence of unauthorized products or substances". In these cases, until the results of the investigations are revealed, they have to temporarily block the products.

4. Swap of data between dissimilar entities and authorities

The European Commission, by introducing Article no. 92 (6) of Regulation (EC) no. 889/2008, has introduced an obligation for Member States to communicate to the paying agencies the results of their own inspections on organic production. This is important as it may affect EU grants to farmers. Thus, most Member States currently have cross-notification systems.

By article no. 92 (4) of Regulation (EC) no. 889/2008, it was introduced the requirement that the control bodies inform without delay the competent authorities about the cases of non-compliance affecting the ecological status of the products. In this regard, even though the communication between competent authorities and control bodies regarding the nonconformities is not always prompt, in order to improve it, the Member States have developed procedures and sometimes technological solutions.

Also, according to article no. 92a, if there are detected irregularities involving products from other Member States or irregularities involving products from the same Member State but have implications for another Member State, with the help of the Commission's online tool (Organic Farming Information System - OFIS), the other Member States and the Commission must be informed as soon as possible.

Thus, with the help of this online tool, communication from the Member States has become faster, with very few delays. According to the special report no. 4/2019 of the European Court of Auditors, the response time has improved, 85% of the answers being sent in a helpful time in 2017 (60% in 2016). "Once a notification has been registered in OFIS, the Commission expects the notified country to investigate the possible causes of the irregularity and to respond through OFIS within 30 days", according to article no. 92a (4) of Regulation (EC) no. 889/2008.

In addition, starting with 2013, based on Article 92f and Annexes XIIIb and XIIIc of the Regulation (EC) no. 889/2008, Member States have the obligation to include in the annual reports on food safety, which they send to the Commission, mandatory information on the ecological sector and controls in this sector.

5. Traceability exercise of the organic products in Romania

In accordance with general food law, must be ensured the traceability during all stages of production, processing and distribution, by the food and animal feeding companies. They must be able to identify the companies to which their products were delivered and to track the origin of the inputs in the food chain to their immediate supplier (also called the "one step forward, one step back" approach). This applies to all types of food. Lindh & Olsson 2010 discovered that the objectives of each actor in gaining and maintaining traceability throughout the supply chain were divided into three categories (food safety and quality, managing the supply chain and internal resources and communication with consumers), highlighting the value of close relations between the actors when addressing consumer concerns regarding the process and product characteristics, such as the imperceptible organic attribute.

In addition, because the traceability should permit the confirmation of the ecological status of the goods along the supply chain, the aim of a traceability check is:

- to verify their ecological certification;
- to identify all the operators involved and;
- to follow the product route back to its origin and confine the problem, in case of noncompliance with the regulations, in this way preventing the products in question to reach to consumers.

The Commission has added a module for imports of organic products to the online instrument for monitoring the imports of food and animal feed, called Trade Control and Expert System (TRACES) and established by Commission Decision no. 2004/292/EC in accordance with Directive 90/425/EEC of the Council. Thus, as of October 2017, control bodies must issue electronic inspection certificates (COI) accompanying each batch of imported organic products. In order to provide more comprehensive statistical data on imports and, especially, to improve the traceability of organic products, the TRACES-COI module has been introduced.

In order to obtain and market the organic products that are bearing specific labels and logos, manufacturers must follow a strict process that must be followed precisely, throughout the all traceability of the product. Thus, before obtaining agricultural goods that can be advertise under the term "organic product" the farm must bear a conversion period of minimum two years. During the whole of the chain of obtaining an organic goods, operators must constantly abide by the rules set out in Community and national law. They must submit their activity to inspection visits, carried out by inspection and certification bodies, in order to check the compliance with the provisions of the legislation in force regarding organic production.

According to the ECA special report no. 4/2019 the traceability checks have proved to take a long time and to be sometimes difficult for different reasons, like:

- "the complexity of the supply chain;

- using different databases which are not harmonized in terms of their content is creating problems related to the assessment of the authenticity of the ecological certificates; moreover, these databases are not practical if the control body of the operator is not known;
- certain competent authorities in the Member States show a lack of coordination between them".

In Romania, private inspection and certification bodies ensure the control and certification of organic products. Based on the criteria of impartiality, competence and independence, established in Order no. 895/2016, these private bodies are approved by the Ministry of Agriculture and Rural Development (MARD). The MARD approval of the inspection and certification bodies is mandatory preceded by their accreditation obtained from a body empowered for this purpose.

The operators who demonstrate, after the inspections, that they have complied with the production rules, will receive the organic goods certificate and will be able to mark their goods with the mention "ecological". On the label applied to an organic good must be stated the followings: the logos, the reference to organic production, the code and the name of the inspection and certification body that carried out the inspection.

The national logo specific to organic products, together with the Community logo are used to complete the labelling, in order to be identified by consumers that the products were obtained in accordance with the organic production methods. Thus, consumers who buy products bearing the national logo and the Community logo can be certain that: "at least 95% of the ingredients of the good have been made in accordance with the organic production approach and the product respects the organic production standards. In addition, the product shall bear the name of the manufacturer, processor or seller and the name or code of the inspection and certification body" (MARD 2020).

Order no. 895/2016 states that the control bodies also check the traceability of the products in all stages of production, processing and distribution, in accordance with art. 27 paragraph (13) of the Regulation (EC) no. 834/2007 and has to verify the existence of all the accounting documents that ensure the traceability of the certified products. Thus, the transaction certificate, issued by the control bodies, provides the insurance of the traceability and the status verification of the products, and it will be issued for each sale of the certified products. To the extent that the sale takes place on different days, the operator will request the issuance of a transaction certificate for each day.

As a result of the information obtained from the MARD (2020) regarding the data on transaction certificates issued by the control bodies in Romania, between January to August 2019, for which the traceability was ensured, they had a total number of 3494, for a total quantity of 367.005,61 tons and 11,389.50 litres (only in July 2019) of products marketed or processed, with final destination, both EU and non-EU countries. The types of operators who received the transaction certificates are: manufacturers, traders, importers, processors.

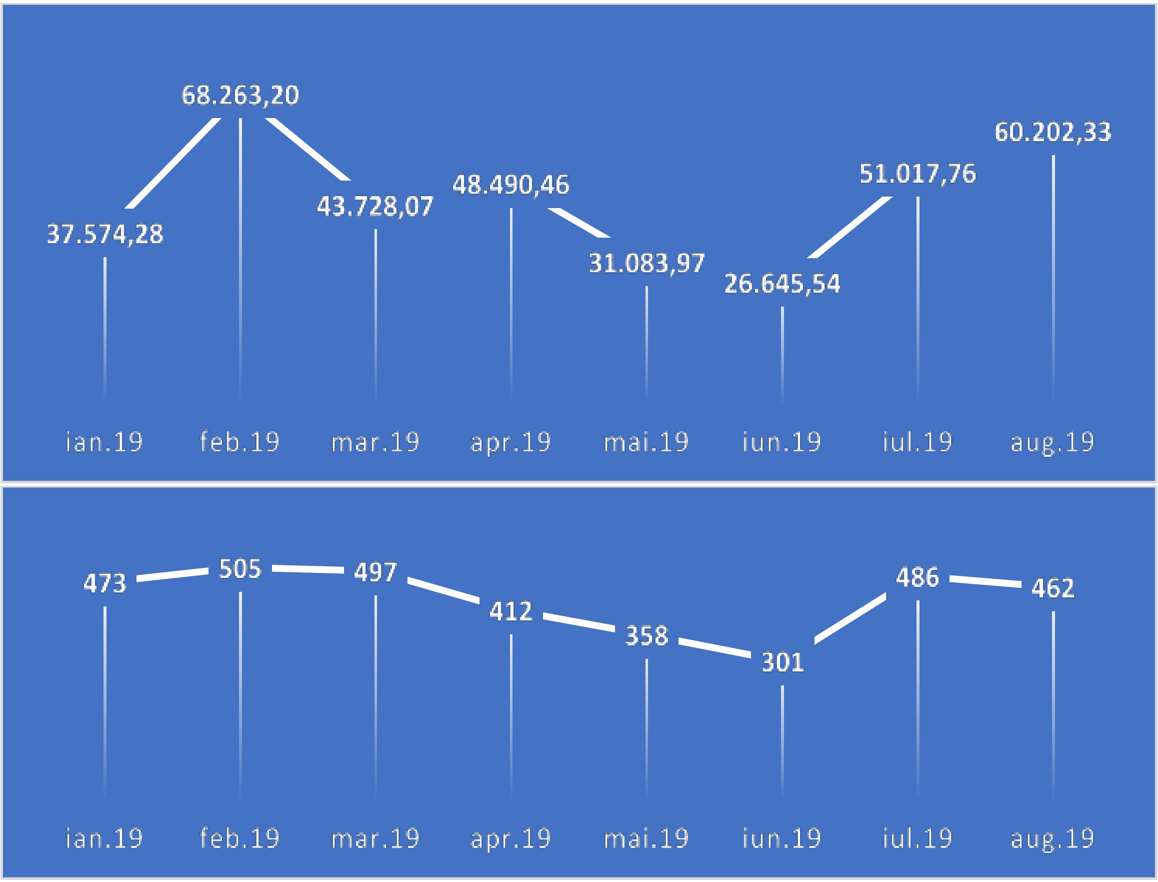
From the graph no. 2 it can be seen that most of the transaction certificates were granted by the control bodies in February 2019, namely a number of 505 certificates, with February also highlighting the highest quantity of traded products during the analysed period (68,263.20 tons). This month, besides Romania as the final destination for 35,661.66 tons (the largest quantity) of organic products, high quantities were also traded (final destination) in EU countries such as Italy (10,755.54 tons), France (5,751.12 tons), Germany (5,063.94 tons) and the Netherlands (2,861.10 tons). Also, high quantities of corn (6,060.66 tons) were transported this month to a single country outside the EU, namely the United Arab Emirates (Dubai).

Also, the graph no. 2 shows the month in which the least transaction certificates were issued, namely 301 certificates issued in June 2019, for the lowest quantity of traded products (26,645.54 tons). As well, this month also Romania was the final destination for the largest quantity of organic products, worth 12,340.56 tons. Other EU countries to which significant quantities of organic products were traded this month were the United Kingdom (4,768.74 tons), Germany (3,706.95 tons), Italy (2,877.54 tons) and

Austria (1,673.50 tons). Outside the EU, the USA was the final destination for an amount of organic products of 20.41 tons (husked seeds of organic hemp – 13.61 tons and organic hemp powder – 6.80 tons).

Analysing the quarterly data, it can be seen that in the first quarter of 2019 most controls were carried out, including on the traceability of organic products, because in this quarter were issued the most transaction certificates (1,475 certificates) for the highest traded values (149,565.55 tonnes), followed by the second quarter of 2019, with a number of 1,071 checks carried out for 106,219,97 tonnes of organic products. In the third quarter of 2019, at least 948 controls were carried out for at least 111,220.08 tonnes, but it must be taken into account that the data related to this quarter is partially missing (missing the data for September of 2019).

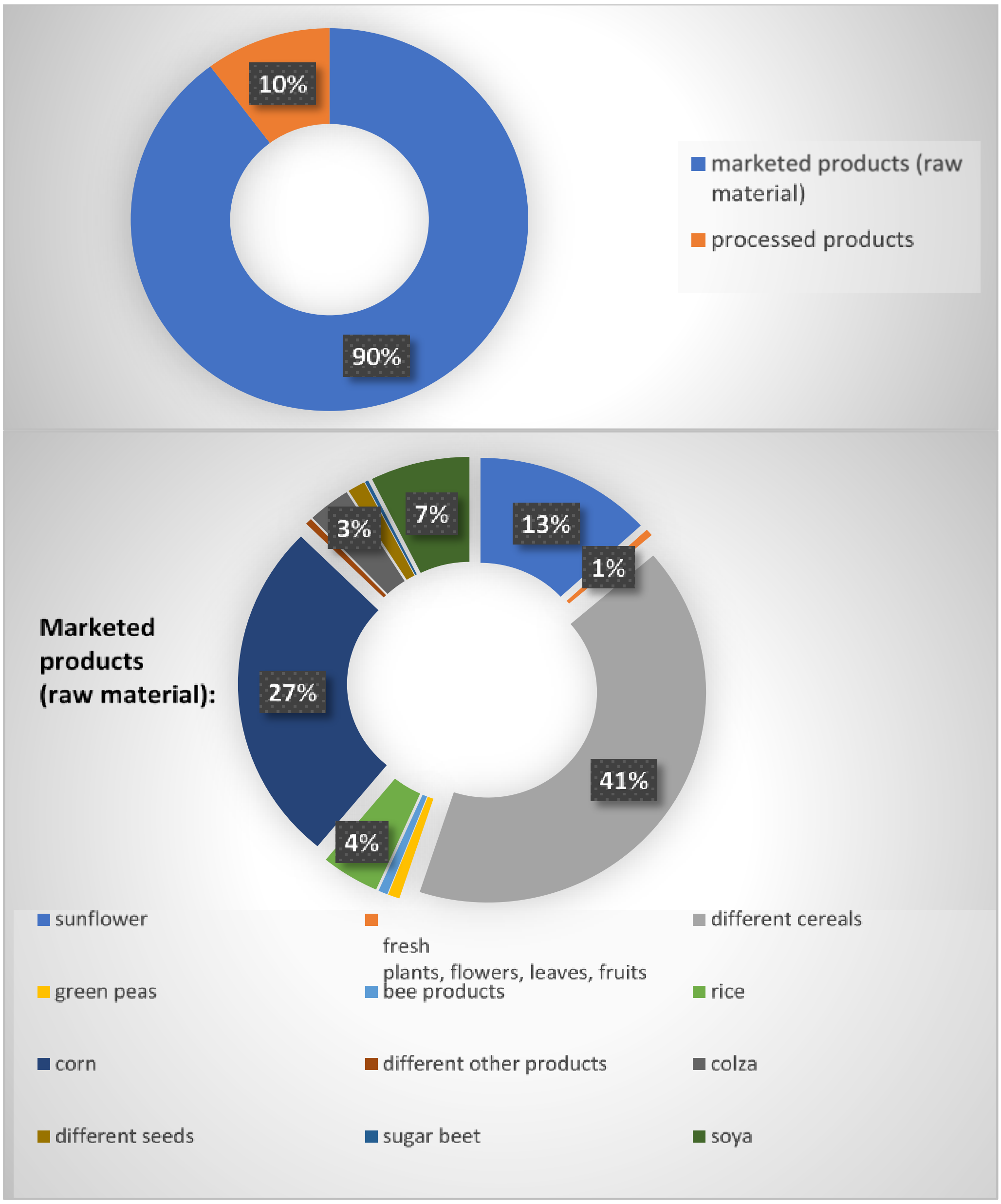
Graph 2. The evolution of the transaction certificates (regarding the number and the quantities) obtained in Romania by the producers, traders, importers, processors, in January-August 2019 period



Source: created by the author based on information obtained from MARD (2020) regarding the data on transaction certificates issued by the control bodies in Romania, between January to August 2019

From the analysis of the graph no. 3 it can be seen that the products marketed as raw material, during the period January-August 2019, represent 90% (329,459.11 tons) of the total of organic products traded for which controls were carried out and for which they were granted trading certificates, while the processed products represented only 10% of the total (37,546.50 tons). Also, of the total products marketed as raw material, the largest quantities traded are those of cereals (wheat, millet, barley, oats, etc.), which represent 41% of the total (136,334.31 tons), followed by corn (27% - 87,129.97 tons), sunflower (13% - 43,317.59 tons) and soya (7% - 24,301.06 tons). There were also checks, including traceability, for products such as rice (4%), colza (3%), different seeds (1%), green peas (0.9%), bee products (0.7%), fresh plants, flowers, leaves and fruits (0.5%), sugar beet (0.25%) and other different products in much smaller quantities than the rest.

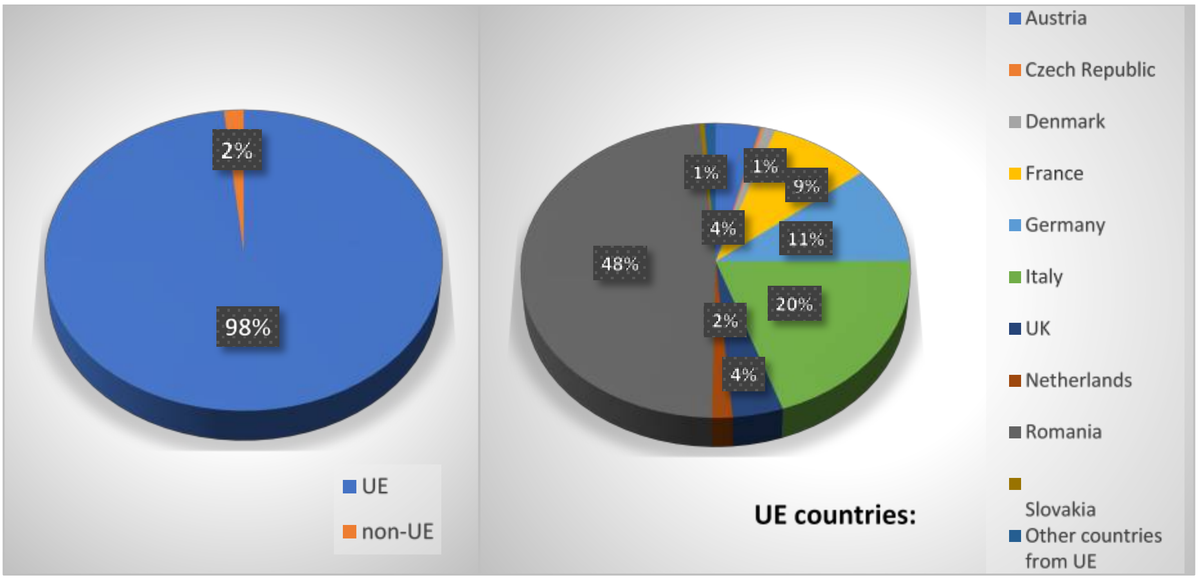
Graph 3. Quantities of organic products for which traceability has been verified



Source: created by the author based on information obtained from MARD (2020) regarding the data on transaction certificates issued by the control bodies in Romania, between January to August 2019

Graph no. 4 reveals the final destinations of the organic products for which checks were carried out by the Romanian control bodies, between January and August 2019. Thus, the highest percentage is represented by countries within the EU of 98% (360,816.24 tons) and the remaining 2% from non-EU countries, such as the USA and the United Arab Emirates (6,186.37 tons). Of the countries within the EU, except Romania with 48% (174,220.47 tons) of the quantities of organic products, to countries such as Italy (20% - 71,482.57 tons), Germany (11% - 38,705.85 tons) and France (9% - 32,190.03 tons) were traded the largest quantities of organic products. As well, the final destination of these types of products were also the countries: Great Britain and Austria with 4%, Netherlands (2%), Denmark and Slovakia with 1%, Czech Republic (0.3%) and other countries within the EU with much smaller quantities of traded organic products.

Graph 4. Quantities of organic products for which traceability has been verified, having final destination within EU and non-EU countries



Source: created by the author based on information obtained from MARD (2020) regarding the data on transaction certificates issued by the control bodies in Romania, between January to August 2019

6. Conclusion

As shown in graph no. 1, the EU ecological sector has grown rapidly in recent years, in terms of the agricultural area involved, its market share and number of operators. The total area of agricultural land used for organic farming in the EU increased with 52% in the 2010 – 2018 period and the value of retail sales of organic products doubled, during the same period. Considering the priorities of the common agricultural policy 2014-2020, as well as 2021-2027, the expectations regarding the main key indicators in terms of agriculture are to continue their growth and development, of the agricultural sector as a whole.

Because the authenticity of organic products can be difficult to verify, it has proved to be necessary the controls regarding the traceability of organic products, being able to identify the companies to which their products were delivered and to track the origin of the inputs in the food chain to their immediate supplier.

According to the information in the special report no. 4/2019 of the European Court of Auditors, between 2012 and the end of 2018, the DG SANTE, within the European Commission, "performed 63 audits related to organic farming, of which 28 were conducted in the EU Member States and the Commission sent 41 letters prior to the finding of non-compliance to 22 different Member States". The competent authorities from the Member States that have been subject to the follow-up audit, have taken numerous measures to improve the supervisory activity of the control bodies, for example:

- "improved guidelines and procedures (Spain, Ireland, United Kingdom and France);
- changes in the legal framework (Spain, Germany and Italy);
- the competent authorities have to verify if the control bodies have established risk analysis procedures for the rotation of the designated inspectors and for the inspections they carry out;
- a better coordination with the accreditation bodies (France, Ireland, Germany and United Kingdom)".

It can thus be concluded that the European Commission plays a central role by overseeing both, the control systems of the Member States, and the actors involved in the different import regimes.

Following the introduction of article no. 92 (4) of Regulation (EC) no. 889/2008, regarding "the obligation of the control bodies to inform without delay the competent authorities on the cases of noncompliance affecting the ecological status of the products", with the help of the Commission's online tool (Organic Farming Information System - OFIS) on the reporting of irregularities, the communication from Member States became faster, with very few delays.

From the chapter regarding the traceability of organic products in Romania it can be observed that, as a result of the checks carried out by the authorized control bodies, during the January - August 2019 period a total number of 3,494 transaction certificates were issued, thus the traceability was respected for a high quantity of organic products, of 367,005.61 tons and 11,389.50 litres (cereals - 41%, corn - 27%, sunflower - 13%, soy - 7%, rice - 4%, colza - 3%, different seeds - 1%, green peas – 0.9%, bee products – 0.7%, plants / flowers / leaves / fresh fruits – 0.5%, sugar cane – 0.25% and other products in much smaller quantities), having final destination countries, both outside the EU - 2% (United States of America and United Arab Emirates) and the EU – 98% (Romania - 48%, Italy - 20%, Germany - 11%, France - 9%, United Kingdom and Austria by 4%, Netherlands by 2%, Denmark and Slovakia by 1%, Czech Republic – 0.3% and other countries in the EU).

Analysing the quarterly data, it can be seen that in the first quarter of 2019 most controls were carried out, including regarding the traceability of organic products, because in this quarter were issued the most transaction certificates (1,475 certificates) for the highest traded values (149,565.55 tons), followed by the second quarter of 2019, with a number of 1071 checks carried out for 106,219.97 tons of organic products. In the third quarter of 2019, at least 948 controls were carried out for at least 111,220.08 tons, but it must be taken into account that the data related to this quarter is partially missing (missing the data for September of 2019).

It can be concluded that, in Romania, a very varied range of ecological products are traded, throughout the year, in each quarter of 2019 analysed being issued over almost 1.000 transaction certificates for over 100,000 tons of ecological products, these products having as destination both EU countries (the most) and non-EU countries (United States of America and United Arab Emirates). It is well known that Romanian organic farming is going in the right direction, but it will take some time until it will be reduced the consistent gap with the economies of Western states. However, for more than 10 years, organic products have strongly entered the business concerns of producers, distributors and retailers.

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Appendix – Definitions of key terms

control bodies - independent private third party or public administrative organization of a Member State (referred to in the law and "supervisory authority"), which carries out inspection and certification activities in the field of organic production;

organic products - a product originating from organic production. Organic production means the use of production methods in accordance with the Regulation (EC) no. 834/2007 at all stages of production, preparation and distribution;

traceability of organic products - the ability to detect and track food, animal food or any product referred to in Article 2 (1) from Reg. 2018/848 or any substance intended or intended to be incorporated in a food or animal food or in any product referred to in Article 2 (1) from Reg. 2018/848, during all stages of production, preparation and distribution;

transaction certificate - issued by the control bodies, allows to ensure the traceability and verification of the status of the products, and this will be issued for each sale of the certified products.

Ch. 2.1

THE CONTROL SYSTEM FOR ORGANIC PRODUCTS OBTAINED OR IMPORTED INTO THE EU – GUARANTEE FOR CONSUMERS

The monitoring, supervision and control system regarding organic products

OBJECTIVES:

- The students will be able to understand the monitoring activity of the European Commission on the control system of the Member States regarding the traceability of organic products;
- The students will be able to understand the exchange of information, especially regarding irregularities, between authorities/organizations;
- The students will be able to identify the main obligations of the Member States regarding the supervision activity carried out on the control bodies for trading of organic products by producers / traders / importers;
- The students will be able to analyse data from a graphic (in this case, different graphics regarding the verifications realized by the control bodies from Romania, based on the trading certificates issued in January-August of 2019 period).

SKILLS:

- Critical thinking on issues regarding monitoring, supervision and control system of organic products;
- Challenge the arguments of other peers and reaching to a compromise after analysing data from graphics regarding the verifications realized by the control bodies from Romania;
- Managing information, regarding organic products, on exchange of information between authorities/ organizations and the system regarding the management of the irregularities.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

The Community logo specific to organic products assures consumers that:

- ☐ at least 98% of the ingredients of the product were obtained according to the organic production method and the product complies with the organic production rules.
- ☐ at least 95% of the ingredients of the product were obtained according to the organic production method and the product complies with the organic production rules.
- ☐ at least 90% of the ingredients of the product were obtained according to the organic production method and the product complies with the organic production rules.
- ☐ at least 85% of the ingredients of the product were obtained according to the organic production method and the product complies with the organic production rules.

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

The Commission meets with the Member States in the meetings of the Committee on Organic Production (COP):

- ☐ four to seven times per year
- ☐ five to eight times per year
- ☐ four to six times per year
- ☐ five to seven times per year

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

The Commission's online tool with the help of which are reported the irregularities that involve products from other Member States or from the same Member State and have implications for another Member State is:

- ☐ AFIS - Anti-Fraud Information System
- ☐ AFOF – Anti-Fraud regarding Organic Farming
- ☐ OFIS - Organic Farming Information System
- ☐ OFAF - Organic Farming Anti-Fraud

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

The TRACES-COI module (TRAde Control and Expert System - certificate of inspection) was introduced by the Commission to:

- ☐ monitor the imports of food and animal feed, to improve the traceability of organic products and to provide more comprehensive statistical data on imports of organic products
- ☐ to monitor the Member States on the checks carried out on imports of organic products
- ☐ to supervise the control bodies regarding the controls carried out on the trading of organic products
- ☐ to monitor the Member States and to supervise the control bodies regarding the controls carried out on the trading of organic products

QUESTION 5 (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

Please, describe the purpose of a traceability control regarding organic products

PRACTICAL APPLICATION. PLEASE, DISCUSS WITH YOUR PEERS AND DESCRIBE, IN YOUR OWN WORDS, THE GRAPHICS NO. 2, 3 AND 4 FROM THE CHAPTER.

2.2. Biochemical difference between organic and conventional foods. A comparative study

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Abstract: Ensuring adequate nutrition and food safety are important issues that lead some consumers to prefer organic products instead conventional ones, although there are insufficient data that organic foods provide both qualities compared to conventional. For this reason, many people have doubts about the choice between organic products, and those obtained under conventional growing conditions. A lot of them believe that conventional foods are healthier than organic ones while others believe the opposite, and few people are indifferent to the choice of foods.
One of the fundamental differences between organic and conventional foods is represented by the method used for crops production. In conventional agriculture, the soil is fertilized with mineral fertilizers, containing plant nutrients, such as nitrogen, phosphate, and potassium (among other minerals), but also with manure, compost, or sludge obtained after sewage treatment of industrial or municipal wastewater. Synthetic mineral fertilizers with nitrogen are not allowed in organic farming, and for this reason soil manure, green manure or other organic materials are used. Therefore, organic food includes agricultural products that are cultivated and processed without using fertilizers, pesticides, feed, additives, or genetically modified organisms (GMOs) obtained by bio-engineered genes.
Generally, there is heterogeneity of the opinion regarding benefits of the organic food consumption. Although, several studies indicate there is no significant proof of the nutritional benefits by eating organic foods, other researches notice that organic foods generally have higher contents of antioxidants, and some micronutrients, like vitamin C, zinc and iron. As well, it is stated that nitrate levels are 30% lower in organically grown crops compared to those obtained conventionally. However, some people do not modify their food shopping routine because they cannot afford organic food, due to the large price difference between the two types of the food.

Keywords: conventional food, organic food, safety, health.

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1. Introduction

Organic farming represents one of the substantial and dynamic sectors of the food industry, characterized by a constant expansion in recent years throughout Europe. Discrimination between organic and conventional products is referring to the modality of the growth (producing) and processing, in accordance with the specific regulations of each region (Simonne et al. 2016). For the European Union, these regulations are included in the last Regulation (EU) 2018/848 of the European Parliament and of the Council of 30 May 2018 on organic production and labelling of organic products that repealing Council Regulation (EC) No 834/2007.

The main reasons that consumers prefer organic products instead of conventional ones are the nutritional intake and safety of these foods, even if the existing data which attest their superior quality are limited and often contradictory. For many consumers terms such as “ecological” food and “biological” food are associated and synonymous with “organic” food.

Food quality can be described by both sensory (subjective) and nutritional (objective) characteristics. Although the sensory quality of foods (expressed by taste, aroma, texture, palatability or satiety index) is important, this is not sufficient if is not taken in consideration the intrinsic quality of the nutritional profile expressed by the energy density index (content balanced by macronutrients and micronutrients), the glycemic index (the ability of carbohydrates in foods to induce insulin production in the pancreas) and the antioxidant score (antioxidant capacity of foods) (Oprica, 2011).

Organic product is those obtained by organic agriculture which enhancing human and environmental health because are obtained without use of synthetic fertilizers and pesticides (Figure 1).

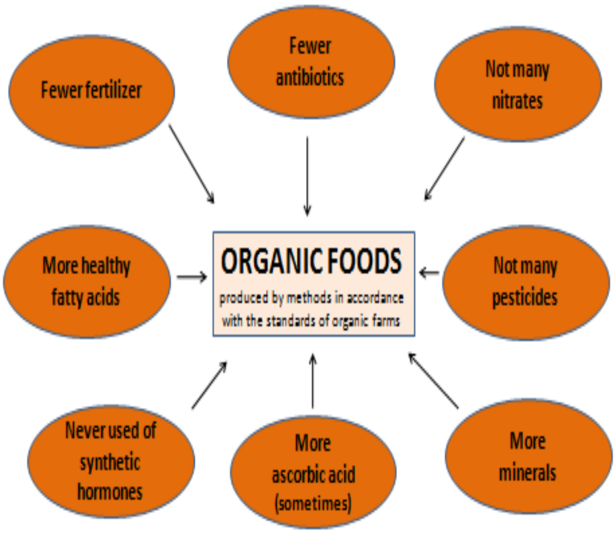

Figure 1. The characteristics of the organic food by comparison to the conventional food (Rembiałkowska, 2016)

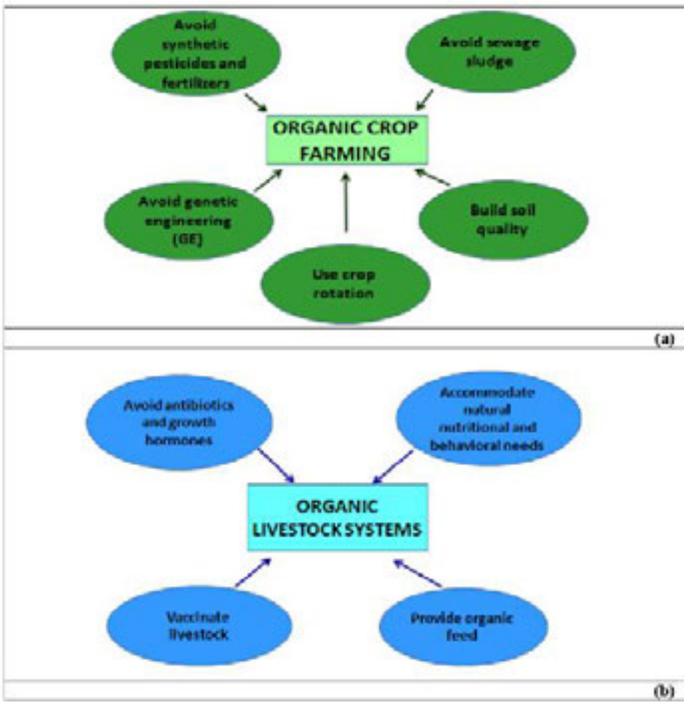

Figure 2. Features of the organic crop farming (a) and organic livestock system (b) (Greene et al., 2017)

Besides, organic food includes farm products which are grown and processed in absence of growth regulators, synthetically fertilizers, biocides, livestock feeds additives (additives such as antibiotics and growth hormone), or genetically modified organisms (GMOs) (Figure 2 a, b).

Organic foods known as certified food is produced according to some rigorous production standards, process closely supervised by official certification bodies. The main argument for the increasing of organic food requirement is that these foods are eco-friendly and more beneficial compared to conventionally obtain products (Brantsaeter et al. 2017).

Although both natural and organic foods are similar concerning colour, size and shape the last of them are often labelled for differentiate (Husain & Padhan 2015). Some studies have found that taste and quality, including the freshness and packaging of the products, also influence the consumption of organic vegetables (Srinieng&Thapa 2018). The market prices of organic products are usually higher than conventional ones because of the higher farms standards for animals’ welfare, environmental enhancement and protection as well as due to more expensive farming practices, or lower crops’ yields (Hemmerling et al. 2015). Also, fears of food contaminants represent one of the most common reasons why people use organic food more often.

Conventional (non-organic) products are those for that the farmers utilize chemical fertilizers to enhance plants growth. In conventional foods production pesticides are used; in animal rearing, the farmers administer antibiotics and growth hormones to improve the growth and health status of the animals.

The present chapter focuses attention on differences between organic and conventional (non-organic) foods regarding the content of nutrients, bioactive substances, and contaminants. Moreover, the objectives were the comparative presentation of macronutrients (carbohydrates, proteins and fats) and micronutrients (vitamins and minerals), which are present in both types of food.

In addition, a sanitary estimation of organic foodstuffs was desired, reflected by the presence or absence of pathogenic microorganisms and phytochemical contaminants. Finally, the potential health benefit of organic foods was highlighted, which differs from conventional ones, mainly due to the absence of pesticides, fertilizers and heavy metal residues.

2. Differences between organic and conventional foods in the content of nutrients, phytomicronutrients, and contaminants

Most countries are trying to pay more attention to the organic foodstuff that is considered more beneficial and safer compared to the products obtained in intensive farming systems. Thus, Bourn & Prescott (2002) found that 70% of food organic consumers which was questioned mentioned that health is the most important reason that people buy organic food. Therefore, for most of the consumers, organic production is associated with the perception of a safety and healthier food, more environmentally friendly production techniques, chemical and microbial superiority.

However, "organic" is not synonymous with "safe". Contrary to popular belief, organic practices themselves are not enough to protect against microbial contamination and proliferation of foodborne pathogens on produce (Ferelli & Micallef 2019).

The nutritional and toxicological level of food produced in organic farming is a matter of major interest and is subject to multiple debates. Foods are considered valuable if these have the lowest amount of contaminants (pesticide debris, nitrates, toxic metals) but contain essential compounds (vitamins, minerals, proteins, etc.) in an optimal level.

There are many questions regarding the nutrient content of crops by using agricultural chemicals and other agricultural methods including organic farming. Some authors reported that organic vegetables do not contain a significantly higher level of nutrients than conventional ones. Contrariwise, some authors suggest that organic crops can be more frequently contaminated with microorganisms, due to the use of organic fertilizers in the production process. (Głodowska & Krawczyk 2019).

On the other hand, according to many scientific analyses the organic food has more of the antioxidant compounds (ascorbic acid) linked to better health than regular food and lower levels of toxic metals and pesticides. In addition, they are also having significantly lower in nitrates and pesticide residues (Crinnion 2010). Unfortunately, there is incertitude because the content of nutrients may be influenced by many factors of which some are uncontrollable (such as rainfall and sunlight).

When we discuss about organic and conventional food basically, we mean organic and conventional agriculture. However, although studies have been done and are still being done, there is not enough data to confirm the superiority of organic crops over conventional ones in regarding the nutritional values.

2.1. Nutritional quality of organic versus conventional foodstuff

2.1.1. Macronutrients content

• **Carbohydrates (sugars)** are the main components of human and animal food, being present in vegetable (89-90%) and animal (1-5%) products. The content of total sugars in vegetable raw materials ensures both a superior quality of the product from a technological point of view and a better taste, as in the case of sugar beet. Several studies pointed that organic vegetables (like carrot, sugar beet, red beet, potatoes, etc.) and organic fruits (such as cherries, red currant, and apples) had a higher amount of carbohydrates comparatively with conventional ones (Rembiałkowska et al. 2012).

Regarding animal products, some studies mention that the major fraction of milk carbohydrates - the lactose - is found in similar concentrations both in organic and regular milk.

The value and content of plant proteins are influenced by the nitrogen from every type of fertilizer. Therefore, high nitrogen content for plants enhances the formation of proteins. Recent meta-analysis studies evidenced that total protein content is more diminished in organic plants as opposed to conventional ones and the value of proteins evaluated by the amount of some aminoacids (lysine, cysteine, and methionine) – is higher in organic crops (Rembiałkowska 2016).

Kind of researches (like Müller and Sauerwein 2010) highlighted a higher level of protein in conventional milk compared to the organic.

In addition, Stergiadis et al. (2015) reported that ratio between κ -casein (a milk-specific phosphoprotein) and casein was upper level in regular milk in comparison to the milk obtained in organic conditions. In contrast, other proteins such as α-lactalbumin, β-lactoglobulin and lactoferrin were found higher in cow's organic milk compared to those of conventional milk (Rembiałkowska 2016).

- Fatty acids are basic components of **lipids** and can be saturated (have no double bonds) or unsaturated (contain double bonds in the hydrocarbon chain). Unsaturated fatty acids can have a single double bond, or several double bonds being called monounsaturated (MUFA) and polyunsaturated (PUFA), respectively.

Essential fatty acids are necessary for the human body but cannot synthesize them which is why they are brought through food. Nutritionists call them essential fatty acids because they have unique beneficial properties and must be brought into the body in an enough proportion because their lack or presence in an insufficient amount prevents the use of other fatty acids in the body. Thus, for the body, very important fatty acids are ω-3 (eicosapentaenoic acid, alpha linolenic acid, docosahexaenoic acid), ω-6 (linoleic acid, arachidonic acid), ω-9 (oleic acid, erucic acid).

The nutritional value of the meat of animals raised on organic farms, in particular expressed by the content of fatty acids, is better compared to that produced by intensive production system. Thus, the high content of unsaturated fatty acids (PUFA) is associated with the prevention of some diseases. As stated in Dalziel et al. (2015), the fat content is lower in organic meat than in industrial livestock production, and organic pork has a higher amount of unsaturated fatty acids. Therefore, pigs which grown reared out-of-doors systems in the organic production and used different diets had the quality of nutrients and fatty acids better than pork from conventional ones (Galgano et al. 2016).

It is obvious that animal husbandry methods have impact on both the nutritional and sensory characteristics of animal products, to which are added a number of factors regarding the age and breed of the animal, as well as storage, transport, and food preparation conditions (Dangour et al., 2009).

Because chickens from organic farms have access to the outside compared to those that grow in cages in the conventional system, the composition of fatty acids is varied. In addition, there are significant differences (like, juiciness, taste, color, fatty acids level) between chicken meats from the two types of farms being to the advantage of the organic one. With few exceptions, many studies show that breasts and thighs of organic chickens have a better content of polyunsaturated fatty acids compared to chickens in intensive production farms (Courtney et al. 2015; Galgano et al. 2016).

Studies showed that feeding cows and sheep with grass on organic farms resulted in a 4-fold increase of linolenic level acid in muscle than in animals which was fed with concentrates (Nuernberg et al. 2002). In addition, Pastsshenko et al. (2000) reported that meat from the cows raised in the open system is richer in polyunsaturated fatty acids compared to that in animals raised in the intensive system.

The diet specific to organic farms (grass-clover silage and hay) also has an effect on the fatty acid content of cow's milk as opposed to milk of cows raised in the intensive system (which uses concentrates). Thus, researches like Bloksma et al. (2008) found higher ω-3 fatty acids level in the organic milk compared with the conventional one.

The composition of fatty acids in eggs depends on the contact of the hen with the open pasture in the system of organic farms. Moreover, the composition of ω-3 fatty acids in egg yolk is higher than that of hens that are raised in cages that do not have access to pasture.

There are differences in the fish flesh quality provided from organic and conventional aquaculture. Thereby, in organic aquaculture it is recommended that animal to be fed so that the fodder provides all the substances necessary for their growth as well as their health maintaining, and as results, the quality of the meat to be superior. In contrast, conventional aquaculture uses dietary formulations that contain minerals, vitamins, and carotenoids with natural or synthetic origin, as well as antibiotics. In the case of freshwater fish (such as salmonids), an important role in obtaining the red-orange color of the skin and flesh, is played by the astaxanthin and canthaxanthin carotenoids, provided through the food chain from different microcrustaceans (zooplankton) (Lovell, 1998). As results, in the fish from organic farm was found a higher content of ω-3 PUFAs (Trocino et al. 2012).

2.1.2. Minerals content

Minerals in food have an important nutritional and physiological role and help our bodies to develop and function. They are essential for good health and they are in different quantities (mg%) in foods. Some of the metals, like chromium (Cr), cooper (Cu) and zinc (Zn) are essential for normal cell functions due to mediating vital biochemical reactions by acting as cofactors for many enzymes, but also as centres for maintaining the structures of enzymes and proteins (Prashanth et al., 2015). Mineral compounds, including iron (Fe), magnesium (Mg), calcium (Ca), potassium (K) and phosphorus (P) are vital for the human body.

Multiple factors, such as anthropogenic activity, elements of soil structure and leakage of the contaminated waters, may contribute to the accumulation of minerals in operating environments, including the heavy metal (Ferelli & Micallef 2019).

Concerning some vegetables like potatoes, carrots, beetroot, lettuce, kale, leeks, turnips, onions, celeriac and tomatoes, there is a tendency for higher contents of Fe and Mg based on fresh weight in organic products, without further significant changes (Lairon 2010).

Regarding cereals, Cooper et al. (2011) reported a lower level of Al, Cu and Zn in conventional wheat compared to organic. Alföldi et al. 1996 showed that in organic barley, there is a higher concentration of Ca, Cu and Zn. Higher mineral content may be due to the cultivation of the soil, achieved correspondingly with organic farming rules and containing several microorganisms able to help the increasing the availability of mineral compounds needed for plants.

In addition, Ciolek et al. 2012 found that wheat grain from organic farming was characterized by a higher content of Mn, Fe, Zn, Ca, and Mg when compared those from conventional farming. Significantly higher amounts of Cr were found in organic flours, and Ni was also more abundant in both organic flours and semolina than in conventional ones (Vrcek&Vrcek 2012). Contrariwise, the increased availability of K in soil, caused by the applied potassium salt fertilization, was reflected in a higher content of this nutrient in grain of all cereals from conventional cultivation.

New data based on meta-analysis (Hunter et al. 2011) revealed that some minerals (mainly B, Cu, Mg, Mo, K, P, Se, Na and Zn) are present in a higher proportion (>5.5%) in fruits and vegetables grown in organic conditions compared to those obtained in conventional agriculture.

Regarding animal products, existing information is very limited. Nevertheless, it has been clearly shown that chickens grown in open fields have a slightly higher Fe level compared to those raised indoors (Castellini et al. 2002). Dietary intake seems to influence the iodine concentrations these being higher in organic than conventional milk without influence of the production season (Payling et al. 2015). Since in intensive agriculture the principal sources of oligoelements are the mineral supplements normally added to the feed, it is justified the significantly lower concentration of these minerals (Co, Cr, Cu, Fe, I, Mn, Mo, Ni, Se, and Zn) in organic milk compared to conventional one (Galgano et al. 2016).

2.1.3. Vitamins content

Vitamins are organic substances that the human body cannot synthesize but which are indispensable for normal growth, harmonious development, and maintenance. Thus, for the normal functioning of the body, an adequate supply of vitamins must be ensured through food. It is known that natural vitamins from food are superior to synthetic ones, even if the active substance is identical. This is one of the reasons why it is wanted to find out if exists it differences and what are them between organic and conventional foods concerning vitamin content. Vitamins can be insoluble in water (such as A, D, E, K) and others are water-soluble (like, C and those from B complex).

In the human body, ascorbic acid (vitamin C) has a crucial role in human health due to its antioxidant role. Moreover, vitamin C protects the body against various chronic diseases and helps to maintain the vascular system in good condition.

The highest amounts of vitamin C were identified in the organic food tested, represented mainly by the fruits and vegetables.

Most of the studies showing that the level of ascorbic acid was higher in many organic fruits (like, peaches, passion fruits) and vegetables (such as tomatoes, potato) tested than those conventional (Table 1). However, some studies have shown a lower or identical level of ascorbic acid in organic plants, especially tomatoes, but there were no differences in leeks, carrots or beets (Lairon 2010).

With regards at vitamin B1 (thiamine) and B2 (riboflavin) levels there are very sparse and inconclusive published data. However, a study showed that the millets grown on the organic farm (with manure) had vitamin B content with 15% higher than those grown on soil treated with chemicals (Bourn & Prescott 2002).

Regarding the content of vitamins (A, D, and E) of cow milk from organic farms this is higher than of the milk from animals that do not utilize the pasture (Rembiałkowska 2016). Some studies show that vitamin A level was higher (with 10-17%) in wheat grown in the manure soil comparatively ones the chemically fertilized soil.

Carotenoids are very important substances for human health; they have an anticancer role, being very good antioxidants (because they have the property to neutralize free radicals).

Comparative studies of carotenoids content in organic and conventional plant products have evidenced various results, often contradictory.

Thus, most of the authors pointed an elevated level of carotenoids in organic carrots, sweet peppers, and tomatoes. In contrast, other studies found lower or similar contents of carotenoids in organic products like blanched carrots and tomatoes. The amount of carotenoids in the plant body is influenced by external factors (climatic conditions, pesticides and fertilizers used) but also by internal factors (genotypes of crop plants) (Barrett et al. 2007).

Lycopene is the main carotenoid present in tomatoes which gives them their vivid red colour. It has been shown to help reduce cancer risk. Nitrogen is one of the factors which increase the content of lycopene in tomato fruits. Thus, by nitrogen fertilization in conventional agriculture obtained a high level of lycopene comparatively with organic tomatoes (Hallman 2012).

The main objective in the dairy industry is to prevent the spontaneous oxidation of milk, a phenomenon influenced by the content of **α-tocopherol** (a type of vitamin E) and **β-carotene** (a precursor/inactive form of vitamin A). The fresh forages contain higher concentrations of vitamins compared with stored or dried fodder and cereals, and for this reason many studies have mentioned higher levels of α-tocopherol and β-carotene in organic milk than milk from animals fed with conventional feeding. However, according to Zagorska and Ciprovica (2008), the levels of vitamin B1 and vitamin B2 are lower in organic milk compared to conventional one.

Several studies have established that egg yolks from chickens raised on organic farms contained more carotenoids (β-carotene and zeaxanthin) than conventional ones. Moreover, high levels of α-tocopherol and flavonoids were found in organic egg yolk by comparison to those from chickens raised in intensive production systems. This is why organic eggs are more expensive in many countries (Rembiałkowska 2016).

Table 1. Nutrient level in organic and conventional foods (according to Popa et al. 2019)

	Foods	**Chemicals studied**	**Results**	**References**
Plant origin food products	Tomatoes	Vitamin C, carotenoids, phenolic compounds	Vitamin C, carotenoids and polyphenols (less chlorogenic acid) were found in higher amounts in organic tomatoes (when fresh matter was reported). When the report was made to dry matter, carotenoids were the same as for conventional tomatoes, while the other components remained more abundant in organic tomatoes.	Caris-Vevrat et al. 2004
	Eggplants	Phenolic compounds	Eggplants from Millionaire cultivar had higher polyphenol content than those from Blackbell cultivar; but the amounts of polyphenols were not statistically significantly increased in any cultivars grown under organic conditions (compared to plants from conventional agriculture).	Luthria et al. 2010
	Tomatoes, Broccoli, Bell peppers and pears	Vitamin C,	Similar content was found in organic and conventionally produced tomatoes, broccoli, bell peppers and pears	Barett et al. 2007: Wunderlich et al. 2008
	Strawberries and corn from organic farm	Ascorbic acid, total phenols	Significant higher ascorbic acid content and total phenols in strawberries and corn than conventional ones	Asami et al. 2003
	Red oranges from Italy	Total polyphenols, total anthocyanins, ascorbic acid	Higher levels of total polyphenols, total anthocyanins, ascorbic acid, total antioxidant activity in organic oranges	Tarozzi et al. 2006
	Grape juice	Total polyphenols, resveratrol	Significant higher levels of total polyphenols and resveratrol in grape juice	Dani et al. 2007
	Potatoes	Ascorbic acid, chlorogenic acid	Lower levels of nitrate and higher levels of ascorbic acid and chlorogenic acid in organically grown potatoes	Haislove et al. 2005
Animal origin food products	Milk	CLA, ω-3 fatty acids (alpha linolenic acid and eicosapentaenoic acid)	Higher content in organic milk compared to conventional milk	Mie et al., 2017; Molkentin&Giesemann 2007
	Meat	PUFA (polyunsaturated fatty acids) and MUFA (monounsaturated fatty acids)	Higher content of MUFA and PUFA organic pork compared to conventional ones	Galgano et al. 2016

2.1.4. Other phytomicronutrients

Secondary plant metabolites are substances naturally synthesized by the plant as survival strategies, in response to adverse environmental conditions (stressors) or in case of pest aggression. The vast majority of secondary metabolites are antioxidant compounds that protect the human body from a number of diseases or impact of several external factors.

Fruit and vegetables comprise multitude types of micronutrients that are secondary metabolites of plants, like polyphenols, flavonoids, anthocyanin, resveratrol and some non-pro-vitaminic carotenoids. These elements have a major role in regulating of cellular activities, being implied in prevention of some diseases including cancers, chronic inflammations, and another pathology (Lairon 2010).

Polyphenols represent a category of micronutrients naturally present in fruits, vegetables, herbs, spices, dark chocolate, wine, etc. Many of the health benefits of polyphenols may be related to their role as antioxidants. They are not essential nutrients in the human diet but play an important role in preventing of many diseases (cancer, cardiovascular or neurodegenerative diseases, etc.).

Most studies indicated that organic fruits and vegetables have high polyphenols content than those grown in conventional farms. Furthermore, organically produced fruit (such as peach and pear, strawberries and corn, Golden delicious apple, and orange) and vegetables (such as tomato, pepper, etc.) often presented greater levels of some secondary plant metabolites (phenols and flavonoids) also with importance for human health (Lairon 2010). Another study indicated that organic oranges had higher content of total polyphenols, total anthocyanins, ascorbic acid, and total antioxidant activity than red oranges of integrated systems (Tarozzi et al. 2006). However, there are authors who found equal amounts of phenolic compounds (or sometimes even smaller) in vegetables and fruits from organic farming. Thus, Stracke et al. 2010 show no difference regarding apple fruits phenols and polyphenols content from two farming systems (organic and conventional). Therefore, the content of polyphenols is different in both organic and conventional vegetables, without preponderance for either of the two agricultural types. *Resveratrol* is probably the most studied phytochemical compound due to its proven properties in pharmaceutical models. This polyphenol contains antioxidants and has many roles, including vasoprotection, preventive action against cancer and positive effect in the treatment of degenerative diseases, being present in large quantities in organic wines (Levite et al. 2000).

2.2. Sanitary estimation of organic foodstuffs

2.2.1. Pathogenic microorganisms

- **Microbial quality of organic versus conventional products**

In organic farming the main fertilizer type is animal manure and no chemical treatment against bacteria is allowed. Thus, it gives rise to the possible contamination of produce with microbial pathogens like *Escherichia coli, Salmonella* spp., and *Listeria monocytogenes*.

It is difficult to quantify the microbial difference between conventional and organic food due to limit and contradictory data from scientific studies. More than that, there is no compelling information indicating that organic foods can be contaminated in a different way than conventional ones.

To measure microbial quality many studies many studies quantify total aerobic bacteria *Escherichia coli* which are a specific indicator of fecal contamination. Oliveira et al. (2017) found a small difference in microbial measurements between 72 samples of organic and conventional lettuce, with a greater dominance of these bacteria in lettuce plants from organic (22.2%) than conventional (12.5%) agriculture. On the other hand, several studies reported nonsignificant results. In respect with other foodborne pathogens like *Listeria monocytogenes* and *Salmonella enterica* results showed that were not significant differences between organic and conventional products (Marine et al. 2015).

- **Mycotoxins** are an enormous family of toxic metabolites synthetized by fungi (such as *Aspergillus* sp., *Penicillium* sp. and *Fusarium* sp.) developing on plants under favourable conditions (high humidity and temperature). Due to the danger to public health, the best-known mycotoxins are aflatoxins, ochratoxinA (OTA), fumonisins, deoxynivalenol (DON), patulin and zearalenone. Mycotoxins from food can affect the human health leading in addition to other, to carcinogenic effects and deterioration of the immune system functioning (Rembiałkowska, 2016).

Mycotoxin levels are a very important indicator of food quality. Mycotoxins contaminate especially cereals obtained on both conventional and organic farms. Considering that no chemicals (fungicides) are used in organic production, the question arises whether an increase in mycotoxins would be possible. The rules of organic farming predict the crop rotation and cultivation of varieties that are resistant to fungi (and therefore to mycotoxins).

It should be mentioned that fungi and implicitly the mycotoxins can occur due to poor storage conditions in both types of agriculture. However, some researchers showed that the content of mycotoxins is higher in organic products than conventional ones, but the differences were small and the levels found were in acceptable limits (Rembiałkowska 2016).

Thus, in their study Błajet-Kosicka et al. (2014) mentioned a significantly higher level of deoxynivalenol, zearalenone, T-2 toxin, and HT-2 toxin in the case of conventional products compared to organic grains.

2.2.2. Phytochemical contaminants

- **Pesticides** (herbicides, fungicides, insecticides) are chemicals that are not found naturally in the environment. They are used to increasing crop production and protect them from losses caused by diseases and pest during cultivation/storage. Many pesticides contain toxic substances with a harmful effect on the environment and thus on humans.

Thus, in conventional agriculture, herbicides have the role of destroying unwanted plants growing in agricultural crops, fungicides protect plants from pathogenic fungi, and insecticides kill harmful insects. Unfortunately, the use of pesticides not only affects the proposed target but on the contrary their residues accumulate in plants and later penetrate (more or less) human body of consumers. It should be noted that the effects of pesticides on consumer health depend on by the dose absorbed from the contaminated food.

In order to reduce pesticides in food, their maximum permissible residue levels (MRLs) have been established. However, the main way to diminish health risk because of pesticides is consumption of organic products from organic farms which theoretically are without pesticides.

One of the major preoccupations of people buying organic food (fruits and vegetables) is lack of pesticide residues. On the other hand, Maruejouls & Goulard (1999) showed that organic food cannot be defined as pesticide-free. Recent researches indicated that the risk to identify the pesticide residues in conventional crops is four times higher than in organic ones.

The content of pesticides in fruits and vegetables is different depending on the plant species and the pesticide dose used in the agriculture of the origins country. Globally, pesticide residues in fruits and vegetables depend on their degree of use, the highest values being recorded in the United States, and Sweden being at the opposite pole (Rembiałkowska 2016).

Some pesticide remains can persist in the soil for a long time and can be found in plants even if these substances were banned many years ago. This is the case of dangerous chemical namely DDT which has been identified in carrots in a proportion of 17% after 20 years from the time it was no longer used (Heaton 2001).

- Some **heavy metals** are essential and beneficial to plants due to their important role in their growth and development. The increase of these elements content in the soil can be realized by anthropogenic activities like agricultural and industrial activities, transport, and from waste disposal.

Agricultural practices such as inorganic fertilizers, pesticides, as well as sewage irrigation are known to be the contaminants sources. Therefore, this is the reason these elements exist in high amount compare to untreated soils. Heavy metals like cadmium (Cd) and copper (Cu) are present in some fertilizers and pesticides. The nitrogen fertilizers used in conventional farms contain hazardous heavy metals which can be absorbed by plants from soil. Being very persistent and non-biodegradable, a repeated application of pesticides and fertilizers leads, over time, to an increase the amount of heavy metals accumulated in agricultural soils. (Głodowska&Krawczyk 2017).

Cadmium is one of the heavy metals often from phosphate fertilizers, which accumulates in the soil when these fertilizers are used annually. Crops that grow on contaminated soils become contaminated because they have absorbed these heavy metals. On the other hand, the metals industry and transport can contaminate the soil with Cd and implicitly in this way, the plant crops.

In a relatively recent meta-analysis that used numerous data it was found that in organic products the level of cadmium was lower (by 48%) than in conventional ones (Rembiałkowska 2016). Fertilizers are rarely used in organic farms and those from industrial waste are practically never used. For this reason, organic products are expected to contain much smaller amounts of heavy metals

A chemical analysis regarding the levels of heavy metals (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn) in the samples harvested from organic and conventional farms showed there are important differences between the vegetables grown in these two systems. Especially vegetables grown on conventional farms tend to have a high content of heavy metals. However, there are also studies that show the opposite, namely that there are no distinct differences in the content of heavy metals between organic and conventional foods, but the results are not conclusive.

2.2.3. Nitrates and nitrites

Nitrate (NO3-) and **nitrite** (NO2-) ions are used as food additives both for preserving and flavouring food and for improving its taste and prolonging its shelf life by inhibiting of microorganisms growth (Kalaycıoğlu & Erim, 2019). Nitrate causes relatively slight damage to the human body but becomes chemically reactive and very toxic, by its reducing to nitrite under the influence of bacteria in the intestinal microflora. Thus, the toxicity of nitrites is 6-10 times higher than that of nitrates. Nitrate is very soluble and if it is not taken up by the roots of the plants it enters the soil through irrigation water or rainwater. On the contrary, if it is taken up by the roots, it can accumulate in the leaves or in other organs of the plant.

Nitrate can get into drinking water mainly as a result of intensive farming practices. Thus, soil contamination with nitrogen-containing fertilizers as well as animal or human waste can increase the concentration of nitrate in the water. The reason nitrate is commonly found in groundwater and surface water is that nitrite is slightly oxidized to nitrate. Nitrogen is a necessary element for the plants growth and development being absorbed from the soil in the form of nitrate. Once in the plant it is used for the synthesis of amino acids and proteins.

Increased amounts of nitrates have a significant negative effect on human health; high amounts of nitrates have a significant negative effect on human health, leading to an increase in the amount of methaemoglobin in red blood cells (a disease called acquired methemoglobinemia); this is especially dangerous for young children and the elderly. Most nitrates enter the human body through the consumption of vegetables (about 80%) and only a small amount comes from foods such as fruits or grains (Lairon2010).

Most studies have shown that plants grown in traditional agriculture have higher amounts of nitrites than plants from organic farming. Compared with composts used in organic agriculture practice, chemical fertilizers lead to higher nitrate accumulations in most vegetables such as lettuce, potato, carrot, beetroot, turnip, leek and spinach (Mäder et al. 1993).

In organic farming, only organic fertilizers (like, compost, manure, bone meal, and green manure crops) are allowed. This is why, in organic vegetables a significantly lower amount of total nitrogen (by 10%), nitrate (by 30%), and nitrites (by 87%), exists comparatively with conventional ones (Rembiałkowska 2016).

3. Potential health benefit of organic food

Till now, many studies were focused on analysis of the amounts of nutrients and antioxidant compounds, pesticides and other chemicals residue content in organic versus conventional foods. In the case of animals and humans, there are few researches that investigated the impact of organic food consumption on health of individuals.

Consumers believe that the production and consumption of organic food results in a controlled exposure to pesticides, and therefore these products are more environmentally friendly and can contribute to a greater degree to the human well-being. Some experimental researches on animals highlighted that components of organic food may improve the physiological condition of animals, such as immune parameters and hormonal balance, but these results are not eloquent and the relevance to human health remains unclear.

Considerable quantities of pesticides have accumulated in the environment because the chemicals have been used all over the world for a long time in conventional farms. This is the reason organic crops are not and will never be 100% pesticide residue-free. However, the effect on human health of the pesticide level from conventionally produced foods is not very clear.

The nutritional profiles in organic products is superior compared to conventional ones, but the differences are almost insignificant and without practical relevance to the well-nourished population. Significant positive results were mentioned in some studies, which showed that an increased organic food intake was correlated with attenuated incidence of infertility, birth defects, allergic sensitization, pre-eclampsia, metabolic syndrome, high body mass index, and of non-Hodgkin's lymphoma (Vigar et al. 2020).

One could assume that organically foods would provide health benefits since they usually have higher levels of beneficial phytonutrients, certain vitamins, minerals, also lower levels of insecticide residues. Most of these studies refer mainly to the antioxidant activity of these products in human health, and only a few *in vitro* researches investigated the anticancer potential of some organic foods.

The beneficial effects on human health of organic vegetables, fruits and other products in a balanced nutrition are scientifically argued, but do not guarantee that organic alternatives could give supplementary benefits. The existing food guidelines, which suggest the consumption of larger quantities of fruits and vegetables, but less meat, are based on scientific studies (conclusive both in the case of organic and conventional products).

Nevertheless, the relationship between organic food consumption and human health is still insufficiently argued by epidemiological researches (Mie et al. 2017). Few researches explored the possible health advantage of eating organic food in humans. Even if these studies offer some indications, the results are insufficient to conclude whether organic foods are more human healthy.

4. Conclusions

Although the subject of organic and non-organic foods has been and it is still in the attention of the public, many controversies remain, especially among consumers who want to know the quality of food. Both in vegetal and animal foods, certain differences between organic and conventional foods were remarked. Inadequate diet and unhealthy lifestyle and likewise food contamination and environmental pollution lead to many diseases of civilizations life such as diabetes, atherosclerosis, cancer, and obesity. This is the reason for many consumers want to eat healthy choosing the organic food.

In addition, a lot of people believe in the nutritional properties of organic foods provided by organic farms (which do not use in the production stage: genetically modified organisms or their derivatives, synthetic fertilizers and pesticides, growth stimulants, hormones, antibiotics). Several comparative researches evidenced that foods from organic production can bring beneficial on health by low content in contaminants, by high content of vitamin C, carotenoids, PUFA, and total polyphenolic content with intense antioxidative properties. On the other hand, conventional foods are characterized by a high content of total proteins and minerals, mainly potassium and phosphorous which are basic constituents of fertilizers used in conventional farms.

Although, there are insufficient data referring to the comparative nutritional food values for products obtained in organic or conventional agricultural systems. In order to make a reasonable comparison between the two types of foods, the analysed plants should belong to the same cultivars, grown in identical soils, and in the similar climatic conditions. Moreover, the nutrient contents could be affected by several factors, many of them uncontrollable, such as rainfall and sunlight.

Results are contradictory regarding microbiological quality of products samples from organic and conventional production. Thus, some studies found that more microorganisms in fresh produce from organic production comparatively with conventional ones, while other studies do not. Quantification of pesticide residues from organic and conventional products faces several challenges and uncertainties. Anyway, on available data it appears indubitable that organic plant products contain lower amounts of pesticide residues than conventional products.

However, the scientific results achieved up to now cannot accurately support the fact that organic products are more nutritious. In any case regardless of the scientific evidence, due to the higher price of organic products and general perception in public, some the consumers will regard them as more nutritious and safer than non-organic food and they will prefer them.

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Appendix – Definitions of key terms

nutrients – substances used by an organism for the maintenance of life and for growth. They can be of two types: macronutrients (carbohydrates, fats, proteins) which are consumed in relatively large amounts (grams) and micronutrients (vitamins, minerals) are needed in smaller amounts (milligrams or micrograms).

MUFA/PUFA – monounsaturated/polyunsaturated fatty acids are component of hydrocarbon chain from fats (lipids) structure. By eating polyunsaturated fats it can reduce the harmful LDL cholesterol and the triglycerides level.

GMOs – genetically modified organisms whose genetic material has been altered using genetic engineering techniques meaning genes from other species (plants, animals, bacteria, viruses or even human genes) have been transferred to it to give it new properties.

MRL – maximum permissible residue of pesticide is the level of a pesticide residue that is legally tolerated in/on food or feed when pesticides are applied correctly.

polyphenols – phytonutrient compounds found in higher concentration in organic crops and foods
mycotoxins –are toxic compounds produced by fungi (which can parasitize plant crops) and can cause disease or even death in humans or animals.

Ch. 2.2.

BIOCHEMICAL DIFFERENCE BETWEEN ORGANIC AND CONVENTIONAL FOODS. A COMPARATIVE STUDY

Organic or conventional foods?

OBJECTIVES: - to define organic and conventional foods;
- to identify which are the main nutrients modified in organic foods compared to conventional ones.
- to compare the benefits of organic versus conventional production.
- to make an estimate of the possible health effects of organic foods.

SKILLS: After studying this chapter, students will be familiar with difference specific between organic and conventional foods

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

Which are the characteristics of an organic food?

- ☐ Organic food is grown with the aid of chemical-synthetic pesticides and growth regulators
- ☐ Organic food is grown without of additives
- ☐ Organic meat and milk are richer in certain nutrients
- ☐ Organic food is often fresher

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

How do you recognize an organic product compared to a conventional one in supermarket?

- ☐ It is labelled
- ☐ It is more expensive
- ☐ It is different in size, style, and color
- ☐ I do not recognize him

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

Which of vitamin was significantly higher in many organic fruits and vegetables tested than those conventional (conform with most of the studies)?

- ☐ β-carotene (vitamin A precursor)
- ☐ Vitamin C
- ☐ Vitamin D
- ☐ Vitamin B

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

Given the link between organic food and pesticides, which of the following statements are true?

- ☐ The lack of pesticides residue on organic foods
- ☐ 100% pesticide residue free of organic foods
- ☐ The lower content in organic food than conventional ones
- ☐ Residue of pesticides do not penetrate in the consumers body

QUESTION 5(PLEASE CHECK THE CORRECT ANSWER)

Although the results of studies are contradictory regarding the effect of foods (organic vs conventional) on health, which do you think that are better to consume because of its higher levels of phytonutrients and certains vitamins as well as the lower levels of insecticide residues ?

- ☐ Organic crops
- ☐ Conventional crops
- ☐ Both

QUESTION 6 (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

Specify a few reasons why you want a diet with organic foods

2.3. Organic agricultural production as a quality standard

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Abstract: Organic agricultural production contributes, on the one hand, to ecological preservation and, on the other, to the sustainable development of agriculture. The main goal of the chapter is the presentation of the organic production from two aspects. The first is the macro level, which will present the available models of organic production at the EU level. The second aspect, the micro level, will show how individual farmers implement an organic production system. This chapter is merely a confirmation that organic farming is a quality standard that is legally regulated in each of EU' countries and, as such, requires certification. In addition, in organic production there is the possibility of issuing individual and group certificates, so the ways of their implementation will be discussed. The fact that organic production is regulated means that it basically has certain principles that must be adhered to by all farmers who are in the organic production system.

Keywords: organic production, quality standard, certification.

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1. Introduction

The chapter is organized as follows: in Introduction are presented information on the current state of organic production. Methodology contains the list of methods and data sources used in this chapter. Subsection 3 Importance and reasons for the implementation of organic production standards in agriculture presents importance and rationales for implementing organic certification of organic standards for all stakeholders, producers, processors, traders, etc. As understanding of legal requirements related to organic production is essential for successful organic production special attention to this is given in the subsection 4 Legal framework. The organic market is significantly growing over the last decade and it is subject to analysis in the subsection 5 Organic products market. Subsection 6 contains an analysis of the significance and costs of certification for organic production. Subsection 7 contains concluding remarks.

Standards are documented agreements containing technical specifications and other well-defined norms that producers must constantly and strictly follow so that provided materials, products, processes, or services are generated under the prescribed guidelines (definition of the International Organization for Standardization, ISO).

In order to produce a healthy product, following the internationally accepted standards is required both for the allowed quantities of fertilizers and plant and animal protection products that can be applied. The essence of organic production is in its contemporary direction of development of agricultural production elevating traditional production with advanced knowledge in the line of genetics, selection, nutrition, protection, and preservation of products. This type of production system forbids the use of synthetic products contributing to the conservation of the environment (Milic & Lukac Bulatovic 2017).

The standards extent of product quality or service delivery, food safety, technical requirements for production activities or packaging rules, specific ethical, environmental and social issues. When products and services are not fitted to the customer's expectations and requirements, it comes to the insufficient attention of the implementation of the standards, actually, customers even are not aware of the role rated to the standard. However, the lack of standards would quickly become apparent in everyday life, from both production and consumption aspects. Accordingly, the safe and sustainable functioning of production systems, materials, equipment, devices and human capital are most often the result of regular implementation of defined requirements within the standards.

There are two types of standards, mandatory and voluntary. Organic production is a voluntary market standard.

Considering the individual and group certificates are available, it makes the process of certification suitable for adjusting both to the individual and the group. While an individual certified manufacturer places products on the market personally, there are two ways for product placement in the situation of the group certification: as self-organized producer groups and as producer groups.

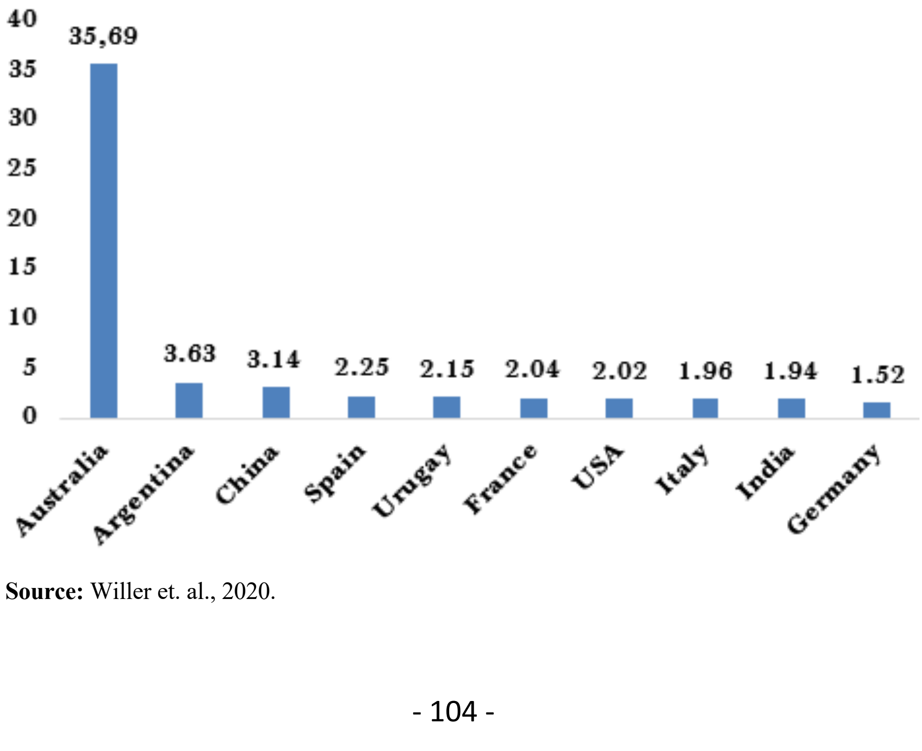
According to (IFOAM, 2008) *"Organic Agriculture is a production system that sustains the health of* ***soils, ecosystems*** *and* ***people****. It* ***relies on ecological processes, biodiversity and cycles adapted to local conditions****, rather than the use of inputs with adverse effects. Organic Agriculture combines* ***tradition, innovation****, and* ***science*** *to benefit the shared environment and promote* ***fair relationships*** *and a good* ***quality of life*** *for all involved."*

Organic agriculture has been increasing significantly all the time since 1999. In 2018, it's been rated that the area under organic production amounts to 11,000,000 hectares from a total of 71,514,580 hectares.

Around 48.2 million hectares of grassland make the most of the organic agricultural land followed by the cropland amounts 13.3 million hectares and permanent crops amounts 4.7 million hectares.

Figure 1 shows countries with the largest organic agricultural land areas.

Figure 1. Countries with the largest organic agricultural land in 2018



Source: Willer et. al., 2020.

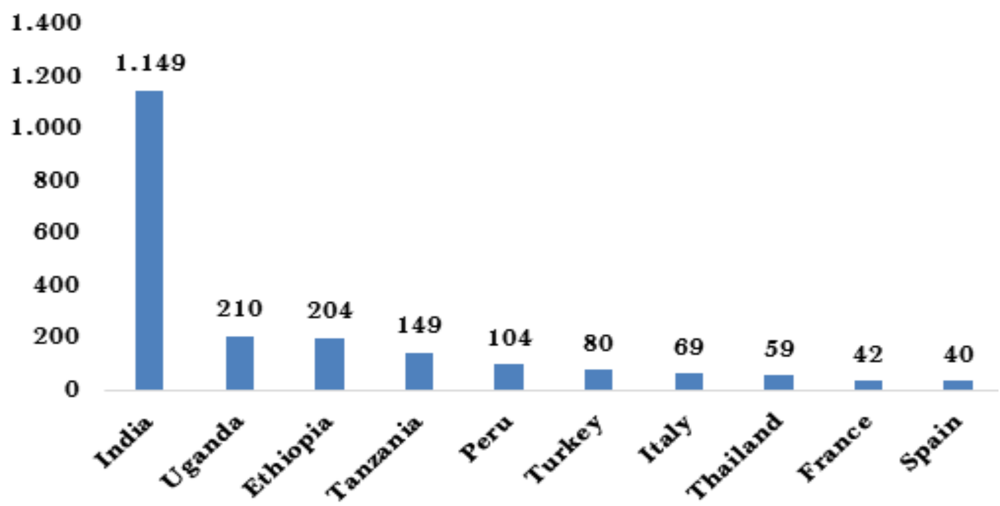
Table 1. World organic agricultural land distribution in 2018 by regions (including land in conversation)

Region	Organic agricultural land	Share of organic agricultural land in total agricultural land (in %)
Africa	2,003,976	0.2
Asia	6,537,226	0.4
Europe	15,635,505	3.1
Latin America	8,008,581	1.1
North America	3.335,002	0.8
Oceania	35,999,373	8.6
Total	71,514,583	1.5

Source: Willer et. al., 2020.

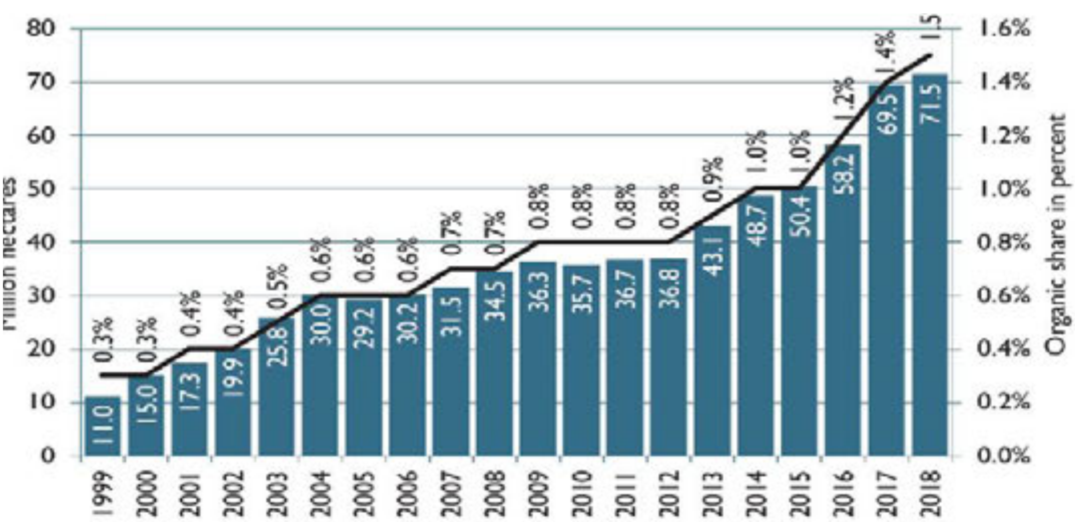
There are around 2,800,000 of producers worldwide and close to 96,000 of processors that has been involved in organic production and processing. Over 90% of the producers are in Asia (India is a country with most organic producers), Africa, and Europe.

Figure 2. Countries with the largest number of organic products (in thousands)



Source: Willer et. al., 2020.

Figure 3. Growth of share of organic agricultural land



Source: Willer et. al., 2020.

Besides the conventional organic production there are fields of organic production besides including wild collection, beekeeping, aquaculture, forestry, grazing area on non-agricultural land. This total area amounts to 35.7 million hectares. More than 2,600,000 beehives are in organic production (2,6% of the total world's beehives) (Willer et. al. 2020).

Considering the developing countries enjoy advantageous conditions such as climatic, geographical, and other conditions suitable for participating in organic production, for their further development the recommendation of the authors (Lee et al., 2012) is greater government assistance, greater involvement of associations linking producers with traders and exporters. In other words, the strengthening of the entire food supply chain is a lot of importance.

Author Smith (2008) believes that collaboration among food producers, traders, non-government organizations (NGO), governmental and agricultural organizations can raise food quality standards in supply chains and enable farmers to adopt more sustainable agricultural practices.

If we know that there is a conventional production that insists on intensive chemicalization on the one hand, on the other hand, we have organic production in which the means applied for the protection of plants and animals are being continually controlled. Also, as much as conventional production emphasizes the quantity of production, so much organic production emphasizes the quality of the product. In addition, organic production is a form of production of health-safe products in each and every sense. Essentially, getting the organic production certificate is at the same time a confirmation of certification of both process and product.

2. Methodology

The list of methods used in this chapter follows: desk research method; scientific literature analyzing of domestic and foreign authors; analyzing the legal framework of organic production in the EU and worldwide. Also, we are consulting relevant experts in the field of certification, production, and trading of organic products and consulting of organic producers and producers in the conversion phase.

For an overview of areas and crops under organic production, both globally and continents, the database of FIBL and IFOAM were used. The same source is quoted when it comes to the presentation of traffic and consumption of organic products.

There are two goals in this chapter. The primary goal involves achieving basic knowledge in the field of organic production which includes understanding the definition, standards, and purpose of organic production implementation. The secondary goal of this chapter also involves understanding the steps in the certification process and understanding about individual and group certification.

3. Importance and reasons for the implementation of organic production standards in agriculture

Organic production provides healthier products and nutritional security. *Organic plant production* strives for land conservation with minimal cultivation, requires suitable crop rotation, and recycling of plant and animal remains. *Organic production in the livestock* sector requires fulfillment of conditions in terms of necessary space according to the need of animals. Fulfillment of those conditions contributes to animal stress reduction and also prevention of disease (Government of Canada 2006).

Organic livestock farming includes the aspect of livestock production within which established balance of lands, plants, and livestock. Such kind of livestock production contributes both to animal stress reduction and better animal health avoiding the use of veterinary medicines and other chemicals substances (Joshi & Khanal 2012).

The term "organic certified" implies that products were grown by organic standards and were certificated by relevant certification company. Products obtained by organic production standards must be of equable quality and an agricultural producer, processor or trader is under the obligation to keep documentation and up to date records (Introduction to organic farming 2009).

There are plenty of reasons to implement organic production standards in agriculture and most often are introduced on the insisting of the target group in the food chain. The reasons for introducing the organic production standards can be observed both from the angle of producer and customer. The group of authors (Jovanovic et. al. 2014) specified the most often reasons for organic production certification and looking from the producer's angle follows:

- *desire of customers to have high-quality agricultural product,*
- *needs of producers to increase the traffic of organic products certificated,*
- *maintaining customer trust.*

Following the interpretation of what are the most often reasons that motivate customers to buy organic products, the authors Nagy-Percsi and Fogarassy (2019) conducted research in Hungary. That survey research showed the freshness of the product in the first place, then taste and at the third and last place the positive influence on health. They concluded that price isn't crucial in deciding to buy organic products, but rather the composition and nutritive aspect are crucial.

Table 2 shows SWOT analysis through the matrix of strengths and weaknesses of organic production, as well as opportunities and threats lifting from the environment.

Table 2. SWOT matrix of organic farming

Strengths	Weaknesses
• large areas of agricultural land; • positive attitude of farmers on organic farming; • consumer needs for quality food; • educated assessors in the field of organic agriculture; • recognizable brand.	• low purchasing power of individual consumers; • in some parts of the world, farmers are not educated on organic production; • insufficient marketing of organic products; • high production costs.
Opportunities	**Threats**
• further development of organic production will require the employment of additional labor, which will reduce unemployment; • economic interstate agreements; • connection with rural tourism; • use of financial funds.	• competition with lower production costs due to the introduction of more modern technology; • poor institutional support; • unfavorable age structure in rural areas; • administrative barriers.

Source: according to the opinion of the author.

4. Legal framework

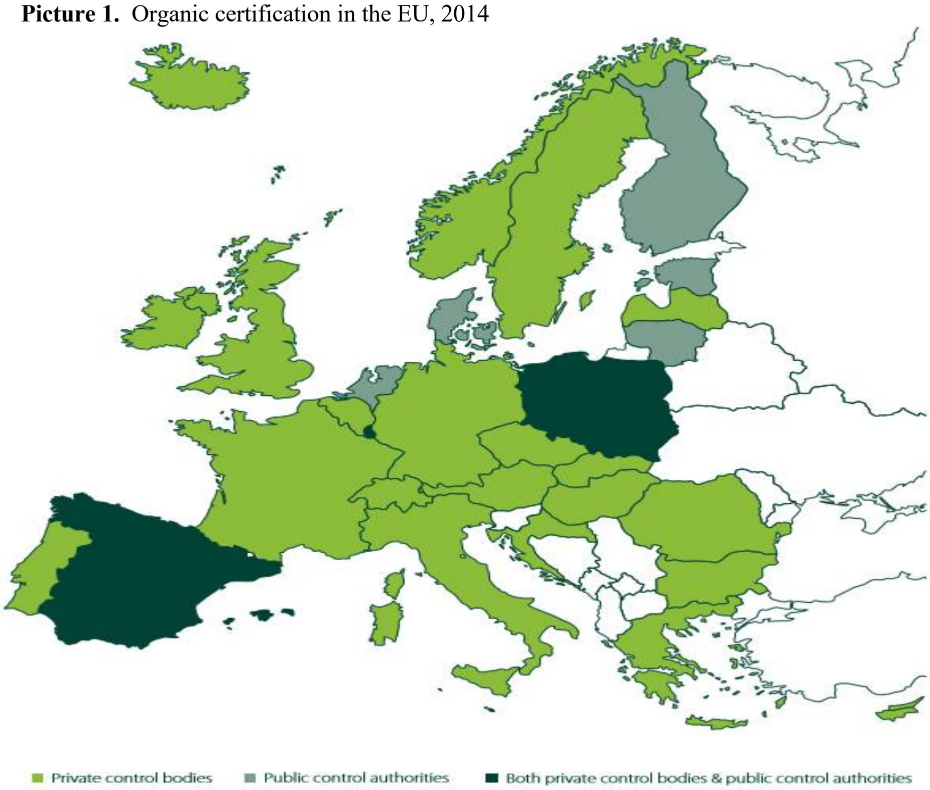
Organic products are considered as goods with characteristics that are difficult or impossible for consumers to observe even after purchase and use. The difficulties for the credence goods markets functioning is in strong incentives for fraud. Because of the price premium of organic food, producers of conventionally agricultural products could dishonestly claim organic status, enjoying the lower production costs, and still collect the organic price premium (Holland, 2016).

According to Willer et. al. (2020), there were sixty-eight counties with organic regulation while eight countries didn't fully implement regulations, seventeen countries were in the process of establishing regulations.

The appearance of particular agricultural and food products in the markets opposite to their traditional destination is related to the development of international trade. The state's role regarding the food quality control and food safety (both in terms of import and export items) has been strengthened, conditioning the development of national accreditation and control institutions. At the same time, the rapid growth in the volume of international exchange has been leading to the development of international organizations (ISO, WTO, UNCTAD, and others) being also protectors of established international standards to adjust the global market and remove market limits. The unification and internationalization of standards and establishing unique tools in world trade consider the international standards as "the international language of trade" currently. Globalization in dealing with organic products increasingly requires the adjustment of regulations in this range including all participants in private control bodies, IFOAM - Organics International, state institutions, United Nations organizations, including FAO, WHO, and the United Nations Conference on Trade and Development (UNCTAD). In aim to adjust the rules controlling the certification of organic production, the UN Codex Alimentarius Commission's (1999) has taken effect since June 1999 and for animal products since July 2001. This UN body has brought out the guidance to governments in developing organic food. The latest version was released in 2013.[1]

Through bilateral agreements the governments at the national level are searching to resolve issues of the mutual recognition of national organic production systems. Countries that import organic food such as the USA, EU, Japan seeking to recognize certification systems in exporting countries as compatible with their national standards. The US and EU have a mutual agreement for regular recognition of the standards of other national organic members except for animal products from the EU, which require further verification. The certification system in the EU is firmly influenced by private organic standards that have expanded since 1991. The procedure of the EU in organic production implies that each Member State must establish a qualified institution that regulates and controls in this range. As part of the control system, the designated institution may delegate part of its responsibilities to one or more private control companies or public institutions.

Picture 1. Organic certification in the EU, 2014



Source: Meredith & Willer, 2016.

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[1] See more: Guidelines for Organically Produced Food.

Public-private partnership based on the EU model occurs in the European Free Trade Association (EFTA) trading community. Therefore, there are three types of ontological systems in the EU: a system operated by private control bodies, a system controlled by public control bodies, and a combined public-private system.

It is important to emphasize for third countries organic producers that for exports to the EU the product must be certified by a control body approved by the European Commission under regulation 1235/2008, the EU publishes a list of authorized control and non-EU certification bodies.

New EU regulation about organic production was introduced in 2018 and will take effect in 2021 - Regulation (EU) 2018/848. The Secondary legal regulations related to production, labeling, control, and trade rules are in the arrangement procedure.

Changes in the EU regulation related to imports of organic products are:

- Countries outside of the EU must establish new regular trade agreements.
- EU Commission will introduce a list of certification bodies authorized for control and certification in third countries[2].

Major changes in new EU regulation is that group certification will be allowed for EU and worldwide operators[3]. Group certification relates to the group of small farmers that can be certified as one entity. It is expected that new EU regulation is going to limit the number of farms pre-certification groups organized as separate legal entities and strict external control practices. Procedures for the internal control of group organic certification entities will be defined in more detail. All those changes according to the IFOAM survey (Willer et. al. 2020) will improve transparency, quality of control and led to confidence in certification.

According to the same FIBL and IFOAM survey, the new EU regulative might have a negative impact on small farms related to group certification which may cause the financial burden for small producers in the matter of registration as a legal entity and may cause expensive additional administrative procedures and external control.

It is estimated that about 80% of the organic producers are small producers. The costs of certification for small organic producers would be expensive and complex for managing. Organizing in group and acquiring organic certificate as one entity would be significant for small producers (Meinshausen et. al. 2019).

Another important innovation is that a mandatory annual inspection will be decreased. Inspection will be based on risk assessment so low-risk operators will be inspected every two years. Decreasing is introduced and will not require certification both for retailers that sell pre-packed organic products and for producers that sell products without packing directly to customers.

The USA organic control system implies an obligation for organic production inspectors to obtain a license to deal with this work. Control companies are certified by the US Department of Agriculture, and until now, about 90 control companies have obtained a license for certification worldwide and issued certificates valid for the US market.

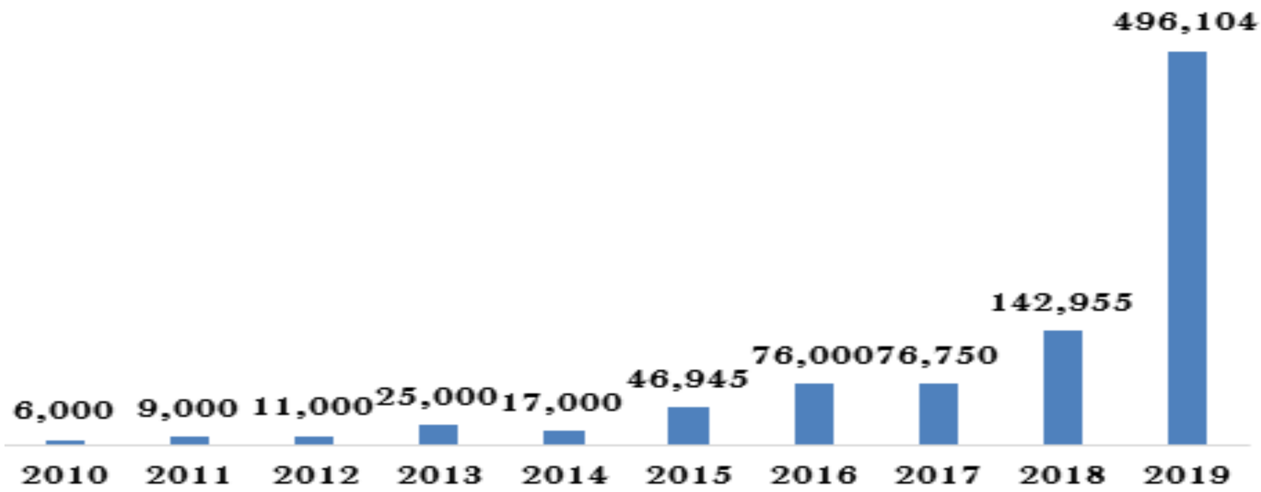
The EU has set up organic standards 10 years earlier comparing the USA. Currently, the USA and the EU regulatory framework are very similar and tend to converge (Fouilleux and Loconto, 2017)

Development of entity that has expanded a common set of organic production standards - Participatory Guarantee System (PGS) is important for further development of organic production worldwide (involving framers group and individual farmers). Producers under PGS are typically using a common label.

[2] Certification process will be identical in EU and third countries, with the exception of allowing pesticides and fertilizers traditionally used in some third countries.

[3] Group certification is currently allowed only for small operators in developing countries.

Figure 4. PGS certified producers worldwide



Source: Willer et. al., 2020.

The equivalence in arrangements between countries, proofing that organic regulations are equivalent are very important for international trade with organic products. This arrangement can be recognized unilaterally rarely or bilaterally more often.

Organizations like IFOAM – Organic international, Food and Agricultural Organization (FAO), UN Conference on Trade and Development (UNCTAD) have been promoting the international organic standards adjustment. The Organic Equivalence Tracker is introduced as a result of cooperation providing information on all equivalence arrangements the organic traders, producers, scientific, policymakers, etc.[4] The Organic Equivalence Tracker is displaying currently 17 entries (16 countries plus EU).

In general, all legal acts and by-laws that contribute to the simplicity of implementation of organic production were accepted. These regulations protect both farmers and final costumers (Home et. al. 2017).

5. Organic products market

According to (Willer et. al. 2020) total global sale of organic products in 2018 have been reached an amount of 105.5 billion US dollars. Table 3 shows the world market data.

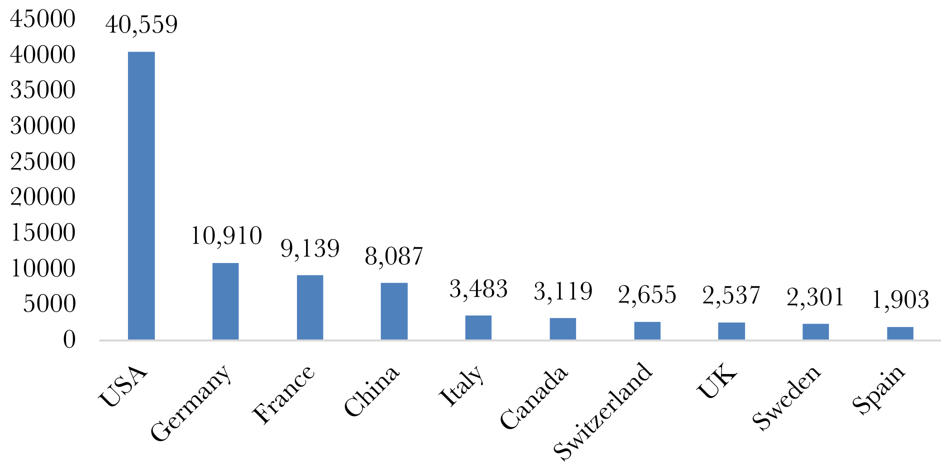
Table 3. World market retail and consumption in 2018

Region	Retail (Million EUR)	Consumption (EUR/capita)
Africa	17	0.1
Asia	10,071	2.4
Europe	40,729	50.3
L. America	810	1.5
N. America	43,677	119.9
Oceania	1,378	33.5
Total	96,682	12.9

Source: Willer et. al., 2020.

4 The Organic Equivalence Tracker is available at: https://www.ifoam.bio/en/organic-equivalance-tracker.

Figure 5. The largest organic markets worldwide by retail sale (million EUR)



Source: Willer et. al., 2020.

The European Union is recognized as the most important buyer of fresh organic products. Accordingly, it is necessary to research the needs of the market in terms of assortment, quality, and price actually to have a marketing approach to exports. Such a quality product could easily become a recognizable brand which is an increasingly important factor of competition (Milic & Lukac Bulatovic 2017).

A considerable organic market growth worldwide is apparent. The highest market growth was in France in 2018. It was 15,4%, while the highest per capita consumption by continent is in North America – 120 EUR, in EU consumption of 312 EUR is in Switzerland and Denmark, 231 EUR per capita in Sweden and 221 EUR per capita in Luxemburg (Willer et. al. 2020).

Although demand for health-safe products produced by the standards and requirements of organic production is increasing worldwide, the group of authors (Anzaku & Salau 2017) believes that organic products better fit to smaller target markets where demand for these products is very high. The group of authors Shaw Hughner et. al. (2007) believes that the most common consumers of organic food are those who actively spend their time in nature on a daily basis, those who play sports, vegetarians, and those who support alternative medicine. In other words, consumers are those who primarily take care of their health.

In other words, any product that results from the controlled use of chemicals always finds its way to final consumer and demand for health-safe products is rising.

Customers at the most important organic markets are recognized and willing to spend on organic food, also having the tendency to prefer food from economically developed over less developed countries and domestic over imported organic food. (Thogersen et. al. 2019) The commodity exchanges don't include organic products trading as these products with special characteristics are not suitable for standardized commodity exchange markets (Kovacevic & Vasiljevic 2017)

6. Significance and costs of certification for organic production

It is well known that certified products are easier to sell because they are in high demand in the international market, especially in the EU market. Also, the certificate allows to establish cooperation with large retail chains looking for products of controlled quality.

Farmers are often asked whether to certify their production. The answer to this question depends on several factors:

- *where they want to market its product,*
- *what quantities,*

- *at what price.*

Depending on the producer:

- *introducing or not introducing a voluntary standard,*
- *if the farmer chooses to introduce it, it is necessary to carry out important procedures to adjust its production with the requirements and standards of organic production and*
- *apply for certification to the chosen controlling organization (certification body).*

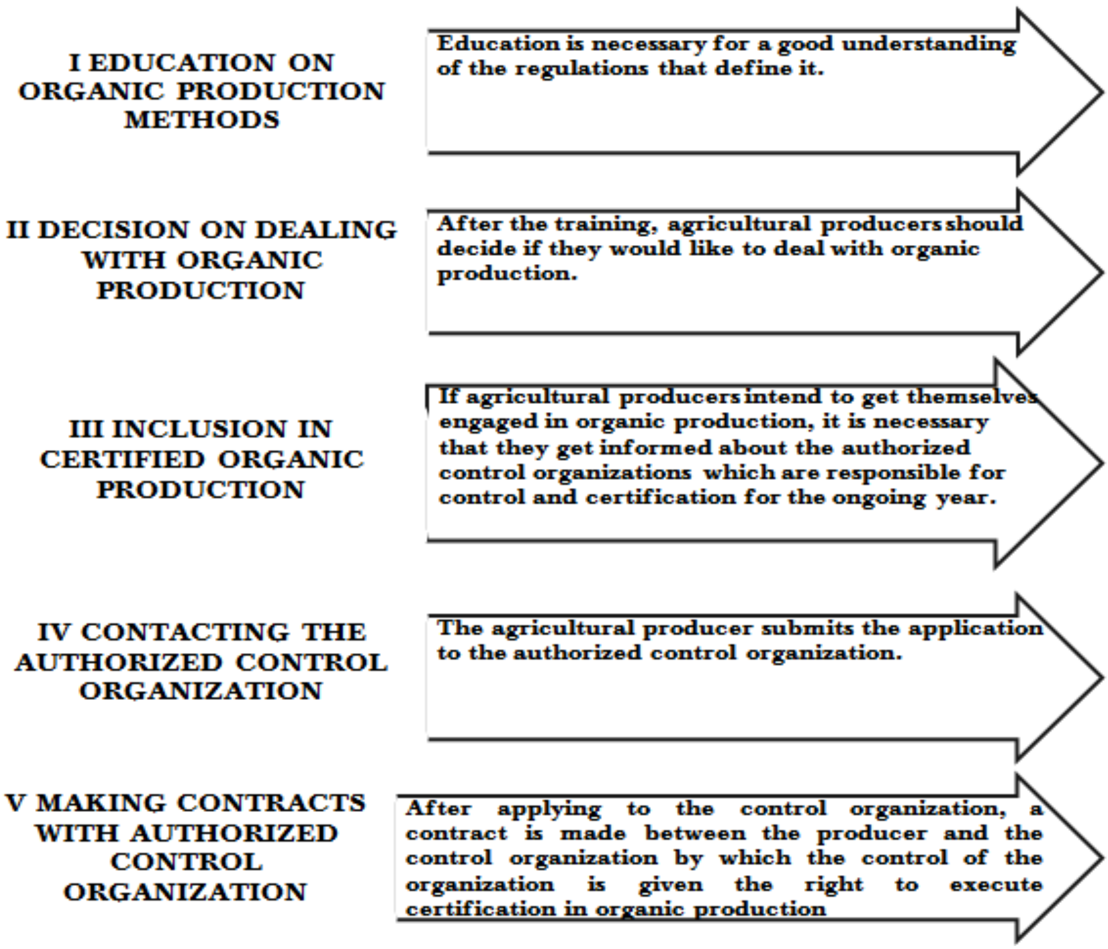
We consider referring to the steps in the certification process is also important which are displayed in figure 6.

If a farmer decides to certify its production, the notification to the authorized inspection organization in writing which includes the dynamics of production is a must. This is especially underlined in the Law on Organic Production implemented by the Republic of Serbia.

The group of authors Milic & Lukac Bulatovic (2017) highlight the following reasons for introducing organic production certificates:

- *the customer is guaranteed that the land has not been treated with synthetic or chemical agents for at least the previous three years,*
- *it is the confirmation that the producer is controlled at least once a year by an approved inspection body,*
- *confirms that non-toxic and sustainable products have been used in the production process,*
- *equipment in the production process was maintained by non-toxic agents,*
- *during operation, the product wasn't exposed to prohibited chemical substances.*

Figure 6. The steps in the certification process



Source: The author's show

The authors (Roljevic Nikolic & Parausic 2019) believe that certified products are more beneficial and that their producers can reach higher sales prices. In other words, the existence of the certificate is by itself added value to certified or branded products.

It is also important to mention that certification organizations could support both farmers and customers at the same time. Their part is manifested in the following:

- *risk management in each food supply segment,*
- *protecting customers from poor quality products,*
- *assist in clarifying procedure and regulations,*
- *product quality is provided through different supply chains.*

6.1. Types of costs for standards introduction

The costs covered in this section are resulted from the implementation of the organic production certification process and will be divided into two groups. The first group takes into consideration the implementation costs necessary for application standards while the second group considers certificate releasing costs actually its price.

There are numerous costs through the implementation of standards and they aren't always displayed on the same level at agricultural producers. Some of them are the following: educational costs of agricultural producers, costs of land conversion, costs of hiring consultants from the authorized consulted organization, cost of venture investment, and many others.

I Cost of production adjustment to the requirements of a particular standard *(implementation costs, i.e. introduction of standards).* These costs depend on the degree of production adjustment with disposed standards, whether it is in crop or livestock production. Big expenses (significant investments) are needed from time to time.

Before starting of the organic production process there is the educational cost of agricultural producers. This cost isn't imperative but education is recommended for producers before deciding to dedicate truly to the organic production.

We classify the *land conversion period* in this group of costs (usually 3 years) because the production process isn't taking place on this surface. This also leads to the fact that animals bred by the organic production standards(if available on the farm) mustn't receive food from areas that are in conversion[5]. A farmer has the obligation to make the conversional plan from traditional to organic production which needs to be evaluated each year by inspection.

The conversional plan from traditional to organic and healthy production is a very significant and complex task for each agricultural producer that has opted for the organic production. To bring out the conversational plan as soon as possible, the relevant facts have to take into consideration and according to the Jovanovic et. al. (2014) are the following:

- *land history including crops, destroying of pests, fertilization;*
- *analysis of modification of existing conditions at a farm from the regulation and principles of standards;*
- *the conversion plan from traditional to organic agricultural production at the whole farm;*
- *the required elements for implementation throughout the conversional period such as, for examples: crop rotation, fodder, fertilization, the process of pests destroying.*

Also, we may include the costs of hiring a consultant from the authorized consulted organisation in aim to support adjustment of production conditions to the requirements and principles of organic production. *We're emphasizing this cost arises only if the producer doesn't know how to manage the alignment of its production with the organic production standards.*

[5] The exception to the above paragraphs is in the Republic of Serbia, which allowed products of plant origin from the conversion period containing only one ingredient of agricultural origin to be marked with the product "CONVERSION PERIOD" and the code/logo of the authorized control organization (Article 27, Law on Organic Production).

Considering agricultural producers cover all costs of hiring a consultant, it is very important to ask them certain questions:

- *Does and how the consultant's services help with the implementation of the demanded standard?*
- *What about producer's practice and customers/references until now?*
- *What's the price?*

It's been recommended to the producer to search for and to compare a few offers before choosing the right one.

If *larger investments are required*, the following costs may arise: construction of the facility, renovation of the premises, business improvement, etc.

It is important to note that costs from this group arise if the farmer certifies production for the first time, which will lead to a reduction in costs in the coming years and an increase in earnings.

II Costs of certification. These costs are practically based on the chosen certification body because each has its price list for certificates releasing, but also costs depend on the type of production (vegetable and/or livestock production) for which the certificate is requested. Within the appropriate culture, their types must be monitored and recorded.

The general price of the certificate for organic production depends on many factors, such as the farm's size, the scope of the business, selected certification body, the country to which you belong. The US National Program for the Organic Production with the Ministry of Agriculture (USDA) remarks that the certificate prices range from several hundred to several thousand dollars. Certificate prices are usually around USD 1,200 for the certification of organic processor, while at least USD 700 is needed for a new farm to get organic production certificate (https://www.thebalancesmb.com/how-much-does-organic-certification-cost-2538018). In later years, small food processors can pay about USD 950 for certification, while small producers and farms should set aside between USD 375 and USD 575 (California Certified Organic Farmers - CCOF).

In Canada, specifically Ontario, producers that own 10 ha or less of land, can get their production certified for less than USD 1,000, while the average ranges from USD 600 to USD 900 per (https://www.organiccouncil.ca/whats-the-cost-of-certification/).

Finally, it should be highlighted that certification organizations are not allowed to be in the role of consultant, as they are there to control them and receive assistance from consulting firms.

The ending of the certification process is when an official confirmation is obtained i.e. Certificate of Conformity to the organic production standards and registration of the certificate holder in the relevant register.

6.2. Individual and group certification

When it comes to certification methods, we could say that there are individual and group methods. In the case *of individual certification*, the producer applies for certification by itself, while in the situation *of group certification* several individual producers join in a group (cooperatives, associations, organizations, etc.) to apply for the certificate. Individual certification is not recommended for farmers with small available land areas because they would not be able to cover the cost of certification from their production capacity. Such farms are often in remote areas, so management and administration on the farm are difficult.

A legal entity as a certification representative is required for group certification. The representative may be the processor, the owner of cold storage, or other legal entity that manages the producers and implements the procedures for achieving the certification. The certification representative, being at the same time the production manager concludes the contract with other producers (subcontractors) with similar sort of production.

The certification representative is responsible to the state and the law and maintains production under control. Also, the certificate representative covers the cost of certificate releasing, and thereby there is no legal obligation to divide costs into members. Hence, there is no legal regulation on how much each member of the group pays but the certification company delivers invoice and expect the realization of costs from the certification representative.

The production control must be performed by the company itself first, then by the state authority and finally by the certification company. If control shows that the producer doesn't follow the standards of organic production, both the control and certification bodies have the legal authority to deliver appropriate corrective measures as well as withdraw the acquired certification.

In the following, greater attention will be given to the group certification, considering that the administration is more complicated than individual certification and that there are requirements that must be accomplished by the group members or producers applying for a group certificate.

The concept of group certification was introduced in 1980. Certification bodies were certified products in accordance with organic production by some organic associations. For the first time, a specific focus was on coffee and cocoa cooperatives (Meinshausen et. al. 2019). Picture 2 shows the total of associated producers that produce according to the organic production standards.

There is a requirement for adjustment of organic group certification procedures worldwide. The first effort was conducted in 1994 by IFOAM. Firstly, the group certification was published including a series of principles, following by Smallholders Group Certification: Compilation of results in 2003. IFOAM published training materials for smallholders' organic producers (IFOAM, 2012).

Picture 2. Estimated organic group certification worldwide

Source: Willer et. al., 2020.

The European Commission published: Guidance Document for the Evaluation of the Equivalence of Organic Producers Group Certification Schemes applied in developing countries. The EU allowed group certification only for third developing countries at that period.

United States Department of Agriculture (USDA) coordinates to the organic production under the National Organic Program. Organic products from the USA or third countries must be certified according to National Organic Program regulation, by USDA approved certification body. Group certification is allowed and there is no specific regulation that determines group certification. Figure 7. shows the most representative crops covered by group certification.

The scope of groups is different between regions and between countries. The biggest groups are in Africa with more than 10,000 farmers and each farm disposed of 1-4 ha at least (Meinshausen et. al. 2019).

As a turning point for organic sector development is considered a future development of organic group certification meaning to improve both cooperatives and group organic certification including all cooperative members (Petkovic et. al. 2016).

Figure 7. The most representative crops covered by group certification

Source: Meinshausen et. al., 2019.

6.3. Types of producer's groups

In this section, it will be discussed the types of production groups that appear in the system of organic production.

In regards to product placement, organized groups of farmers can be further divided into two categories (Meinshausen et. al. 2019):

I self-organized producer groups that organize agricultural producers to place their products at the market because they are members and co-owners of the group at the same time. Cooperatives also operate on this basis. These types of producer groups dominate in Latin America.

In the northern part of Paraguay, agricultural producers are most often self-organized and joined into cooperatives. In these areas, there are 5 to 70 farmers in cooperatives, both male and female. This type of production groups is most often dominated by producers engaged in livestock with a maximum of 50 units of livestock, but also those who grow corn, soybean, wheat, sugar beet, banana, pineapple, tobacco, cotton, and other. This type of self-organized producers also has certain disadvantages. Primarily, a considerable lack of knowledge and experience for business and organization management. In addition, they are not financially empowered enough to have access to bank loans and expect the government's assistance (Roman 2013).

II producer groups that are linked with a trader or exporter that buys products from a defined group list. This form of organizing producer groups is dominant in Asia, and to some extent in Africa.

This type of association was named by the authors Vinayak et. al. (2019) as Farmer Producer Organizations (FPO). In Vietnam, this type of association is legalized as an activity that creates economic benefits. In South Africa, producer groups most often form agricultural trade unions to put together a list of products they offer. However, in Bolivia, FPOs are registered as non-profit organizations that have certain social goals as well. They usually consist of household members who buy, sell and advertise their products together.

According to Shepherd (2007), the advantages of connecting agricultural producers with traders are reflected in the fact that there does not have to be a formal type of organization, on the one hand, while on the other hand, the farmer wants to ensure a long-term sustainability for themselves. The disadvantage of this form of association of producers implies limited access to high-value markets, and also the fact that they have to accept deferred payment in the short term.

According to the same author (Shepherd 2007), an agricultural producer in Thailand, who specializes in the production of lettuce, cabbage and cucumber, picks up vegetables from another 40 farmers and delivers them to customers in Bangkok. These vegetables are not treated with chemicals, which fully meets the rules and principles of organic production. Mango and watermelon growers drive the fruit at a distance of 300 km to the Myanmar-China border, to the city of Muse. When drivers arrive in the city, the fruit is delivered to intermediaries who contact Chinese buyers to negotiate the price.

It's difficult to obtain data on the number of producers that market their products within production groups. The producers who are in the system of group certification and sell their products through traders, aren't recognized in the database and their exact number can't be known. When it comes to organized groups in the form of cooperatives, they are more recognizable because of their name (Meinshausen et. al. 2019).

The following is the table overview of the total of Internal Control System (ICS) groups in the world in the organic production area, as well as the approximate number of certified producers being members of the group (table 4).

Table 4. Estimated group certification in world

	Number of Groups with ICS	Producers Certified in Groups
Organic	almost 5,900 groups	almost 2,600,000 producers

Source: Meinshausen et. al., 2019.

The table below shows that the world is dominated by a very large number of manufacturing groups that have introduced ICS, as well as the number of certified manufacturers that are members of the groups.

6.4. Prices and cost-effectiveness of certification for organic production

The interpretation of many researchers from different states about the production based on the standards of organic agriculture is that it gives lower crop yields than traditional, but lower yields from organic production could be refunded with various benefits. Authors Roljevic Nikolic et. al. (2017) show benefits of organic production from the angle of: agriculture (high-quality food), environment (conservation of agro-ecosystems) and economy (profit security as a result of strengthening local communities).

As mentioned earlier, organic production excludes using of synthetic origin agents. This type of production has a limit refers to the reduced production quantity and hence the economic result will record lower values.

The question is how this type of production can be attractive for producers and therefore for implementation. One of the elements that could involve farmers in organic production is the ability to sell organic products at significantly higher selling prices.

Placement of organic products at higher selling prices empowers farmers to cover the following types of costs: *investment in production (raw materials), lower yields, and certification.* Costs lifted from lower yields are especially essential of the conversion period (the transition from traditional to organic production), as well as in the early years of participating in organic production.

Agricultural products that were produced according to the organic production standards are more expensive particularly because the price increased by a certain percentage due to cover the certification costs actually the price of releasing certification. We consider the significance of emphasizing the certification price doesn't depend on the land area under a culture but on the number of cultures and the number of locations that certifier must visit. Beside keeping record of certain cultures, the documentation for each type of culture is needed.

Considering the period of time, the person-in-charge on-site needed to provide certification, it will depend on the price of certification including the person-in-charge on-site daily payment. Unless certifier need two or more days to visit every parcel, it must be also considering the cost of overnights stay at a certain place. Exactly, the price of a certain culture isn't fixed but there is a price list of each certification company whereby price variation isn't high.

It's important to notice that all agricultural producers being in the certification process or they already have certificated production are in obligation to keep documentation up to date since one of the duties of the person-in-charge on-site covers the control of all needed documentation.

Considering the economic efficiency of production on a farm dominated by the organic production standards is the most often reduced, the authors of Milic & Lukac Bulatovic (2017) point out some of the reasons:

- *reducing the amount of crop production because of the considerable reduction of mineral fertilizers applied;*
- *reduction in the volume of meet production due to reduction in the volume of fodder produced;*
- *increase in production costs refers to the significantly higher labor costs and use of machinery in crop and livestock production on the farm.*

Often, there's a wonder if the group certification is more payable than individual certification. Theoretically speaking, the group certification should be advantageous considering the costs of releasing certification can be divided between group members but that's the unwritten rule. The grand producers, processors, the owner of cold storage and many other often starts from the expectation that certification is profitable, they believe their business will be economically sustainable hence they don't consider the possibility of splitting the costs between group members.

Also, there is no exact answer does group certification is more payable than individual certification because the costs of certification primarily depend on the internal rules of certification company.

If we start from the acceptance that is useful for an agricultural producer to get the education about organic production in the first place, before the implementation of organic production standards, then this acceptance increases the certification costs. However, there are certification companies offering free education so an agricultural producer easily decides to hire them. Additionally, there are certification companies offering producers free production inputs under conditions to conclude the contract. In the end, an agricultural producer should choose the certification company to conclude the contract depending on the benefits the producer receives.

In other words, it isn't possible exactly determine the savings in group certification relative to individual certification.

Group of authors Roljevic et. al. (2012) consider that developing countries still haven't reached a significant level of industrialization have particularly large benefits in the practice of organic production. Accordingly, developed countries require more organic products that they import from developing countries, thus contributing to their socio-economic progress.

It is concluded that the implementation of organic production can bring economic benefits if establish properly. The benefit of participating in organic production comes primarily from the higher selling price that can be achieved in comparison to traditional agricultural products.

7. Conclusion

Organic production is a high potential area, both in terms of extension of the land under organically grown products and in terms of added value, which these products achieve. Improving this type of production, both vegetable and livestock, create beneficial conditions to raise the profit of exports and positioning in the international market. Regarding each country has certain natural conditions, it is recommended to take advantage of it and to participate more intensively in organic production.

Organic production is law regulated and in accordance with organic production standards and such products are traded. Although the European Union market is the most significant customer of organic products, demand is uprising worldwide. Organic market research authors believe that it is always possible to find a way to place organic products at targeted markets, depending on whether final consumers are athletes or people who follow the healthy nutrition postulates.

The possibility to apply whether for a single or group certification further make easier the certification process as it shapes to the requirements of the producer. The individual certification isn't recommended for producers placed in the isolated areas of a certain country because they usually have small agricultural land. It can't be claimed that group certification is more payable than individual certification because the division of costs between group members wasn't specified by legal norms but recognize only the certification representative as responsible for covers the costs to both the certification company and state.

Organic production certification is preferable from the angle of protecting the health of customers, but the most important thing is to keep in mind that there is no need to enter into the certification process unless there is a stable placement of such products. In other words, the certification is implemented at the request of the customer (third parties) because only in this way it can be taken into consideration, justified, and cost-effective.

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Appendix – Definitions of key terms

organic plant production is a system that integrates cultural, biological, and mechanical practices that encourage the cycling of resources, promote ecological balance, and conserve biodiversity.

organic livestock farming includes the aspect of livestock production connecting lands, plants, and livestock. Such an enclosed system contributes both to animal stress reduction and better health conditions which is achieved without using of veterinary medicines and other chemicals substances.

conversion period that refers to organic agricultural production is a period of time demanded for the transition from traditional to organic production throughout producer implement the organic production method at that land.

individual certification indicates that agricultural producers submit the application (apply) by themselves. Depending on a plant species, certification could last 2-3 years.

group certification indicates that several agricultural producers are joined in cooperatives, associations, and some other organizations and their representative is responsible for the observance of prescribed legal norms and covering the costs of certificate releasing.

self-organized producer groups manage agricultural producers to place their products at the market because they are members and co-owners of the group at the same time.

producer groups are linked with a trader or processor that buys products from a defined group list.

Ch. 2.3

ORGANIC AGRICULTURAL PRODUCTION AS A QUALITY STANDARD

OBJECTIVES:

It can be said this chapter consists of two parts. The first part gives an overview of legal norms within which the organic production standards describe, following an overview of all areas worldwide being in the organic production system, as well as the total of agricultural producers intensively participating in health-safe food production. These facts are very important showing constantly increasing both lands and the number of agricultural producers deciding to transfer from traditional to organic production systems. In support of that, it's been a recorded increase in trade and organic products turnover worldwide, both in total value and per capita. The second part of the chapter provides the expertise from the range of organic production certification. Specifically, an insight is given into the importance of certification, costs, procedure, and types of certification, as well as the economic viability of dealing with organic production. These insights emphasize the benefits of certified products in regard to find the easier way to the final customer considering the added value of the product.

SKILLS:

The aim of this test is acquiring basic knowledge on the process of organic production certification, some examples for prices to obtain certification, types of certification, and finally cost-effectiveness of
certified products.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

What's the type of the standard matched with organic production?

- ☐ mandatory
- ☐ voluntary
- ☐ scientific

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

Organic production is a system that integrates:

- ☐ special cultivation practices
- ☐ biological
- ☐ mechanical
- ☐ all above

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

List two basic costs groups appearing throughout the implementation of organic production standards?

- ☐ the cost of adjustment with the requirements of standards and the certification costs
- ☐ the educational costs and investments.
- ☐ the costs of consulting and certificate releasing

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

Which is the aspect the price depends on?

- ☐ depends on the necessary period of time to visit one or more parcels
- ☐ depends on culture and type of culture.
- ☐ depends on land area, culture, type of culture, and risk assessment of organic producer.
- ☐ all above

QUESTION 5 (PLEASE WRITE THE CORRECT ANSWER)

LIST THREE REASONS WHICH IMPACT ON REDUCING THE ECONOMIC EFFICIENCY OF ORGANIC PRODUCTION.

USING THE SWOT MATRIX LIST AT LEAST TWO CRITERIA ON EACH WHICH DESCRIBE YOUR STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS IN DEALING WITH ORGANIC PRODUCTION

2.4. Beliefs and health-related effects of organic food consumption

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Abstract: The aim of this chapter is to expose principal beliefs about organic food and effects of organic food consumption on health. Organic agriculture is a relatively small phenomenon; however, it is steadily growing. It may be important for producers to understand what are people's beliefs about organic food and what are their effects on the body to better target their marketing strategy. The present chapter will start exposing the principal people's beliefs about organic food. Indeed, various studies indicated that people purchase organic food because they believe that this kind of food is healthier and free from harmful chemical residues; moreover, people think it tastes better and has less impact on the environment. Because one of the most important people's beliefs about organic food is related to its effects on health, in the second part of the chapter the effects of organic food consumption on health will be exposed. At the moment, the potential health benefits for humans related to organic foods have not been yet fully investigated. Anyway, it is known that the consumption of organic products is generally associated to specific lifestyle factors, such as for example healthier dietary patterns including a high intake of fruit, vegetables and wholegrain foods and a low intake of meat, which in turn reduce the risk of metabolic and cardiovascular diseases. Thus, it is not currently possible to associate organic food consumption to specific health advantages.

Keywords: organic food; beliefs; health-related effects

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1. Introduction

The aim of this chapter is to present principal beliefs about organic food as well as effects or organic food consumption on health. The articles in this chapter have been chosen to present research results coming from studies using different methodology and that were conducted in various countries around the world.

Organic food is a growing market, indeed, as asserted by Willer et al., (2019) all around the word here were about 2.9 million organic producers in 2017, which has increased by about 5% respect to the previous year. The majority of the producers are located in Asia (40%), followed by Africa (28%) and Latin America (16%). Hand in hand with these increase in producers, the development of organic market reached 97 billion US dollars in 2017, and the largest organic markets were the United States (40 billion euros, 47% of global market), followed by the European Union (34.3 billion euros, 37%), and China (7.6 billion euros, 8%). These data indicate that more and more people decide to produce or consume organic food, for this reason it is important to examine the beliefs that people have about organic food and what are effects of organic food on people's health.

In the first section of this chapter, a review of studies investigating beliefs about organic food was made. Were analyzed various studies carried out in various countries all around the world, with the aim to better understand what people believe about organic food. It is important to analyze people's beliefs, because they work as real knowledge (Peter & Olson, 1990), that is people may believe that a specific object has a certain characteristic, even if there is no evidence. Beliefs about specific objects were developed through various direct and/or vicarious experiences and provide the basis for the formation of the attitude. Beliefs and attitudes, even if not lead directly to behavior, are important because they can push or not toward a specific behavior, influencing how people respond to a specific object, for these reasons they are used to predict behavior and to place a particular product in the market (Schiffman & Kanuk, 1994).

The second section of the chapter shows the main recent studies about the possible effects of organic foods on human health. This section argues on the possibility that differences in nutrient composition of organic food compared with conventional food could lead to specific advantages for human health. Anyway, it is difficult to separate health benefits deriving from an organic diet from the overall lifestyle factors that may potentially protect human health. In particular, it seems that who habitually consume organic food has generally healthier dietary patterns which are in turn associated with several health advantages. For example, a reduced risk of cardiovascular disease and metabolic diseases (e.g., type 2 diabetes) has been observed when the consumption of wholegrain products, fruit and vegetables is higher than the consumption of meat. For this reason, to date very few studies have directly investigated the possible correlation between organic food consumption and its potential health-related effects. Anyway, it has been found a low rate of allergic diseases, as well as a lower concentration of urinary pesticide residue metabolites in organic food consumers than the general population. Nonetheless, there is the need of more data from long-term studies in order to verify these associations in a sufficiently large representative population.

2. Beliefs about organic food

In the last years, various studies were carried out in different countries to better understand what are people's beliefs about organic food.

Lea and Worsley (2005) conducted a study to examine consumers' beliefs about organic foods. Participants were Australian adults randomly selected from the Victorian population that completed a questionnaire-based mail survey containing a 12-item scale regarding beliefs about organic food. Results showed that the majority of participants believed that organic food is healthier, better for the environment and tastier than conventionally grown food. At the same time, participants report that organic food is more expensive and difficult to find than conventional food. Despite these positive beliefs, around half of the participants consider unreliable the label of organic food and think that organic harvests are too small to be an effective alternative to conventional harvest. Just a few participants report doing not buy organic food, because of its unattractive appearance or because they think organic food is a fad or can be dangerous for the health. Another study carried out in Australia by Lockie and colleagues (2002) used a series of focus groups planned to investigate the issues production and consumption of organic food. Results showed that the main factor that restrains the consumption of organic foods was related to its cost, convenience, and availability. Moreover, even if participants believe that organic food brings benefits for environment and nutrition, some participants were doubtful about the effective benefits of organic food for personal security and sustainability, and worries about the use of animal manure as fertilizer. Finally, also in this study emerged some skepticism about organic food labeling, joined with the importance of independent certification as organic food.

A study conducted by Dumea (2012) in Romania shows that participants attitudes towards organic food is ambivalent: on the one hand they think organic food is free form pesticide and fertilizer contamination and contain more nutrients, on the other hand, they believe that organic food is difficult to find and identify and that its labels are confusing; moreover, participants believe that the price is too high and the appearance is less appealing compared to non-organic products. Another study carried out in Romania, was performed by Gherman (2014) to investigate social representations of Romanians regarding organic food. Participants (a convenience sample of adults from Huşi, Vaslui County, Romania) completed an associative map task asking to write the first five words coming to mind regarding organic food (first-order association). After associating these words with organic food, participants were asked to write the first three words coming to mind reading those associations (secondo order association). Regarding first-order associations, results showed that most cited words were: price, health, authenticity, and availability. With regards to second-order associations price was associated with expensive, money, income, and rich; availability was associated with distance, supermarket, and scarcity; authenticity was associated with whims, food labels, trust, and suspicion; finally, health was associated with additives, benefits, natural, and nutrients.

A study carried out in South Africa by du Toit and Crafford (2003), using a questionnaire administered to consumers of organic food, shown that participants believe that organic food is healthier, tastier, more nutritious and more flavorful respect to non-organic food. Most participants believed that organic food is free from artificial additives and less contaminated by pesticide residues than non-organic food. Concerning appeal, participants shown no difference between the attractiveness of organic and non-organic food. Regarding availability, participants indicate that organic food was harder to find compared to conventional food. Finally, most participants think that organically produced food products should be certified.
Schifferstein and Ophuis (1998) carried out a study in the Netherlands with a sample of customers of natural food stores. Results showed that crucial reasons for buying organic food were connected with the belief the organic food is wholesome, free from chemicals, environment-friendly, and tasty.

Sangkumchaliang and Huang (2012) carried out a study in Thailand, showing that the principal motives for buying organic food are the beliefs that this kind of food is healthier, fresher, pesticide-free, environmentally friendly, and give support local farmers. As in other studies, consumers' trust in the authenticity of the food and price appears to be an issue; in the same way, consumers report they need more information about organic foods.

Gracia and de Magistris (2007) conducted a study in Southern Italy administering a questionnaire to participants from Naples. Results indicate that consumers believe that organically grown products are healthier and have higher quality than conventionally grown products.

A recent study carried out by Wojciechowska-Solis and Soroka (2017), administering a survey to Polish adults, investigate the requirements for organic food expected by consumers. Results showed that the main requirements for consuming organic food are the absence of chemical contamination and the related implication that this kind of food is not harmful to people's health, as well as the taste, the richness of nutrients, and the care for the environment.

With regards to the United States, a study performed by Jinghan Li and colleagues (2007) analyzed determinants of buying organic food in a random sample of United States food shoppers, using a survey. Results indicate that factors that enhance the use of organic food are related to environmental or animal welfare as well as to beliefs that organic foods are more nutritious; on the other hand, factors limiting the consumption of organic food ore related to search costs, diet patterns, and awareness of the organic label.

An interesting study carried out very recently by Danner and Menapace (2020) investigates consumer beliefs analyzing online comments about organic food posted on news websites and forums in German-speaking countries and the United States. Results showed 65 beliefs (e.g., "Organic products are (more) expensive than conventional products", "Organic products are healthier than conventional products", "Organic Products are more nutritious than conventional products", and "Organic products protects the environment") grouped in 22 themes (e.g., "Food safety", "Hight price", "healthiness", "Taste", "Environment and animal welfare") and then in four main themes (e.i., "Product", "Food system", "Authenticity", and "Production"), most of them already referenced in previous studies. However, results revealed several beliefs never or rarely mentioned in previous literature (e.g., "Best practice approach of organic and conventional farming", "Organic is a fad", "The term organic has no meaning", and "Organic produce wrapped in plastic is less organic").

As we have seen so far, various studies showed that the main beliefs associated with organic food consumption were related to wellbeing, which was almost always considered as a motivational antecedent of organic food consumption. Two studies, carried out by Apaolaza and colleagues (2018) analyzed the subjective wellbeing as a consequence of organic food consumption. The first study was carried out a study in Spain, with a nationally representative sample of the population, using an online-panel of the Spanish population. The aim of this study was to analyzes the relationship between organic food consumption, health concern, health beliefs, and subjective wellbeing. Results showed that organic food consumption positively influences subjective wellbeing and that this relationship was partially mediated by health beliefs; that is, people that consume organic food report to have a high level of subjective wellbeing, in part because they believed that they were having a healthy diet. Also, these effects were moderated by individual health concern: for people more concerned about health the effects of organic food consumption were higher. In the second study, Apaolaza et al. (2018) performed an experiment, with students from an Australian university, manipulating health concern (health information vs. control) and organic food consumption (organic vs. not organic). In the health information condition participants were presented a text discussing health issues and nutrition, while in the control condition participants were presented a text not related to health. Then, participants were invited to drink one glass of orange juice. In the organic condition, participants were informed that the juice was certified as organic showing an official organic certification label, while in the non-organic condition did not receive any information about the juice. The results were the same that the first study: participants with a high level of health concern reported a stronger association between organic food consumption and subjective wellbeing; this moderation effect affects both the direct and indirect (through perceived healthiness) influence of organic food consumption on subjective wellbeing.

Up to this point, we present studies investigating people's beliefs about organic food; however, an important aspect is also the knowledge that people have about organic food. To explore this aspect, Pieniak et al. (2010) conducted research investigating subjective and objective knowledge about organically produced food. The study was carried out in Belgium, using a survey administered to Dutch-speaking consumers contacted in various shopping streets or supermarket gates and distributed among members of organizations promoting ecological lifestyle and organic product consumption. To investigate objective knowledge participants were asked questions that should be common knowledge about organically produced food (e.g. "Organic farmers may use synthetic pesticides", "Organic farmers may use synthetic fertilizers"). To investigate subjective knowledge about organic food, participants were asked questions about their perceived knowledge (e.g. "Compared with an average person I know a lot about organic vegetables", "I know a lot about how to evaluate the quality of organic vegetables"). Results showed that consumers think to have good knowledge (subjective knowledge) and were well informed (objective knowledge) about organic food; moreover, members of organizations promoting ecological lifestyle and organic product consumption have higher scores as compared to respondents contacted in the street or at the supermarket.

3. Health effects of organic foods

Following an organic diet has been linked to a reduction in terms of frequency of some chronic diseases. It has been argued that this correlation may be due to differences in the composition of nutrients between organic and non organic foods. Anyway, it is not clear if or to what extent these differences may have protective or negative effects on human health and a higher number of human cohort studies is needed to verify this hypothesis.

In vitro studies on cell lines have revealed antimutagenic effects of the organic plant extracts or juices in comparison with the conventional ones (Ren, et al., 2001; Olsson, et al., 2006; Kazimierczak, et al., 2014). These findings could be explained by the fact that, although the content of polyphenols and ascorbic acids is similar in concentrations, in organic juices these compounds have and antioxidant activity higher than the ones in conventional food (M. Gastoł, et al., 2011). However, none of the studies included healthy control cell lines.

Several animal experiments suggest that the feed production system, from both organic and non organic production, may be responsible of the development and functioning of the progeny's immune system. Although at the moment it is not clear how these statements could be applied to humans, it is well known that the restriction in the use of antibiotics in breeding could minimize the risk of antibiotic resistance in bacteria. However, a transition to organic manufacturing could be not sufficient to cope with the antibiotic resistance problem. In fact, also the misuse and overuse of antibiotics in humans, are responsible for antibiotic resistance to move from farm animals to humans (Pignato, et al., 2010; Marshall & Levy, 2011; Argudin, et al., 2017).

When compared to non-organic food, organic food generally shows a lower level of pesticide residue as well as a lower amount of nitrate-nitrogen. In fact, organic foodstuffs are produced according to specified standards that refrain from using synthetic chemicals like pesticides and fertilizers (European Community Council Regulation, 2007). Specifically, organic cereal crops have lower concentrations of cadmium than conventional crops, due to the absence of mineral phosphorus fertilizer in organic soils (Baranski, et al., 2014). Taking into consideration the Public Health standpoint, this is very important because exposure to cadmium can cause kidney toxicity and bone demineralization directly through bone damage or indirectly through renal dysfunction (Bernard, 2008). Moreover, a possible link between hypospadias, a malformation characterized by an abnormal positioning of the opening of the urethra in males, and exposure to pesticides during pregnancy has been observed (Rocheleau, et al., 2009). The lower pesticides content in organic food compared with conventional food could explain the correlation between a lower risk of hypospadias in male babies and their mothers' organic dietary choice during pregnancy (Christensen, et al., 2013; Brantsaeter, et al., 2016)

The minerals and vitamins content in organic crops is generally the same that the one recovered in conventionally produced crops (Dangour, et al., 2009; Brandt, et al., 2011; Smith-Spangler, et al., 2012). Anyway, a higher content of phenolic compounds, flavanones, flavonols and anthocyanins in organic versus conventional crops has been reported (Baranski, et al. , 2014). There is evidence that these compounds are related to a reduced risk of cardiovascular diseases, neurodegenerative diseases and certain types of cancers (Del Rio, et al., 2013; Wahlqvist, 2013).

The omega-3 PUFA and ruminant fatty acids content has been found significantly higher in organic milk in comparison with conventional milk (Średnicka-Tober, et al., 2016a), as well as a higher content of omega-3 PUFA in organic compared to conventional meats (Średnicka-Tober, et al., 2016b)has been found. *n*-3 PUFAs are responsible for numerous cellular functions. In particular, they regulate the nervous system, blood pressure, blood coagulation, and glucose tolerance. Furthermore, in case of regular physical activity, *n*-3 PUFAs may provide health benefits and an improvement in performance due to the fact that they increase the production of reactive oxygen, showing an anti-inflammatory and antioxidant activity (Gammone, et al., 2019). However, a modest increase in omega-3 PUFA intake due to the consumption of organic milk or meats cannot be specifically associated to any specific health advantage (Mie, et al., 2017). Moreover, there is a need for further research in order to better determine the health effects of ruminant fatty acids because associations between their intake through organic milk and the prevention of chronic diseases, in particular cancer and cardiovascular disease, are inconsistent (Gebauer, et al., 2011).

Some studies have investigated on the possible association among organic food consumption and a lower risk of childhood allergies and atopic diseases. In 2006, the PARSIFAL study (Alfven, et al., 2006) recruited 14,000 children between the age of 5 and 13 years in Austria, Germany, the Netherlands, Sweden and Switzerland in order to verify whether organic diet could modify the incidence of sensitization and allergic diseases. Anthroposophic families, whose lifestyle is primarily characterized by an organic diet, and a control group were considered for the study. Results showed that children from the first group had a lower prevalence of allergic symptoms than the ones belonging to the control group. Anyway, these findings were not the same among the five countries included in the study. More recently, in order to investigate allergic disease during childhood,

the ALADDIN prospective birth cohort study (Stenius, et al., 2011) followed from the prenatal period to the age of 2 years 330 Swedish babies belonging to families with an anthroposophic or conventional lifestyle. Results showed a 75% reduction in allergen sensitization in children from anthroposophic families. Finally, in 2008, the KOALA Birth Cohort Study in the Netherlands (Kummeling, et al., 2008) prospectively investigated on a possible association between non-organic food consumption by children and the development of atopic manifestations in the first 2 years of life. At 2 years of age, 27% of the 2,764 children considered for the study were sensitized against at least one allergen, while the risk of eczema decreased of 36% in children with exclusive consumption of organic milk or other dairy products. Anyway, this association may be due to other lifestyle factors rather than the preference for organic dairy products during infancy, although it has been seen that organic diet in pregnant or lactating women may influence the health status of their children. To this purpose, the MoBa study (Torjusen, et al., 2014) included more than 28,000 pregnant Norwegian women. Among the participants, women who reported a reduction of 21% in the risk of pre-eclampsia - a disorder of pregnancy threatening both the mother and the baby and causing premature birth - was observed in women who frequently consumed organic vegetables during pregnancy. Rist *et al.* (2007) found that the amounts of vaccenic acid in human breast milk were higher in women consuming organic dairy products regularly. Since the plasma levels of vaccenic acid may affect the risk of cancer and coronary heart disease in a beneficial manner (Field, et al., 2009), it could be argued that an organic diet in women who feed their babies with breast milk may be associated with a lower risk of childhood chronic diseases. However, also the evidence for these results is not at the moment conclusive because other long-term studies are needed.

Currently, there are very few prospective cohort studies investigating the correlation between organic food consumption and health benefits in adults. In 2014, 623,080 UK women were observed over a 9.3-year follow-up period in order to test the hypothesis that eating organic food may reduce the risk of cancer. No reduced risk of cancer overall was found among women who usually or always consumed organic food, but it was observed a reduction of 21% in the risk of non-Hodgkin lymphoma (Bradbury, et al, 2014). Although it has been reported that the potential link between organic food consumption and the low risk of non-Hodgkin lymphoma may be related to a lower exposure to pesticides (Schinasi & Leon, 2014, replication of this result is needed to have sufficient power to examine the association. More recently, the French NutriNet-Santé Study (Baudry, et al., 2018) found that among 68,946 participants observed from 2009 to 2016, the higher frequency of organic food consumption was associated with a reduction in the overall risk of cancer. In particular, a reduced risk for postmenopausal breast cancer in women and all lymphomas in the general population was observed among people with an organic diet pattern. Anyway, further prospective studies are necessary to confirm these results, mainly because, independently from the their possible health benefits, generally who regularly consume organic foods tend to make food choices healthier than non-organic food consumers (Eisinger-Watzl, et al, 2015; Kesse-Guyot, et al., 2013).

4. Conclusion

This chapter aimed to expose the principal beliefs that people have about organic food, as well as the effects of organic food consumption on health, through a review of the literature.

Concerning beliefs, the analysis carried out in this chapter showed the principal factors inducing people to consume organic food were related to health. Indeed, people believe that organic food is more nourishing than conventional food; moreover, the absence of pesticides and chemical residuals make organically grown foods safer for health than conventionally grown ones. In addition to these beliefs, other common beliefs were related to the environment, indeed people consider organic food as more environmental and animal friendly because they take care of the environment and animal welfare. With regards to factor inhibiting organic food consumption, these are mostly related to price and trust, indeed people believe that organically grown foods are more expensive than conventionally grown food; moreover, they do not trust how organic food is produced as well as organic food labeling; moreover, with regards to labels, people consider them unclear. These results support Schleenbecker and Hamm (2013) that conducted an extensive literature analysis, considering both qualitative and quantitative studies conducted in various countries around the world, to understand consumers' perception of organic food. Results showed that principal properties assigned to organic food are related to nutrition, health, sensory and ethical aspects. Moreover, authors investigating a specific aspect of organic food, such as labeling, founding that with regards to labeling issues results showed that in Europe consumers' knowledge about labeling is poor and not founded on objective consumer information; on the other hand, in the USA label of organic food is used to identify organic products. Moreover, the level of trust in labels varies across the countries and depends on state involvement.

The majority of studies on the health effects of organic food has focused on the potential differences in terms of nutritional composition of organic food compared to non-organic food. Some recent studies have shown that specific dietary patterns such as a high intake of fruit, vegetables and wholegrain products together with a low intake of meat, may be advantageous for the human health. Anyway, there is the need of further evaluations in order to understand to which extent the organic food consumption may have specific health benefits for humans.

As we can see, the most common consumer belief for consuming organic foods is a belief that organically grown food has health benefits. However, studies carried out on this topic indicate that organically grown foods do not offer more nourishing respect to conventionally grown foods. Despite this evidence, people continue to use organic food principally for health reasons. A study, carried out by Olson (2017) shown how persistent are beliefs about health advantages of consuming organic food also after exposure to information disconfirming these beliefs. In its study, Olson analyzed reader responses to reports or editorial about the Stanford University meta-analysis (Smith-Spangler, et al., 2012; results of this study indicated that organic food does not offer significant nutritional advantages compared to conventional foods) published in mainstream outlets. Results showed that the explosion to Stanford results does not change the beliefs of pro-organic peoples regarding the health benefits of organic foods. At the same time, results indicate that the exposure to Stanford study results confirm the opinion of organic-skeptic people that organically grown food is too expensive considering little or no health advantages. These results indicate that to improve the use of organic food consumption between people that are skeptics towards this kind of food could be do something (for example, improve the organic production efficiencies) to reduce its price.

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Appendix – Definitions of key terms

allergen – allergen is a substance that causes an allergic reaction.

antibiotic resistance – antibiotic resistance is the ability of bacteria and other microorganisms to resist the effects of an antibiotic to which they were once sensitive.

antimutagenic effects – antimutagenic effects are able to counteract the effects of mutagens. Mutagenicity refers to the induction of permanent changes in the DNA sequence of an organism, which may result in a heritable change in the characteristics of living systems.

antioxidant activity – antioxidant activity is a limitation of the oxidation of proteins, lipids, DNA or other molecules that occurs by blocking the propagation stage in oxidative chain reactions.

associative map task – the associative map task is a method used to investigate the content and elements of social representations.

atopic diseases – the atopic diseases (eczema, asthma and rhinoconjunctivitis) are clinical syndromes each defined by a group of symptoms and signs. Both genetic and environmental factors determine the development of atopic disease.

attitude – attitude is a generic evaluation of an object.

belief – belief is a form of mental representation in which a proposition is taken to be true.

convenience sample – a convenience sample is a type of non-probabilistic sampling which consists in taking the sample from that part of the population that is at hand.

chronic diseases – chronic diseases are conditions that last 1 year or more and require ongoing medical attention or limit activities of daily living or both.

cytotoxic activity – cytotoxic activity is the quality of being toxic to cells.

eczema. eczema is an inflammatory condition of the skin characterized by redness, itching, and oozing vesicular lesions which become scaly, crusted, or hardened.

focus group – a focus group is a qualitative technique used in research in the human and social sciences, in which a group of people discusses their attitude towards a given theme.

immune system – the immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease.

mediation – mediation is a procedure to check whether a third variable explains the relationship between two variables.

meta-analysis – a meta-analysis is a research tool, that aims to summarize data from different studies.

moderation – moderation is a procedure to check whether a third variable influences the strength or direction of the relationship between two variables.

national representative sample – a national representative sample is a group of participants selected from a larger population that accurately reflects the characteristic national population.

non-Hodgkin lymphoma – non-Hodgkin lymphoma is a group of blood cancers that includes all types of lymphoma except Hodgkin lymphomas. Lymphomas are types of cancer that develop from lymphocytes, a type of white blood cell.

objective knowledge – objective knowledge regards accurate information that people have about a given theme.

omega-3 PUFA – omega-3 PUFA are polyunsaturated fatty acids (PUFAs) characterized by the presence of a double bond three atoms away from the terminal methyl group in their chemical structure.

online-panel – an Online panel refers to a group of participants who have agreed to provide information over an extended period of time.

phenolic compounds – phenolic compounds are chemically defined as compounds containing hydroxylated aromatic rings, the hydroxy group being attached directly to the phenyl, substituted phenyl, or other aryl group.

ruminant fatty acids – ruminant fatty acids refer to a class of fatty acids that contain one or more double bonds in the *trans* configuration.

qualitative methods – qualitative methods are a set of techniques used in various fields, without the aid of formulas, mathematical models and/or statistics. These kinds of methods are focus on obtaining data through open-ended and conversational communication.

quantitative methods – quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data. These kinds of methods focus on assembly numerical data.

questionnaire – a *questionnaire* is a research tool consisting of a series of written questions for the purpose of gathering information about people.

random sample – a random sample is a kind of sampling in which the selection of a sample unit is based on chance.

social representation – social representation is a set of values, ideas, metaphors, beliefs, and practices shared between members of social groups and communities.

subjective knowledge – subjective knowledge regards personal perception about how much people know about a given theme.

subjective wellbeing – subjective wellbeing is a self-reported measure of perceived personal well-being.

survey – a survey is a data collection instrument used to assemble information about individuals.

vaccenic acid – Vaccenic acid is the predominant kind of trans-fatty acid (a type of unsaturated fat) found in human milk.

Ch. 2.4

BELIEFS AND HEALTH-RELATED EFFECTS OF ORGANIC FOOD CONSUMPTION

OBJECTIVES: The aim of this chapter is to provide an information about principal belief that people have about organic food consumption and its effects on the health.

SKILLS: The student should have acquired what are principal beliefs that determine the consumption of organic food and what effects the consumption of organic food has on the health.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

Regarding the study carried out in Romania by Gherman (2014) aimed to investigate social representations of Romanians regarding organic food, which of these words does not appear in the first-order associations:

- ☐ Price
- ☐ Authenticity
- ☐ Availability
- ☐ Animal welfare

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

The studies carried out by Apaolaza and colleagues (2018) showed that:

- ☐ Organic food consumption positively influences subjective wellbeing
- ☐ Organic food consumption negatively influences subjective wellbeing
- ☐ Subjective wellbeing negatively influences organic food consumption
- ☐ Subjective wellbeing positively influences organic food consumption

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

Regarding the study conducted by Pieniak et al. (2010) aimed to investigate subjective and objective knowledge about organically produced food, results showed that:

- ☐ Consumers have poor subjective and objective knowledge about organic food
- ☐ Consumers have poor subjective and good objective knowledge about organic food
- ☐ Consumers have good subjective and poor objective knowledge about organic food
- ☐ Consumers have a good subjective and objective knowledge about organic food

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

Chose the right statement.

- ☐ The minerals and vitamins content is generally different in both conventionally and organically produced crops
- ☐ The feed production system, from both organic or conventional production, has the same impact on the development of animals, specifically on the offspring's immune system
- ☐ There is evidence to indicate that organic food has lower levels of pesticide residue and lower levels of nitrate-nitrogen than non-organic food
- ☐ It is possible to conclude specific health benefits offered by a modest increase in omega-3 PUFA intake from a change from conventional to organic milk or meats

QUESTION 5 (PLEASE CHECK THE CORRECT ANSWER)

Evidence that women who reported frequent consumption of organic vegetables during pregnancy exhibited a 21% reduction in the risk of pre-eclampsia comes from:

- ☐ The PARSIFAL study
- ☐ The MoBa study
- ☐ The ALLADIN study
- ☐ The KOALA Birth Cohort Study

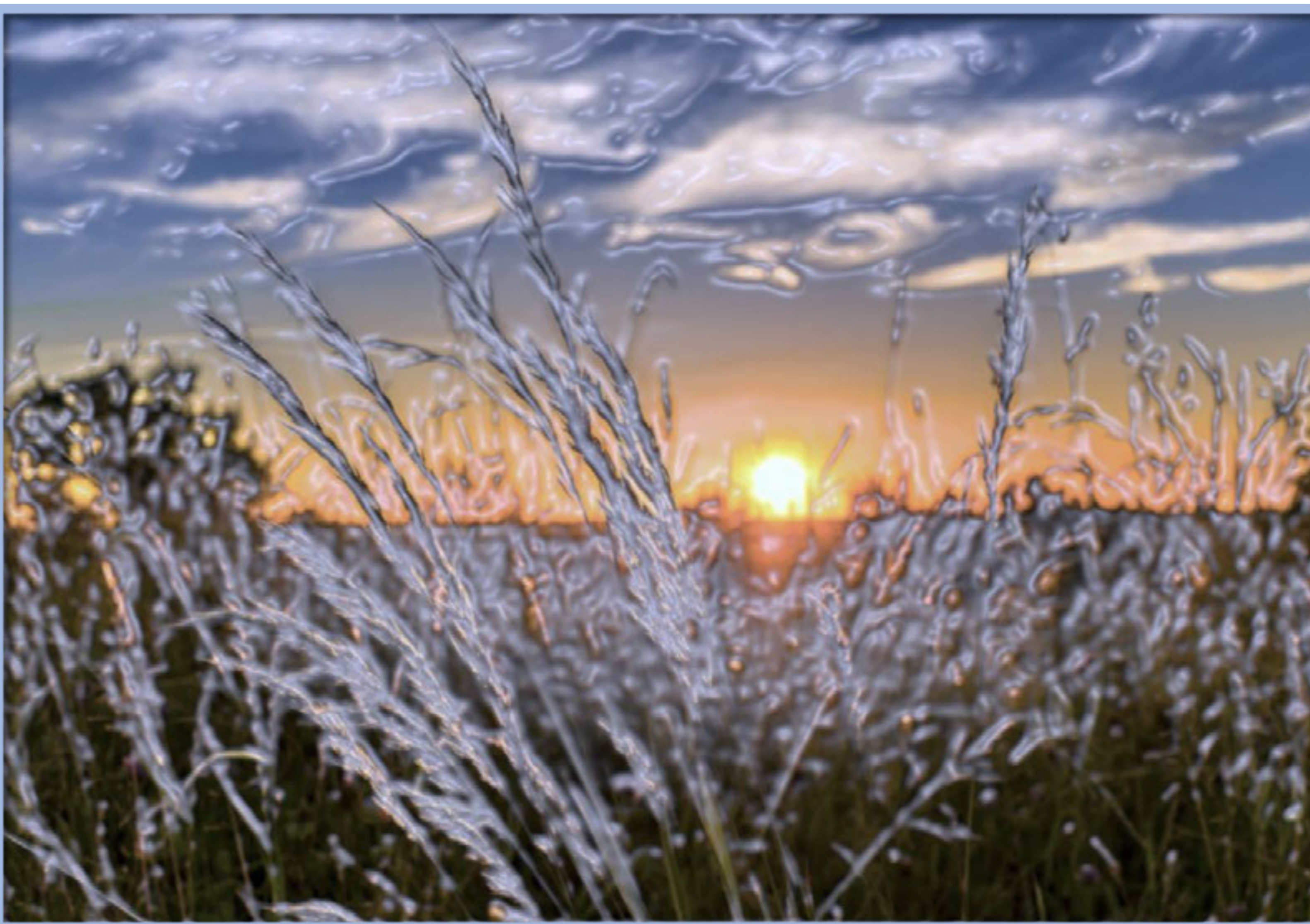
QUESTION 6 (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

Write the principal beliefs that determine the consumption of organic food and the effects the consumption of organic food has on the health

PRACTICAL APPLICATION OF THE PREVIOUS CHAPTER

IMAGINE YOU ARE TALKING TO A PERSON WHO THINKS ORGANIC FOOD CONTAINS MORE NUTRIENTS THAN NORMAL FOOD. WHAT WOULD YOU SAY TO SUPPORT OR UNDERMINE THIS STATEMENT?

THIRD SECTION: Sustainability



- The impact of organic farming on the environment, with accent to the changes occurring in agroecosystems
- Innovation and sustainability of business models: learning, generative practices and school (university) – work transition in the organic agri-food sector
- The impact of the European funds financial support on the organic production in the EU
- Organic farming and sustainable development of rural areas: A case study of Serbia

3.1. The impact of organic farming on the environment, with accent to the changes occurring in agroecosystems

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Abstract: Both the positive and negative impact of organic farming on the environment (compared to conventional agriculture) were highlighted.

The positive impacts of organic farming on the environment are the following: reduction of pesticides, antibiotics and other chemicals released into the environment; increasing biodiversity by reducing chemical pollution (especially soil biodiversity which is strongly affected by the use of chemicals in agroecosystems); preservation and increasing the populations of pollinators, which are affected by the use of insecticides (reducing the number and diversity of pollinators leads to decreases the agricultural production in general); reducing pollution at all levels (soil, air, water).

The negative impacts of the ecological agriculture on the environment are the following: the decrease of the production on the surface unit leads to the need to increase the surfaces included in the agricultural circuit (especially by deforestation); thus the CO_2 emissions are higher to obtain the same amount of agricultural products in organic farming as compared to traditional agriculture.

Keywords: biodiversity; environment; organic farming; pesticides; pollinators.

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1. Introduction

The impact of organic farming on the environment is a subject still disputed by specialists worldwide. Whether the benefits of organic feed on the human body are generally accepted, the environmental impact of this type of agriculture is questionable.

But is the Earth capable of feeding its entire population organically?

In 2017 Clark & Tilman publish a comprehensive study in which they synthesize known data from 742 food production systems of over 90 foods from 164 published life cycle assessments (which measures the environmental impact of food production systems). This highlights an interesting idea: organic farming has a smaller impact on the environment in areas that naturally benefit from good conditions for plant growth (soils, precipitation, etc.). The impact, however, increases as the environmental conditions are less favorable for plant growth (due to the need to compensate them with various additions).

Providing the necessary food for the nearly 8 billion inhabitants of the planet implies, however, a significant impact on the environment. This process results annually in the production of 13.7 billion metric tons of carbon dioxide equivalents (which represents about 26% of human-made GHG emissions) (Poore & Nemecek, 2018). These authors point out in their study published in the Science journal (2018) that food production creates about 32% of global terrestrial acidification and about 78% of eutrophication.

Based on the literature, the main positive effects that organic agriculture has on the environment, particularly in terms of reducing pollution (especially with pesticides) and conserving biodiversity (with an emphasis on pollinators) were highlighted.

2. The positive impact of organic farming on the environment

Most specialists consider organic agriculture to be much more environmentally friendly than traditional agriculture; this idea also emerges from meta-analysis studies (Reganold & Wachter, 2016). But the quality of the environment and specific biodiversity are more or less affected by any type of agriculture (by the simple fact that natural ecosystems are replaced by agroecosystems) (Lorenz & Lal, 2016).

2.1. Reduction of pesticides

The most important benefit of organic farming on the environment is undoubtedly the reduction of the amount of pesticides. Over the time, pesticides have been associated with human diseases, and the most dangerous have been removed from use (the best known being the case of DDT), as their negative effects have been proven. In the human body pesticides can enter in different ways, either they are ingested with food or water, or they are inhaled if they persist in the air or they can even enter by diffusion through the skin. No matter how protected a person is, she is inevitably exposed to a dose of pesticides (larger or smaller) during her lifetime. At the same time, pesticides affect animals in similar ways, whether they are domestic and companion animals or wild animals.

The harmful effects of pesticides on humans are among the most diverse: if constant exposure to low and moderate doses can induce dermatological, gastrointestinal, respiratory, reproductive, endocrine or neurological disorders, higher doses may also have carcinogenic effects (Nicolopoulou-Stamati et al. 2016). If high doses of pesticides are accidentally ingested, serious illness or even death can occur.

But the widespread use of pesticides has been, over time, one of the main methods to increase the productivity of agriculture, to satisfy as much as possible the needs of a growing population of the planet.

Pesticides are classified according to the target organisms they destroy and according to their chemical structure (over 1,000 pesticides have an ISO approved standardized name). A classification of pesticides according to their physicochemical characteristics and their behavior in water and soil is made by Gavrilescu (2005) (Figure 1).

In 2010 World Health Organization (WHO) made for chemical pesticides the following classification by hazard (in 4 toxicity classes):

Class Ia = pesticides considered extremely hazardous
Class Ib = pesticides considered highly hazardous
Class II = pesticides considered moderately hazardous
Class III = pesticides considered slightly hazardous
Class U = product unlikely to present acute hazard in normal use.

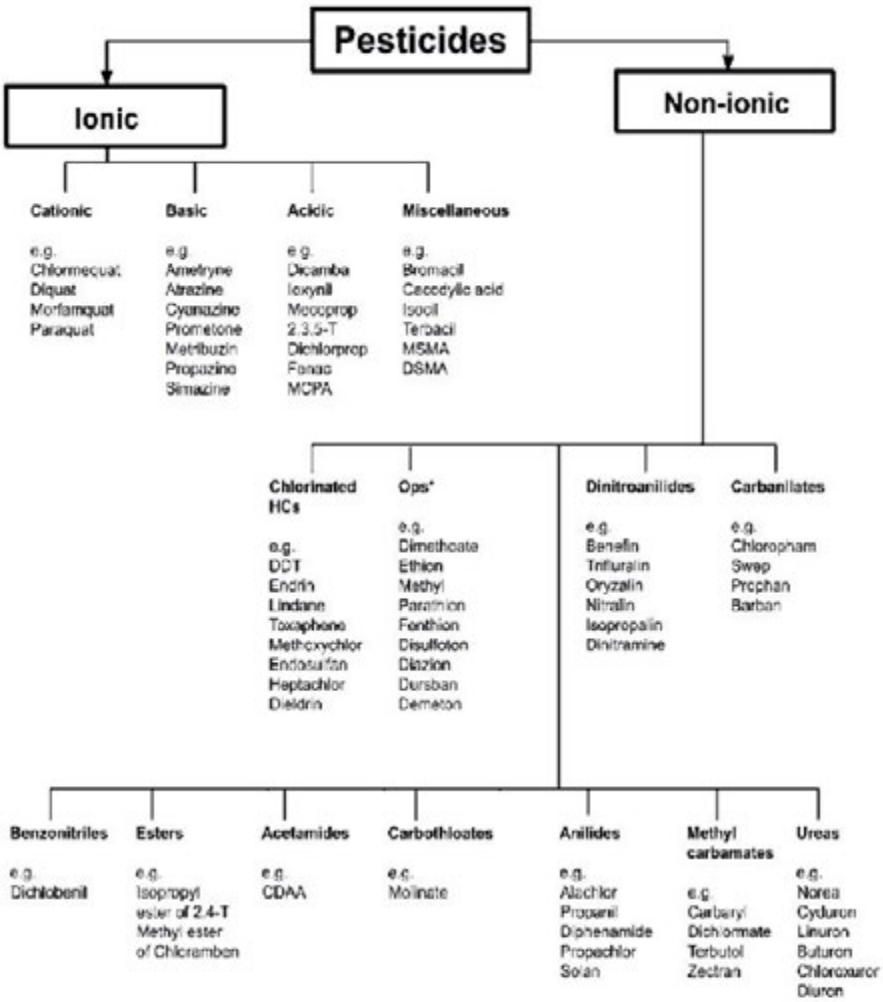
Although pesticides have been used in one form or another for about 3,000 years, the widespread of chemicals used as pesticides has been massive since World War II (their use is not only for agriculture, but also for recreational green spaces, sometimes in forests or to combat insect-borne diseases, such as typhus or malaria) (Gavrilescu, 2005). Their widespread use in recent decades has led to dramatic increases in food production. But at what cost?

A suggestive scheme of the pesticide circuit in nature was made by Jinturkar in 2019 (Figure 2). Once in the soil or water, pesticides can undergo processes of transport in the environment, transfer between its various compartments and physical and chemical degradation until their complete destruction (Gavrilescu, 2005). Despite the negative effects of pesticides, their complete elimination, especially from agriculture, can lead to a decrease of about 40% in food production.

Once released into the environment, synthetic pesticides contaminate water, soil and plant communities (which are not the target of herbicides). Among the pesticides, the most dangerous for the environment are insecticides, which also attack useful insects (e.g honey bees); for this reason, several insecticides have been prohibited in recent years (e.g. neonicotinoid insecticides have been banned in the EU since 2018, after studies have shown that they significantly affect honey bees - *Apis mellifera*) (Valavanidis, 2018).

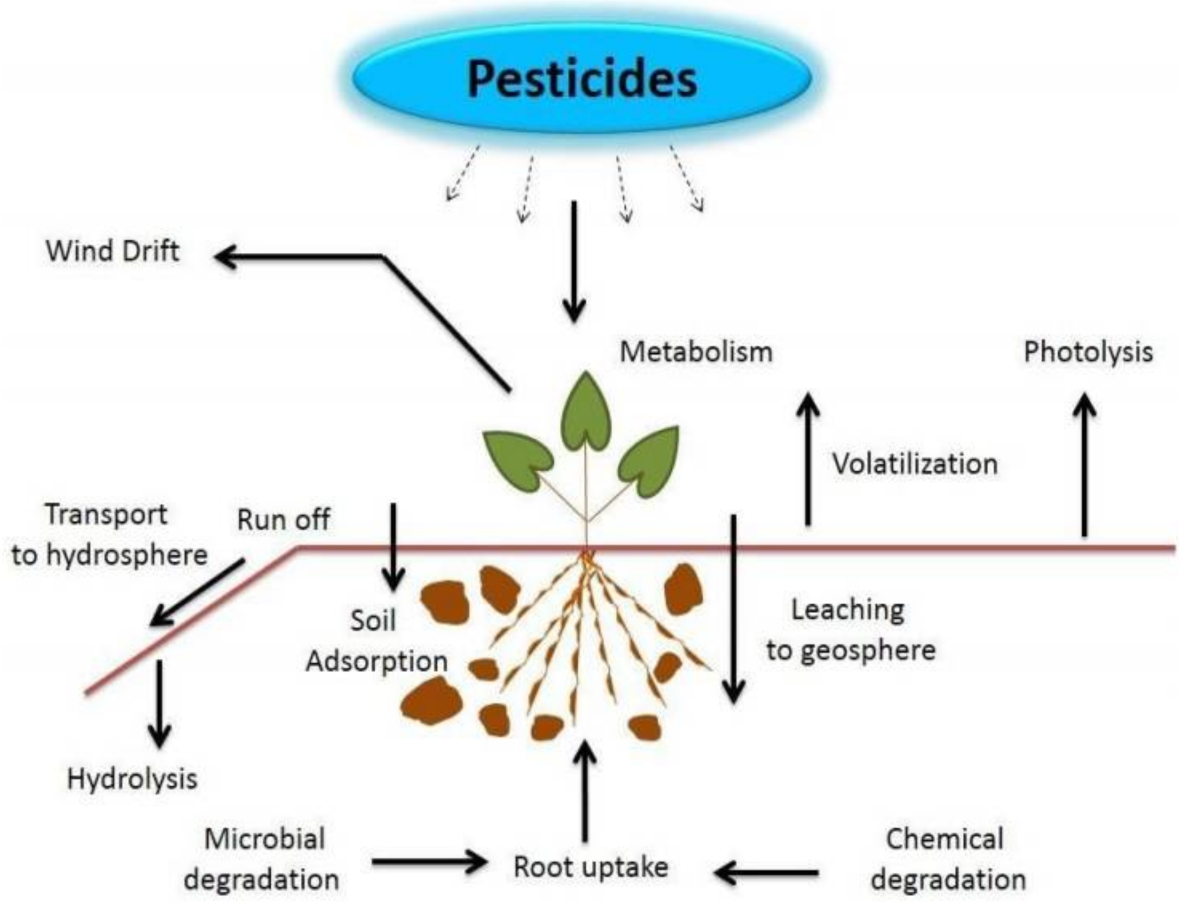
Neonicotinoids were widely used in agriculture, especially for controlling insects that attack the root system of plants, which can be more difficult to remove by other methods (tobacco leaf extracts - *Nicotiana tabacum* - being used as insecticides since 3-400 years ago). Also, they were used with foliar applications in different crops or ornamental plants in gardens, but also for the removal of pets parasites

Figure 1. Classification of the pesticides (Gavrilescu 2005



(because they have low toxicity to mammals) (Jeschke et al. 2011). But neonicotinoids not only affect bees, but also many other insect species. The dramatic decrease in their number led to the decline of entire populations of insectivorous birds (which no longer had anything to feed their young).

Figure 2. Movement of pesticides in the environment (Jinturkar, 2019)



DDT is a synthetic chemical that was first obtained in the late 19th century. But it use as a pesticide began only in the 1930s and 1940s (World Health Organization, 1990). The beneficial effects of DDT in pest control have led to its widespread use around the world. Its main problem was that it is particularly persistent, accumulating in increasing concentrations in organisms from the food chain (the phenomenon is called biomagnification). Following the discovery of the negative effects of DDT on birds (revealed for the first time in the book Silent Spring published by American author Rachel Carson), it has been banned for use in agriculture since 1962. Carson write „Where do pesticides fit into the picture of environmental disease? We have seen that they now contaminate soil, water, and food, that they have the power to make our streams fishless and our gardens and woodlands silent and birdless."

The soils resulting from organic farming are much cleaner than those that support traditional agriculture. Pesticides accumulate from year to year in the soil, which is practically non-existent in the case of organic agriculture. The same benefit has the waters (surface and groundwater network) located near the areas used for organic agriculture - they are free of pesticides that inevitably drain from the soils treated for traditional agriculture (the effects of eutrophication and acidification of water due to pesticides that accidentally reach them are well known - Clark & Tilman, 2017).

For organic agriculture, which does not accept the use of conventional pesticides in the production process, there is the option of biopesticides. Over time, pesticides obtained from plants in particular have been used empirically to control crop pests or human or animal parasites. Biopesticides are represented by substances from natural sources (plants, animals, bacterial products or even some minerals). Their use has increased in recent times, parallel with the significant expansion of organic farming. According to the data available at the moment, the biopesticides market has grown from USD 1600 million in 2009 to USD 3147,1 million in 2018, and will increase by approximately 14% annually by 2024 (Abd-Elgawad & Askary, 2020).

In recent years, the use of alternative solutions in combating fungi that attack crop plants is increasingly being considered (Mahmood et al. 2017). Thus, salicylic acid and hydrogen peroxide can be used (harmless to the environment, instead of synthetic fungicides); Biofungicides based on hormones, enzymes or volatile oils have also been tested. Some fungicides have also been made based on nanoparticles, due to their biological compatibility and physico-chemical properties (especially those based on TiO2, a non-toxic and environmentally friendly product, which has proven its antifungal qualities - Boxi et al. 2016). They are effective against *Fusarium solani* (which affects potatoes and tomatoes) and against *Venturia inaequalis* (which affects apple leaves and fruits).

2.2. Increasing biodiversity

Conventional agriculture has among its effects the dramatic decrease of the natural biodiversity in the cultivated areas, but also in the adjacent areas.

The main reason for the decline of biodiversity in agricultural ecosystems is the profound change in natural habitat for species living in those areas. This cannot be avoided by organic farming, which also involves monoculture. But local biodiversity is also reduced due to the use of chemicals in traditional agriculture; this inconvenience can be overcome by organic agriculture, which does not allow the use of this category of substances (or uses them in minimal quantities, only in emergencies).

Organic farming and pesticide limitation primarily maintain increased biodiversity of soil fauna and microflora. Also, insects are no longer affected by harmful substances (insecticides), which allows the maintenance of populations that are the food of insectivorous birds (indirectly affected by insecticides that reduced the amount of food available). The waters are cleaner because they are no longer poisoned by pesticides. Their flora and fauna remain healthier and more diverse.

The positive effects of biopesticides use on soil biodiversity are noticeable. However, in some cases, biopesticides alone are not effective enough to completely (and timely) eliminate the targeted pests. Therefore, they may represent a possibility to significantly reduce the amount of conventional pesticides used (with which they can be administered in combination - according to studies conducted by Abd-Elgawad & Askary, in 2020 that analyzed the effects of biopesticides on nematodes attacking crops in Egypt).

Also, the communities of mycorrhizal fungi in the soil benefit from the reduction of the quantity of chemical substances, together with the practice of organic agriculture. Although their diversity does not change considerably, their abundance increases significantly in organically grown soils (Bavec & Bavec, 2015). Organic agriculture has the effect of consolidating a more fertile soil, with a greater diversity of animal organisms and microorganisms in it, which is a net advantage for plant cultivation (van der Werf et al. 2020).

In Europe, the reduction of biodiversity is reflected in the increasing decline in the number of plant and animal species. The EU Biodiversity 2020 Strategy proposed stopping the reduction of biodiversity and strengthening the protection of natural ecosystems, including by limiting invasive species; they strongly compete with local species and, having no pests and dedicated consumers (especially in the early stages of colonization), eliminate them. Organic farming is generally more environmentally friendly and less aggressive with biodiversity than conventional farming (Bavec & Bavec, 2015).

In order to maintain an increased biodiversity in the areas with organic agriculture, it is necessary that the land is not occupied to a large extent by cultivated areas; the portions of land at the edge of the crops, the areas interspersed with unworked natural meadows, the small patches of forest represent important refuges for the species of insects, birds and small mammals. Also, wild flora can be preserved only in these areas.

The combination of organically cultivated areas and uncultivated areas between them can be a way to conserve and increase the abundance of rare species listed in the Red Book (these are plant species or insect species- such as butterflies – Figure 3)(Pfiffner & Balmer, 2011).

Figure 3. Aspects of the positive impact of organic agriculture on biodiversity (Pfiffner & Balmer, 2011)

Bengtsson et al. 2005 publish a comprehensive review of the scientific literature up to 2003, relative to the impact of organic farming on biodiversity. From the analyzed studies, 95% show a positive effect of organic agriculture on the abundance of plant and animal species; they are 50% more abundant in areas with predominantly organic agriculture, and species diversity increases in these areas by 30% (birds, predatory insects, such as carabids, soil fauna and some plant species) (van der Werf et al. 2020).

Butterfly species are even more advantaged by organic farming: it is estimated that their abundance can increase by up to 60% near organic farms, compared to areas containing traditional farms (Bavec & Bavec, 2015).

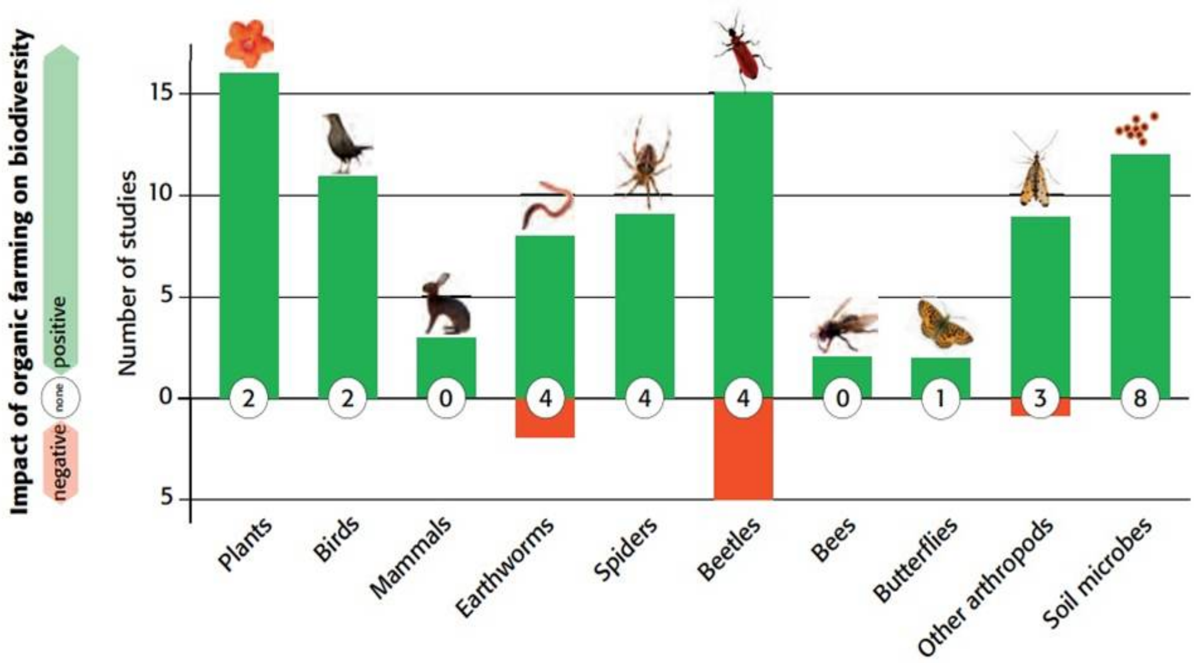
Another study, which summarizes data from the literature on variations in density and diversity of some plants, animals and microorganisms species in organic farming areas compared to those with traditional agriculture, was conducted by Pfiffner & Balmer (2011). The schematic result of the study is presented in Figure 4.

The main reasons why biodiversity is higher in areas where organic farming is practiced compared to those where traditional agriculture predominates are:

1. reduced use of synthetic chemicals, pesticides not allowed;
2. reduced pollution at all levels: soil, water, for the same reasons;
3. the existence of uncultivated areas interspersed with cultivated areas;
4. lower density per unit area of cultivated plants;
5. greater variety of cultivated plants, the frequent rotation of crops, the lack of very large areas of monoculture.

Increasing biodiversity in agroecosystems is also beneficial for farmers. An ecosystem with greater biodiversity is more adaptable and can respond more effectively to stressful situations. More fertile soils, with less erosion, increased populations of pollinators also have obvious benefits for agriculture (Pfiffner & Balmer, 2011).

Figure 4. The diagram shows the number of studies that showed a positive (green), neutral (white circle) or negative (red) impact of organic agriculture on various species (the analysis covered 95 papers) (Pfiffner & Balmer, 2011).



2.3. Preservation of pollinators

Pollinators are essential for the realization of biological cycles in agricultural crops. In the last half-century, pollinators worldwide have suffered a drastic decline, mainly due to the anthropization of more and more ecosystems. Of the crops, about 35% of the species (representing 8-900 plant species) are pollinated by insects (Nicholls & Altieri, 2013). Among insects, bees are the most common category of pollinators (there are many species of bees - in Central Europe alone several hundred have been identified).

The use of pesticides in conventional agriculture (especially insecticides) greatly affects bee populations. The emergence and expansion of organic agriculture can help restore pollinators, absolutely necessary for the fruiting of species that pollinate through them.

Wild pollinators are disadvantaged by modern agricultural systems, which involve cultivating a single species on large areas of land; therefore the uncultivated spaces between the agricultural lots, in which species with different types of flowers can appear, are very important for maintaining the biodiversity of the pollinators. Also, wild pollinators are more sensitive to chemicals used in agriculture than honey bees, and may even disappear completely from some agroecosystems (Nicholls & Altieri, 2013).

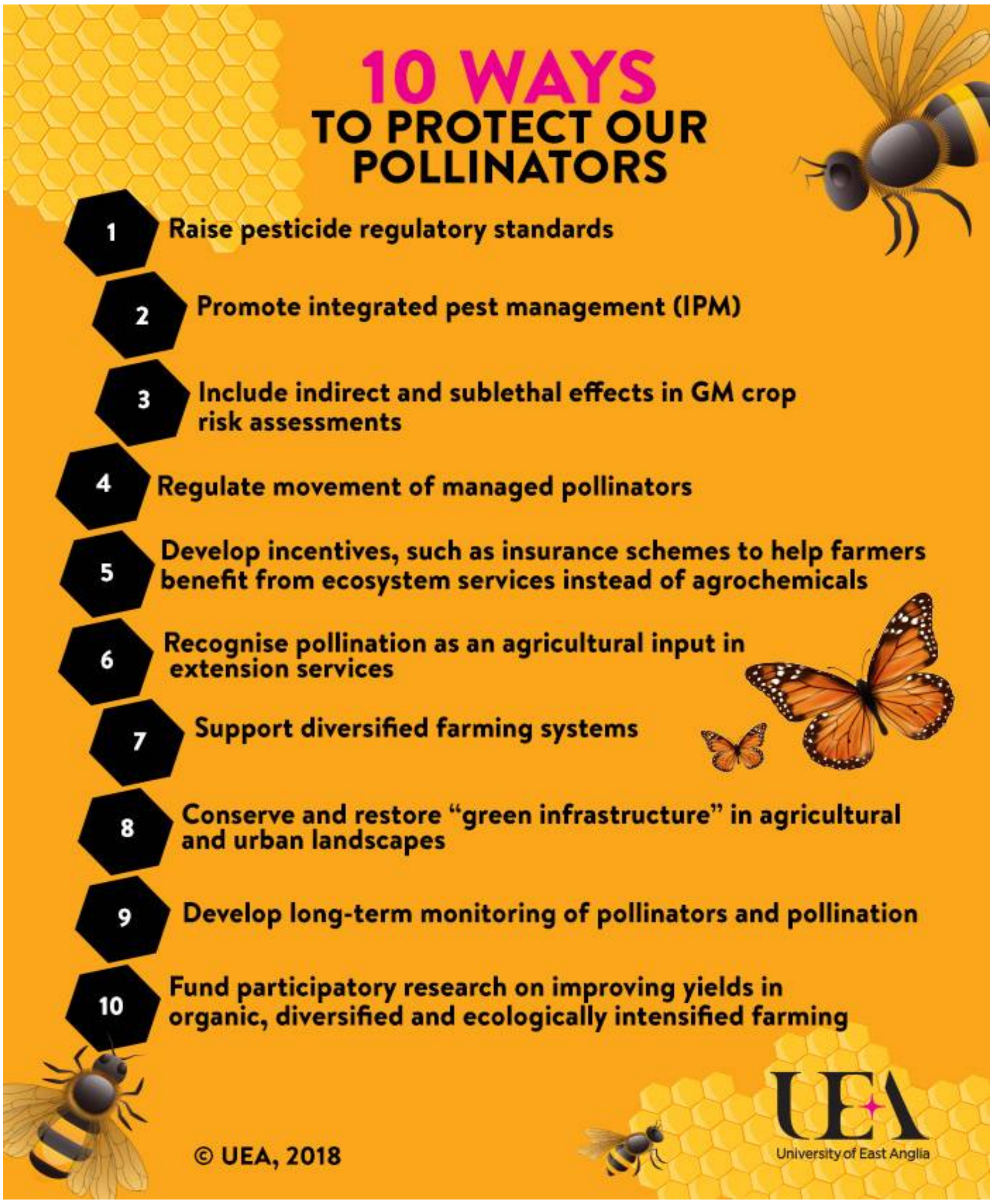
On the other hand, monoculture plants all bloom at once, giving pollinators an increased amount of food for a short period of time. But after their fruiting, pollinators are left without available resources.

Pollinators benefit from organic farming in two ways:

- primarily because it does not use pesticides, so the degree of damage to insects by chemicals is very low. As already mentioned, certain insecticides from the neonicotinoids group are very harmful to bees; in conventional agriculture, pesticide treatments should never be done on plant species with entomophilous pollination during their flowering;

- secondly, organic agriculture involves the cultivation of plant species on smaller areas of land, areas that alternate with uncultivated portions (at least at the edge of the field) and areas cultivated with other crops; pollinators haveat their disposal a much greater variety of plant species, from which they can collect nectar, species on which they can lay eggs for reproduction (butterflies) or make their nest.

Figure 5. Set of 10 suggestions for protecting pollinators (Dicks & Bourke, 2018)



Pollinators, so beneficial to agriculture, may also be affected by chemicals used for non-agricultural purposes: for example, in the US and Canada, the massive decline in pollinators has been caused by mosquito control (Nicholls & Altieri, 2013).

In the case of bumblebees (bee species of the genus *Bombus*), the problem is even more delicate. Their number does not seem to increase significantly even in the case of organic farming. This is because bumblebees especially need flowers of perennial plants, more diversified, which grow in natural habitats; in agricultural crops they found mostly single species of annual plants (in monoculture) (Henriksen et al. 2014). For them, buffer zones of wild vegetation in the vicinity of cultivated fields are essential.

Researchers from the University of East Anglia, School of Biological Sciences developed a set of 10 suggestions for protecting pollinators (Figure 5). In support of pollinators could come plant species from gardens located near cultivated fields; because pollinators travel several kilometers near the nest, the diversity of flowers they find in gardens can supply the monotony and seasonality of flowers in cultivated fields. Avoiding the use of insecticides in these gardens is essential. All honneybees from a hive, for example (about 60,000) visit 225,000 flowers only in one day!

Did you know that one of the most appreciated (and loved!) cultivated plants is in danger of extinction due to the disappearance of pollinators? It's about the cocoa trees (*Theobroma cacao*) that provide the raw material for chocolate! It depends on the pollination of some flies, from the genus *Forcipomyia*. Artificial pollination is often used to supplement the work of pollinators, because the demand for cocoa on the world market is constantly growing in the last half-century.

2.4. Reducing pollution

Pollution of the planet is a major problem in our society. Among the anthropic activities that lead to air, water and soil pollution, agriculture also plays an important role (although industry and transport have the first places). The main pollutants in agriculture are nitrogen compounds (resulting from fertilizing the soil with synthetic chemicals) and organic pesticides.

Nitrogen, for example, is a necessary element for living organisms. But most forms of nitrogen are not accessible to animals and plants. In conventional agriculture, large amounts of nitrogen are used as fertilizer. Conventional agriculture is an important source of N_2O (a very dangerous greenhouse gas, about 300 times stronger than CO_2, but much less widespread than this); it can destroy the ozone layer, which can lead to the formation of acid rain in contact with water, pollutes the water. Organic farming has a major advantage that it does not use chemically synthesized fertilizers. In these systems, organic fertilizers are used, which bring the intake of nitrogen from compost/ manure or nitrogen fixed by bacteria of the genus *Rhizobium* (from the nodules on the roots of plants of the *Fabaceae* family).

Organic farming has definite benefits in reducing water and soil pollution. The soil on which organic crops grow is much less polluted than that occupied by classical crops; in organic agriculture, a large part of the nutrients are recycled, crop rotation is frequently used to avoid depletion of soils into nutrients, erosion is combated, etc. Also, the ban on the use of synthetic chemicals reduces the intake of heavy metals, nitrogen and phosphorus from the soil (Sivaranjani & Rakshit, 2019).

Surface water and groundwater are much less affected by pollution in organic farming; eutrophication of lakes is prevented; healthier soils are the condition for keeping the waters cleaner in the surroundings.

The negative effects of pollution do not only concern the natural environment but also negatively affect the products of agriculture - conventional and organic: air pollution harms crop plants in the same way that it affects wild plants; pollutants also affect farm-raised animals, altering their health and reducing their fertility. Water eutrophication affects fish in lakes and fishing, as well as fish farms.

Genetic engineering could play an important role in reducing the amount of pesticides used in agriculture in the future (especially fungicides and insecticides). Researchers are already questioning whether genetically modified organisms could receive organic certification in the future (Husaini & Sohail, 2018).

Currently, fungal attacks cause significant damage to crops; about 10,000 species out of 100,000 species of fungi can cause plant diseases. Among these, the most well-known and widespread are *Puccinia graminis* (which attacks wheat), *Ustilago maydis* (which attacks corn), *Alternaria alternate* and *Fusarium oxysporum* (which attack tomatoes) (Mahmood et al. 2017).

New plant breeding techniques (NPBTs) have the potential to create plant varieties resistant to pests but, at the same time, acceptable for organic farming (Husaini & Sohail, 2018). For example, in the US in 2014, the cultivation of genetically modified organisms (GMOs) reduced the use of synthetic pesticides by 584,000 tons and reduced CO_2 emissions by 27 million tons (the equivalent of 12 million cars on the road for a year).

A new concept has also emerged – “orgenic plants” - which involves the creation of genetically engineered plants that are accepted by organic farming. This type of plant can contain DNA only from species with which it could exchange genes naturally “naturally mixing gene pool” (but whose transmission would be quite slow without the intervention of genetic engineering) (Ryffel, 2012). But in this case, the insertion of genes that induce pesticide resistance is not (yet) accepted. Another category of orgenic plants are transgenic (containing genes that could not be obtained naturally in the ecosystem), but sterile, to prevent their spread in wild plant populations. These apomictic plants exist in the case of about 400 species (which do not include major species of crop plants)(Ryffel, 2012).

3. The negative impact of organic farming on the environment

Although it is generally accepted that organic farming has a lower impact on the environment than conventional agriculture, to have a complete picture of the situation, indirect effects must also be taken into account. Although organic farming has a lower impact per unit area, the impact per unit of the resulting product is greater than in the case of conventional agriculture (van der Werf et al. 2020).

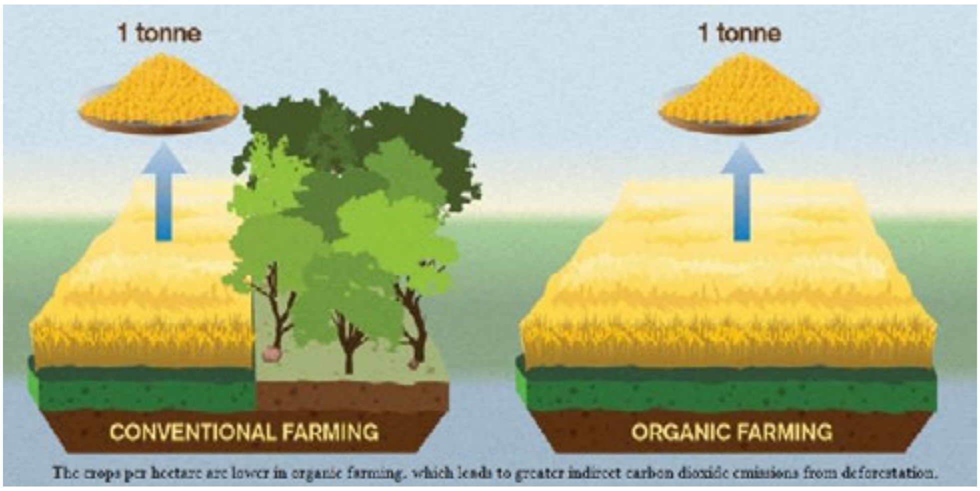
3.1. Increase the surfaces included in the agricultural circuit (especially by deforestation)

Organic farming does not only come with environmental benefits. As in any situation, there is a negative influence here too! First of all, it is well known that the production per hectare is considerably lower in the case of organic crops, compared to traditional ones. So, to produce the same amount of food, a larger area must be used. As the agricultural areas on the planet are limited, obtaining new ones is done mainly by deforestation (secondarily and with high costs by drying the swamps, bringing back to the agricultural circuit the eroded lands, desalination of some soils, etc.).

Because about a third of the planet's land area is currently occupied by agricultural land, increasing their share will inevitably lead to a dramatic decline in biodiversity by depriving plant and animal species of the conditions in their natural habitats.

Wirsenius (2018) makes a suggestive graph that shows that the cultivated area almost doubles to obtain a ton of organic production (compared to a ton of the same product obtained conventionally) (Figure 6). In the case of organic animal products, the impact is even greater than in the case of plants.

Figure 6. Comparison between the land area used to obtain a ton of agricultural product through organic agriculture versus conventional agriculture (Wirsenius, 2018)



Deforestation to obtain agricultural land is a major threat to biodiversity. According to the FAO (2016) in just 5 years (2010-2015) 6 million hectares of tropical forest have disappeared to make space for agriculture. Although in developing countries that practice massive deforestation (for the expansion of cultivated areas), organic agriculture is much less widespread than in developed countries, the visibly higher land need for organic agriculture has remained a problem. But without practicing certified organic farming, developing countries have fairly ecological farming, mainly due to low access to pesticides and synthetic fertilizers. Massive deforestation occurs in countries in South America (Brazil, Argentina and Paraguay) and in SE Asia (Indonesia, Myanmar and China) (Muller & Bautze, 2017). Although deforestation for agriculture in the EU is low (because there is a strong emphasis on environmental protection and conservation), imports of products (organic and conventional) from developing countries lead to massive deforestation in these areas. In other words, the cost is paid by the exporting countries.

Increasing productivity (through various methods) in organic farming could lead to a reduction in deforestation (by reducing the need for agricultural land). Even for conventional agriculture the problem of reducing of the cultivated areas used by increasing productivity is discussed in the same way (Kubitza et al. 2018).

Thus, forest resources can be better preserved, with numerous benefits both on the environment and on the economy of the affected states. No matter how favorable organic farming is for biodiversity, no agricultural ecosystem can sustain biodiversity as well as equatorial forests (which today face the highest degree of deforestation) (Clough et al. 2016).

Deforestation in tropical areas have a larger negative impact at global level, contributing to climate change that is increasingly affecting the earth.

3.2. Higher GHG emissions

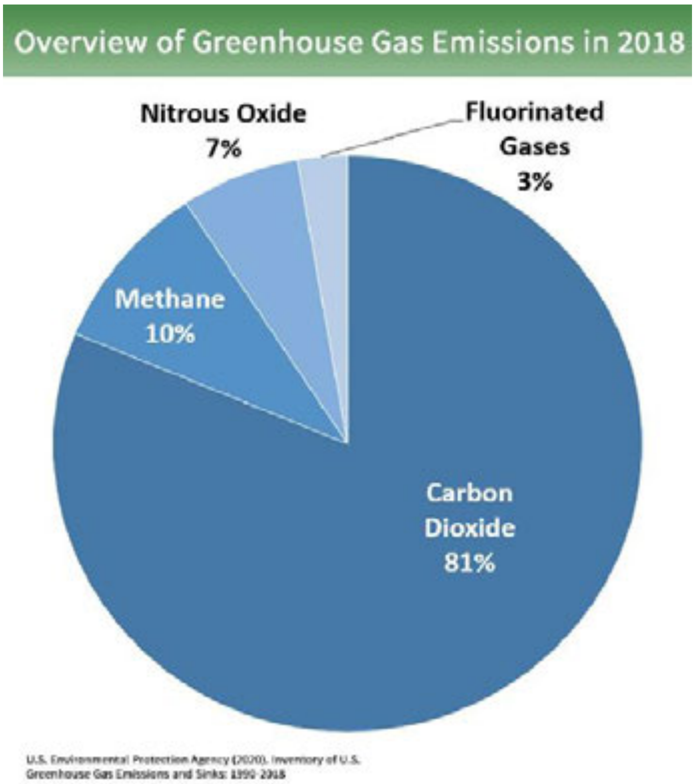


Figure 7. The main types of GHG (Environmental Protection Agency SUA, 2018)

The main negative effect of GHG emissions is global warming and the greenhouse effect. Agriculture contributes about a quarter of CO_2 (the main GHG) emissions to the environment. The main types of GHG are carbon dioxide, methane, nitrous oxides, chlorofluorocarbons (freons) and hydrofluorocarbons (Figure 7).

Because it requires larger areas than conventional agriculture to obtain the same unit of agricultural product, organic farming does not have an advantage in terms of CO_2 footprint (Husaini & Sohail, 2018).

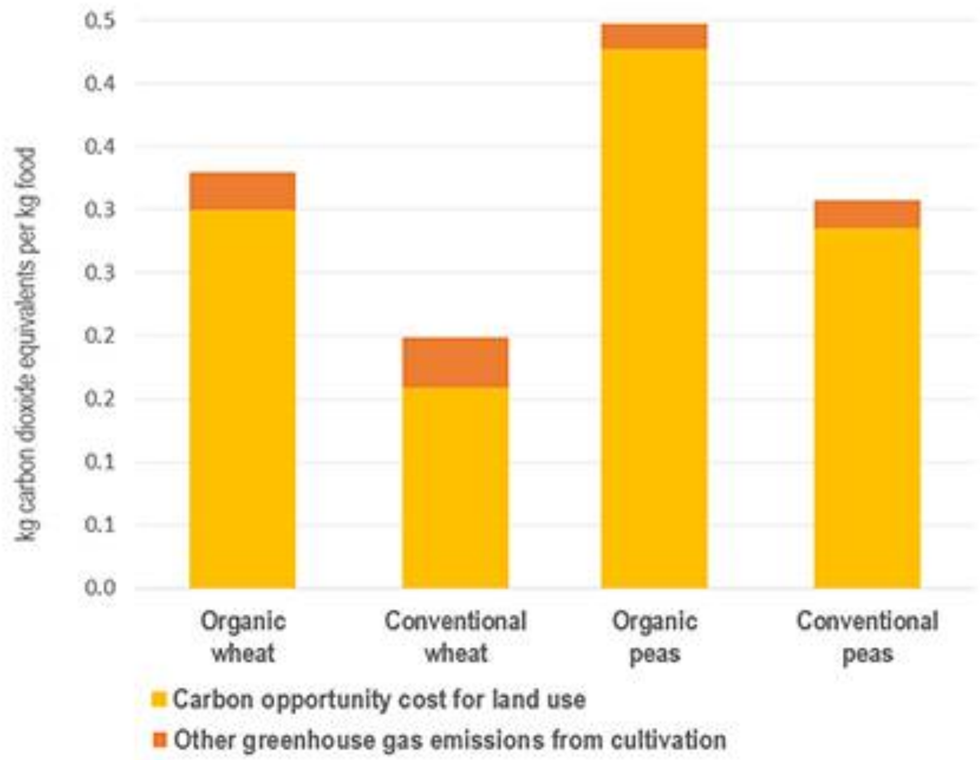
But, unlike the conventional one, organic agriculture could counterbalance the increase of GHG emissions in several ways:

- by reducing / avoiding the administration of chemical fertilizers and pesticides (fungicides, herbicides and insecticides) to cultivated plants. Pesticides are mostly produced from petroleum products; chemical fertilizers are manufactured based on ammonia, coal, potassium chloride, limestone, dolomite, ferrous sulfate, etc. GHG emissions come from the activities necessary for the processing of raw materials, packaging, transport to farms and their distribution. Most of these activities are excluded from organic farming.
- by increasing carbon storage (Squalli & Adamkiewicz, 2018): this is achieved especially by the rotation of crops that characterize organic agriculture as well as by increasing the accumulation of organic matter in the soil, due to the use of natural fertilizers for several years.
- the rotation of crops can increase the amount of water maintained in the soil, the biodiversity of microorganisms and thus reduce the emission of nitrogen oxides.
- by recycling the waste (which is converted into fertilizers) GHG emissions are reduced which would have resulted from the process of transport, processing and neutralization.

A study conducted in Sweden by Wirsenius (2018) shows that CO_2 emissions are much higher when 1 kg of organic product is produced compared to 1 kg of the same product obtained by conventional means. The increase is significant - 50% for peas and 70% for wheat (Figure 8). The researcher also shows that not all types of organic foods (plant or animal) have the same intensity of impact on the environment. For example, it is more beneficial for the environment to eat organic chicken than organic beef or sheep. Also, giving up animal proteins and replacing them with plant proteins (from soy, peas or beans) leads to decrease GHG emissions for the production of a similar quantity of food (in number of calories).

A recent study published in Nature communications by Smith et al. (2019) show that, although GHG emissions are lower in the case of organic farming, the use of a larger area of land to obtain a unit of the product effectively cancels this benefit.

Figure 8. Comparison between the surface amount of CO_2 produced to obtain 1 kg of peas and wheat in organic agriculture versus conventional agriculture (Wirsenius, 2018)



The study refers to the trend of expanding organic farming in England and Wales, to the detriment of traditional agriculture, amid growing demand for healthy food in this country. The researchers show that if all of England and Wales' agricultural land were devoted solely to organic production, GHG emissions would fall by 20%, but also agricultural production would decrease by 40%. Production would decrease significantly in wheat and barley, but also in animal husbandry, especially in sheep and cattle (where the amount of meat / slaughtered animal is lower in organic agriculture than in conventional agriculture); in the case of vegetables, production declines are not so significant. Achieving a similar quantitative production would require the introduction into the agricultural circuit of an area of approximately 6 million hectares in England and Wales alone.

Although there is a general idea that animal farms contribute significantly to increasing greenhouse gas emissions, not all have the same impact on the environment. Due to the different management in organic farms (based on extensive growth, not intensive, as in the case of conventional farms) carbon sequestration often compensates in surprising percentages the amounts of CO_2 or equivalent CO_2. Because they use large areas of land for animal husbandry (according to EU regulations in organic agriculture are allowed between 0.18 and 0.6 livestock unit / ha (LU/ha) to prevent soil degradation and erosion) and because the waste is often recycled into natural fertilizers, cows farms can compensate the CO_2 emissions with 35-89% and those of dairy goats up to 100%. In the case of Iberian montanera pigs, the level of carbon sequestration is higher than the emissions produced by these farms (Horrillo et al. 2020).

4. Conclusion

It is necessary to reach a balance between organic and conventional production. Organic farming alone will not be able to provide the full food needs of a growing planetary population (estimated to reach nearly 10 billion by 2050).

But the benefits of organic farming for the environment must be maximized. The intercalation of organically cultivated areas among those conventionally cultivated (in compliance with the requirements of preserve the buffer zones) can ensure the maintenance of the biodiversity of plant and animal species (especially pollinating insects). Maintaining pollinator populations is also essential for the normal development of the biological cycle of wild plants and those cultivated in conventional agriculture.

Also, a possibility to reduce the negative effects of conventional agriculture on the environment would be for it to apply some methods and solutions from organic agriculture. Even the introduction in organic agriculture of some methods from traditional agriculture (respecting the conditions for the certification of organic production), but which would allow a significant increase in productivity, could be accepted.

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Appendix – Definitions of key terms

apomixis - a form of asexual reproduction of certain species by seeds; the result is a generation genetically identical to the mother plant.

agroecosystem - represents a functional unit of the biosphere created by man, in order to obtain agricultural production; agricultural ecosystem.

DDT - Dichlorodiphenyltrichloroethane

eutrophication - is the enrichment of water in nutrients (nitrogen and / or phosphorus compounds), causing an accelerated growth of algae and other higher plant forms.

food chain - is a series of species in an ecosystem, which are in feeding relationships. Each species depends, in order to feed, on the species / species in the previous link, and constitutes the food for the upper link.

GHG - greenhouse gas

greenhouse effect - is a natural phenomenon that can be intensified by the presence of gases in the Earth's atmosphere; in this way the atmosphere heats up, by changing its permeability to solar radiation.

ISO - International Organization for Standardization

mycorrhizal fungi - are fungi that form a symbiotic bond with the roots of a higher plant.

neonicotinoids or **”new nicotine-like insecticides”** - a class of insecticides chemically similar to nicotine which affect the central nervous system of insects

pesticides - any substances used to destroy certain plants or animals considered to be pests. They include herbicides, insecticides, fungicides, bactericides, rodenticides (poisons for mice and rats), plant growth regulators and others.

Ch. 3.1

THE IMPACT OF ORGANIC FARMING ON THE ENVIRONMENT, WITH ACCENT TO THE CHANGES OCCURRING IN AGROECOSYSTEMS

Organic Agriculture and the Environment

OBJECTIVES:

- to understand the impact of organic agriculture on the environment;
- to identify the positive effects of organic agriculture on environmental health;
- to identify the negative aspects of agriculture in general and organic agriculture in particular on the environment.

SKILLS: Students will understand the specific terminology, will be able to compare organic agriculture with conventional one in terms of environmental impact.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

How much would agricultural production be reduced with the complete elimination of pesticides?

- ☐ 20%
- ☐ 10%
- ☐ 40%
- ☐ 80%

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

How pollinators benefit from organic farming?

- ☐ they find more food;
- ☐ no insecticides are used and there are wild plants in the spaces between the cultivated areas;
- ☐ the deposition of eggs by pollinating insects is favored;
- ☐ by the existence of large areas with monocultures.

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

What type of agriculture requires a larger area of land?

- ☐ conventional farming;
- ☐ organic farming;
- ☐ both require similar areas;
- ☐ agriculture performed with genetically modified plants.

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

Given the relationship between organic farming and pollution, which of the following statements is false?

- ☐ air pollution has a negative impact on crop plants in the same way that it affects wild plants;
- ☐ water eutrophication affects fish in lakes and fishing;
- ☐ crop rotation is frequently induced depletion of soils into nutrients;
- ☐ organic farming has definite benefits on reducing water and soil pollution.

QUESTION 5 (PLEASE CHECK THE CORRECT ANSWER)

In which situation are CO_2 emissions higher?

- ☐ production of a unit of product in organic agriculture;
- ☐ production of a unit of product in conventional agriculture;
- ☐ they are the same in both types of agriculture;
- ☐ in case of crop rotation.

QUESTION 6 (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

Why is biodiversity higher in areas where organic farming is predominant?

3.2. Innovation and sustainability of business models: learning, generative practices and school (university) - work transition in the organic agri-food sector*

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Abstract: In the past two decades, entrepreneurship education has gained increasing popularity internationally. Calls from higher education institutions to contribute to the education of an increasing number of students with "creativity, innovation and ability to take risks" are increasingly frequent by EU institutions. The constant reminder to entrepreneurship education however, is a concrete foundation in the developments that occur within patterns of entrepreneurship that are becoming common in various sectors of the economy, with particular attention to those areas that make sustainability a lever to develop and to increase the competitive advantage. The agri-food is just one of the areas where the innovation of business model is developed through an awareness of environmental challenges and an investment in human capital that starts right from schooling.

Keywords: Sustainability, Business, Entrepreneurship, Bio-economy and agricultural production, Learning, Higher Education, European policy.

* Giuseppe Santisi is author of paragraphs 1-4; Roberta Piazza is author of paragraphs 5-8.

1. Introduction

Pursuing policies of sustainability demands with extreme force that innovation will become more effective in terms of social and environmental terms, while providing new sources of innovation and competitive advantage for companies to be framed in a general Corporate Social Responsibility (CSR) model (Hansen et al., 2009).

In recent years, consumer awareness of sustainability has increased so much (Porter, Kramer, 2006; Porter, Kramer, 2011; Shen, 2014) to reconcile innovation in business models with the development of sustainable products. Porter and Kramer (2006, p. 88) affirm that "strategic CSR goes beyond good corporate citizenship and mitigates the impacts of the harmful value chain to assemble a limited number of initiatives whose social and corporate benefits are wide and distinctive. Strategic CSR involves both internal and external dimensions in tandem. This is where the opportunities for shared value are truly found. Many opportunities to pioneer innovations for the benefit of both society and its competitiveness can arise in the product offering and in the value chain". Innovation is not just a long-term strategic competitive advantage, but it is essential for the creation of a sustainable society (Schaltegger et al., 2012; Seebode et al., 2012) since the phases of entrepreneurship education.

Within higher education models, entrepreneurship training has grown significantly in the past 20 years and this growth is expected to continue. In order to support the economic recovery from the 2008 crisis, the European Commission since 2010 has emphasized the importance of promoting entrepreneurship in higher education institutions (HEIs), creating a link with strategies aimed at promoting smart growth, sustainable and inclusive of Europe 2020 (European Commission, 2010). From this point of view, however, the attention towards the modernization of university curricula was mainly directed towards the theme of the new models of production cycles adopted by the companies, without extending it towards a real updating of the teaching staff to the topics of the entrepreneurship and stakeholder relevance.

This chapter has two objectives. First, to identify the main business models those are establishing themselves as effective models for the realization of sustainable innovation in the agri-food sector. Secondly, identify the ways in which entrepreneurship education can contribute to the development of entrepreneurship, right from school education.

2. Economic Sustainability and Corporate Sustainability

For a social system, focusing attention on the concept of economic sustainability means using a specific set of resources in a responsible way that will allow us to use the profit in the long term. Furthermore, it means producing profit and making the company grow without generating a negative impact on the other two pillars of sustainability: people and the environment. The revolutionary idea of sustainability is that if you take care of people and the planet, you will also get profits, which means balancing profit with its impact on the surrounding environment (Corporate Financial Institute, n.d.; Soppe, 2004).

However, for many companies this relationship can be very demanding. Therefore, they should adopt an innovative business model. In this regard, the main question for investors and managers is whether or not sustainability is an advantage for a company. The answer to the question is positive because sustainability offers a broader purpose for companies and helps them renew their commitments towards basic objectives such as efficiency, sustainable growth, multiplication of value for shareholders and a better reputation (Pedersen et al., 2018).

Some definitions of corporate sustainability are:

1. "The concept of corporate sustainability refers to sustainability at an organizational level being a multifaceted paradigm that involves environmental, social and economic results" (Carcano, 2013).
2. "Corporate sustainability is the way a company constantly creates shared value through economic development, good governance, the responsiveness of stakeholders and environmental improvement" (Visser, 2013, p. 4).

In general, this means that corporate sustainability focuses on the company's ability to meet the needs of current stakeholders (customers, shareholders, employees, communities, etc.), also ensuring the satisfaction of future ones (Dyllick, Hockerts, 2002). Therefore, corporate sustainability policies, in order to be successful for the company itself and for its shareholders, should be combined with long-term strategic development, while trying as much as possible, at the same time, to apply these strategies to many business processes (Epstein, 2008).

We can distinguish three main approaches to corporate sustainability: the first considers environmental and social sustainability policies as a tool to achieve a competitive advantage; the second involves measuring sustainability performance; the last one focuses on the proposal of multidimensional corporate sustainability measures. Therefore, the concept of corporate sustainability concerns the shift of the company's focus from the single financial (profit) dimension to the approach of the three bottom lines in which the economic, environmental and social dimensions should be equally relevant.

Considering the definitions of corporate sustainability just exposed, there is no doubt that embracing these strategies also means opening up to a more general process of innovation of the business model. Formally, the innovation of the sustainable business model can be defined as: "(...) innovation in the way in which the activity is carried out by creating a competitive advantage through a superior value for the customer and contributing positively to the company, to the society and the environment by minimizing damage" (Bocken et al., 2015, p. 68). With regard to corporate sustainability, through this concept all strategies are placed at the center of attention, very often of an intangible nature (for example reputation and trust) instrumental to improving the satisfaction of stakeholders and therefore strongly correlated to improving financial performance (Orlitzsky et al., 2003; Surroca et al., 2010). However, the literature on the "innovation / sustainability" binomial suggests the importance of a systemic change that must involve multiple actors (Rohrbeck et al., 2013). As noted by Bocken and associates "(...) collaboration between a wide range of stakeholders in the industrial system is necessary to ensure sustainability. A sustainable society cannot be achieved if individual agents independently promote their interests "(Bocken et al., 2015, p. 67). This is why today two different opinions prevail on the impact of environmental and social sustainability in important sectors of the European economy.

The focus of the first opinion is on the analysis of the negative consequences of business actions on the environment by checking the unpaid costs of this use; in this case, the sustainable solution to consider would be to invest money in the company by increasing the total costs. The second vision, on the other hand, considers the sustainability factor as an attribute of processes and products which is beneficial for the stakeholders leading to innovation and value generation. In general, however, it is worth pointing out that the emergence of new business models oriented towards innovation and sustainability is an extremely frequent process in recent years. There are several contributions that analyze examples defined as: sustainable innovation, CSR innovation, systemic CSR, eco-innovation, sustainable entrepreneurship, "cradle to cradle", collaborative consumption. (Bocken et al., 2015; Klewitz, Hansen, 2014; Hansen, Grosse Dunker, 2013; Mair et al., 2012; Visser, 2013; Pedersen et al., 2018).

That said, as noted by Bocken and associated "Business models are often perceived from the perspective of value creation that focuses on the needs of customers' satisfaction, the economic return and compliance. For the thought of sustainability, this attention does not is sufficient and requires the need for new values that integrate social and environmental objectives, to ensure the balance or ideally the alignment of the interests of all stakeholders to offer a "sustainable value creation" (Bocken et al., 2015, p. 70).

We believe that in the last decade three basic concepts represent the link between economic and consumer processes, sustainability and innovation, to the extent of being real new business models: The Circular Economy, the Green Innovation and the Sharing Economy.

The Circular Economy is a business model based on the idea of restoration and regeneration in order to keep products and materials at the highest levels of utility and value at all times. Particular attention is paid to the "recycling" processes, intended as the reuse of raw materials that would otherwise have been discarded in order to create new products. The main point of the circular economy is that it separates economic growth and development from the consumption of products. To do this, the attention is focused on three processes: design optimization; effective use of materials; the care and development of natural resources. The circular economy, above all, offers opportunities for innovation in the design of products, services and business models and, consequently, establishes a long-term framework (Webster, 2013).

The Sharing Economy presents itself as a real bet of a global and cultural nature, as well as an economic one. The paradigm is based on the objective of promoting innovative economic growth aimed at mitigating the environmental impacts of large-scale production. The Sharing Economy focuses on "collaborative consumption", that is, the expansion and reinvention of exchange, sharing, loan and donation practices, between people not previously connected (Botsman, Rogers, 2010).

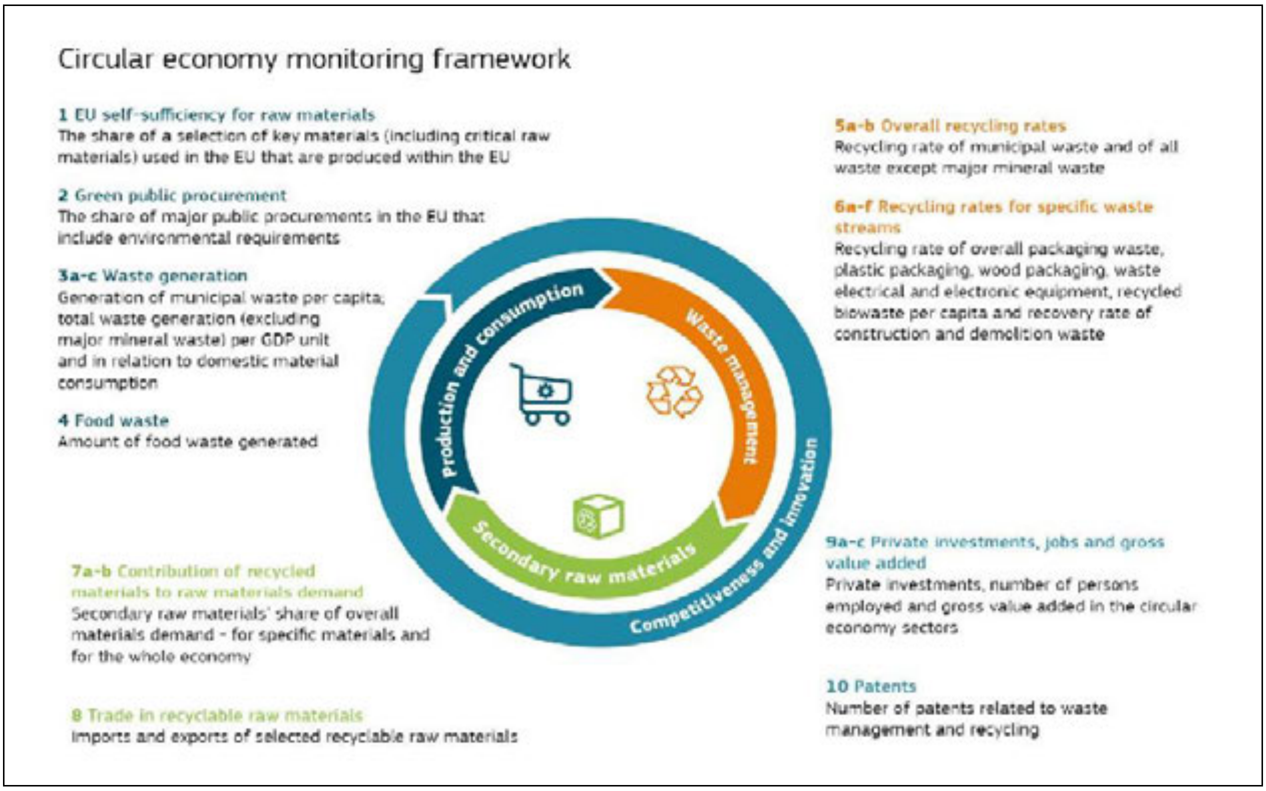
Even closer to the practices of Sustainability presents the business model based on the concept of Green Innovation. Green Innovation is defined as that business model that aims to produce "new products and processes, which provide value to customers and business but significantly reduce the environmental impact" (Bartlett, Trifilova, 2010; Liu, Yan, 2018). Furthermore, it is intended as a corporate sustainability practice that focuses on both the ecological and economic aspects of the business and should establish a new *innovative/green* standard for the company (Liu, Yan, 2018).

3. Circular Economy and Sharing Economy in agri-food sector

As previously introduced, the Circular Economy is a Business Model. In fact, it reveals itself as a cycle in which the waste deriving from a normal production process is traced back to another and different process, aimed however at the generation of a different product. According to the definition of the Ellen MacArthur Foundation: The Circular Economy is "an industrial economy that is conceptually regenerative and reproduces nature in actively improving and optimizing the systems by which it operates ..." (Ellen MacArthur Foundation, n.d.). In summary "natural capitals are protected and rebuilt; there are no process waste in industrial value chains, as they become feedstock for others. The "purer" these flows are, the better the quality "with which they circulate, the greater the added value that is produced by the circular economy" (Ragazzoni, 2017). A fundamental paradigm therefore emerges in which the economic system and the ecological system are not found, as in traditional economic analysis, on the same level in which natural resources, production factors, economic goods and services, waste and refuse are exchanged, but on the one in where today's products are tomorrow's resources, where the value of materials is kept or recovered as much as possible, where there is a minimization of waste and impacts on the environment.

This change in the traditional economic paradigm was officially sanctioned at Community level through the "Action Plan for the Circular Economy", adopted by the European Commission in 2017 (Circular Economy Network, 2019), (Figure 1).

Figure 1. Circular Economy Monitoring Framework



Source: European Commission, 2018 ("Monitoring Framework for the Circular Economy", p. 3).

In the case of the agricultural sector in general, or agri-food in particular, one of the "golden rules" on which a circular economy strategy is developed is that based on the concept of "users and non-consumers". That is, it becomes necessary to develop a "new contract" between companies and their customers based no longer on the sale of products, but on the provision of services based on durable, recoverable, regenerable goods, which can be sold, rented, shared. If ownership is to be transferred, recovery is encouraged at the end of the period of primary use: the agricultural entrepreneur becomes a real player in the circular economy by participating in the use of technological innovations.

The development of the circular economy can also be favored by innovative forms of consumption that promote the use of products and services instead of owning products or infrastructures. The provision of Sharing Economy services allows to increase the rate of use of the products and to improve their efficiency in general. The collaborative economy (or Sharing Economy) refers to a relationship model based on networks, distributed and formed, in turn, by communities of interconnected individuals, in which the latter exchange goods, services, experiences and other resources through the use of digital and physical platforms. This indicates a wide and varied availability of practices and models in which, thanks to the use of digital technologies, collaboration between individuals is facilitated and the use of unused resources is maximized: the networks of relationships and the technological dimension therefore represent the characteristics of the collaborative economy.

In addition, the concept of *prosumer* emerges strongly in the collaborative economy: a term that refers to a person who is both a supplier and a user of a good or service. Since the 1990s, the development of communication networks and the spread of the IP protocol have led to a new phenomenon which, from a niche reality in the technological field, has spread to other sectors of the economy and society, giving shape to what appears to be a new economic and social model. Synonyms such as shared economy or, according to other synonymous phrases, "collaborative consumption", "peer economy", "community production" "rental economy" "demand economy", however, share some fundamental aspects: a) the presence of a technological platform, where digital relationships are inserted; b) forms of collaboration, understood as relational dynamics between subjects who start a path based on sharing goods and services; c) the preference for peer to peer relationships (i.e. horizontal and equal relationships).

The different combination of these three factors produces a range of activities whose value and effects affect differently on production and consumption patterns, innovation and social relations. For this reason, all the models that refer to the shared economy put some key words at the centre of attention: learning, production, consumption, governance; which give rise to four main forms of shared economy practices: that based on the reuse of goods; that based on the exchange of services; the one based on the sharing of the means of production and the production spaces and finally the one based on the optimization of the use of durable goods (Schor, Fitzmaurice, 2015).

Regarding the application of strategies and models of circular economy in the Italian agro-food sector, the 2020 Report on Circular Economy in Italy (Circular Economy Network, 2020) affirms that without prejudice to "the need for an approach that respects the hierarchy of use of bio-resources and therefore compliance with the priority criteria which they see at first is guaranteed given the use for human nutrition (Food), and to follow the use for animal nutrition, the production of biomaterials and finally the energy enhancement "(p. 58), the Italian agri-food sector can be investigated paying attention to the critical issues and capability emerging from the following table:

Table 1. Critical issues and Capability in the Italian Agricultural and Agri-food sector

Issue	Capability	Solving
high presence of marginal, abandoned and degraded land	a rich local biodiversity	spread more effective models of agriculture and forestry production (e.g. organic agriculture, agro-ecology, regenerative agriculture) to improve productivity and resilience with respect to climate change, contribute to climate mitigation, to the maintenance of natural capital
depletion of agricultural land to build new infrastructure	ability to develop innovative farming and breeding techniques based on animal welfare and low-impact	develop cultivation and soil management techniques also based on digital services and satellite monitoring
excessive concentration of monocultures and intensive breeding	presence of available digital services that can support sustainable quality production	maintain and increase biodiversity and the study of the role of microorganisms, as strategic biological actors, to improve the resilience, safety and productivity of animals and plants
abandonment of rural areas due to the limited profitability of agricultural activities and the scarce presence of services	availability of business models for the diversification of rural incomes, to add value to local production and products (agritourism, educational farms, direct sales, renewable energy production, use of by-products for bio-based industrial activities)	reduce greenhouse gas emissions by developing the production and use of renewable energy, improving cultivation and farming techniques and decreasing the use of fertilizers
weak and poorly organized chain of marketing and sale of local agricultural products	availability of unused and unmanaged agricultural land and pastures	improve the efficient use, management and saving of water in agriculture
volatility of agricultural commodity prices and increased competition for agricultural products from the global market, with lower quality, security and controls	new professional and entrepreneurial opportunities given by some bioeconomy activities that support agriculture	prevent food losses and the production of waste, water and energy consumption and improve food conservation, distribution and logistics
lack of training and information for farmers on commercial opportunities and innovation management	strengthening of demand, production and distribution of fresh local food, a short chain and high quality	promoting urban food systems with local food production, the distribution of fresh products and products with high nutritional value in the short chain
inadequate protection of farmers' income and transition of young people to more remunerative jobs	success on the Italian food markets, with a high variety and quality, with a large number of typical and certified food products (DOP, IGP, STG, organic)	promote networking among small food enterprises for the development of new, longer and solid production chains and chains of regional value
high consumption of natural resources and insufficient reuse, recycling and recovery of residues and waste		promoting short and local food chains and combating illegal food supply networks
plant shortage for the recycling of organic waste		develop innovation support systems by integrating different production systems, sharing infrastructures and logistics solutions, in order to maximize returns and reduce waste
unfair competition, high level of counterfeiting and imitation of Italian food products		develop new technologies or innovative solutions that accompany food companies to the transition to a circular economy model
lack of sustainability of food consumption		
lack of coordination among the different stakeholders involved in the food industry lifecycle		

Source: our elaboration on Circular Economy Network, 2020, pp. 58-64.

In conclusion, the goal is to enhance human capital and social capital through actions aimed at: enhancing the skills, human and social capital of farmers and other actors of the rural economy, also through education and use of digital-based technologies; support young entrepreneurs in the agri-food sector in less favored Italian areas through training programs; preserve and enhance traditional knowledge and promote the connection with the ecological and socio-economic values of agricultural systems through the transfer of good practices to young farmers and entrepreneurs. Actions that require opening an alternative intervention perspective, starting from higher education strategies and practices.

4. Networks and Organizational Learning to meet the challenge of Sustainability

As argued so far, there are many challenges that companies face in implementing sustainability. In all this, adequate Business Model strategies take on a role of significant importance, provided that other important dimensions are not overlooked. If we look outside the organization, consumer expectations take on an extremely important role; if we remain within the organization it becomes fundamental to reflect on the processes by which new learning and training practices of the main organizational actors are structured. The attention of this paragraph focuses precisely on this last aspect.

The expansion of the boundaries of the markets we are witnessing requires companies to take on a fundamental mission: investing in innovation. It is precisely the small companies that today very often represent a hotbed of alternative growth strategies. Within them, the logic of the worker and his ability to manage risk would also seem to have changed, an element that perhaps outlined the transition from Fordism to post-Fordism most of all: the risk is nowadays directly loaded on the shoulders of each working subject (therefore no longer managed by the large company), which is why it becomes crucial to invest in professionalism and in the possibility of accessing communication networks, which act as a driving force in the production scenario (Rullani, 1998).

A culture of innovation is possible where the organization will begin to seriously pay attention to some important dimensions: creativity; a consistent technological development with respect to market requirements; a development of human resources consistent with the complexity of the scenarios; the relevance of informal problem-solving processes; individual autonomy. In short, a particular mix between new decision-making solutions and the central role of some dimensions of the psychological capital of the organizational actors (Luthans, 2002; Luthans, Youssef, 2007; Seligman, Csikszentmihalyi, 2000). Only in this way: "the worker certainly acquires a central role and is recognized for his value, given that he qualifies as the main actor capable of activating and developing the processes of knowledge creation on which the value production of modern is based contemporary society" (Santisi, 2004, p. 50).

The entrepreneur has long understood that he has a whole new risk to manage. How could a creative but isolated entrepreneur ever compete in the globalized scenario? In this sense: "shortening the supply chain is not only valid for vegetables and citrus fruits, but also for knowledge" (Marino, 2011, p. 55); this is why we must try to always keep the threads intertwined: individual, relational and contextual that shape the innovation processes, in order to avoid feeling isolated in a global context.

Sennett's (2013) idea of thinking about *doing* as *creativity* must come to an agreement with two new facts represented on the one hand by the forms of collaboration that increase the competitive advantage and on the other by the wise use of new technological tools, which increase these forms of collaboration.

That theorized *organizational future* (Kanter et al., 1992; Hatch, 1999) seems to have really arrived, with the networks having taken over the ancient organizational forms rationalized by rigid boundaries and formal hierarchical levels. In this sense, the thousands of virtual organizations proliferated in recent years in the current working scenario would be a clear demonstration of the fact that it is possible to act in a completely flexible way, without necessarily remaining anchored to an old industrial work model, in which there was of defined spaces and regular rhythms (Jacques, 1990). On the other hand, over the last twenty years the image of a technological revolution that has involved not only institutional architecture, social relations and forms of organized collective actions, typical contexts of the 1950s and 1950s, has become increasingly real (Santisi, 2004), but other, new and important variables such as, for example, all the interactive forms of communication-cooperation existing today (Levy, 1996).

In the current network of global interdependence the greatest challenge will be to be able to conceive what is woven together *in organizations* and *between organizations*: the problem will not be represented so much by the abundance of information circulating in the system, as rather from being able to understand how they are organized by each in relation to the other organizational actors, near and far. What is certain is that the strong relationship between man and machine is becoming ever more rapid, as a means of support for the management of knowledge and for the movement of social boundaries. Concepts such as networking, e-learning, web marketing, viral marketing are now in common use. The Internet has triggered and consolidated numerous interactive foci, establishing digital learning environments (Wenger et al., 2009) that have brought about an innovation in the diffusion, distribution and management of knowledge by individuals, groups and organizations such as to be able to found a paradigm inspired by the concept of positive technology, a scientific-applicative approach that would use new technologies to transform the characteristics of personal experience, in order to increase well-being for individuals, organizations and societies (Riva et al., 2010; Botella et al., 2012).

But what process is hidden behind those creative networks that multiply day after day in the participatory web (Bennato, 2011), demonstrating with their widespread diffusion also the changing and changing shape of our organizations?

Organizational and managerial research has always been very careful with respect to the possibility of investigating the very nature of networks, understood as objects of knowledge and intervention tools that each organization can use for the affirmation and survival in its own context; for the generation and capitalization of shared knowledge, through negotiation, cooperation and communication circuits between all the actors involved in the process. From a purely social point of view, attention is paid to the intensity of the relational lever in the self-affirmation of the network. From an organizational point of view, it is important to observe the strategic functionality that the networks cover, because they allow organizations to access resources (tangible and intangible) and to become flexible and more competitive in the external context. The non-coded scripts that feed the collaborative exchange within an organization also represent a social capital which, like any other form of capital, can significantly affect the competence of an organization in the face of any possibility of change. In fact, only one type of collective intelligence (Levy, 1996) can lead over time to the construction of new artefacts, including those technological artefacts that are accepted and disseminated through a series of social processes such as closeness between members of a group and openness in the face of the advancement of new information. Since, in fact, there is no standard modality or inevitability in their affirmation, all the artefacts will be flexible, that is to say extremely dependent on norms and powers in force in the context, in a continuous social process of participation and reification (Bijker, Law, 1992).

Through a network analysis approach (Iannelli, 2006), it is therefore possible to choose the object of study as relationships between multiple individuals or interacting groups, observing the bonds, strong and weak, that will emerge through continuous tangible exchanges (goods, money, services) and intangibles (the various forms of aid or social support), in order to be able to understand why the innovative idea of a single individual passes through recognition and valorisation in the social network to which it belongs.

Compared, however, to an unstoppable technological evolution, the risk that would be emerging would seem to be the lack of a governance capacity on the part of the organizational actors: without a serious eco-system of co-evolution they will no longer be able to do business. This means that the advanced tools of technology should be used to activate initiatives for the benefit of all (social innovation) and to have results of improvement at an organizational level: some companies have therefore focused on co-evolution, intended as a search for balance also in the possible collaboration with competitors, with the other nodes of the network (Panzarani, 2013).

In a dynamic of change, therefore, we will find a flexibility that always plays on at least two levels: that of subjectivity that will want to get involved, reinventing itself day after day, sensitive to the environment and to the people who "breathe" cognitively and emotionally inside it the organization (cultivating a sense of community); that of the organization that cannot remain indifferent in the face of growing self-entrepreneurship and the willingness of the subjects to take part in the process of organizing, in the creation of an democracy of enactment (Weick, 1997).

The perspective from which to approach the business practice would gradually shifting from the characteristics of the work itself, the characteristics of the subject, dedication investing to improve the quality of his technique and his rootedness in communities of practice socially recognized (Wenger et al., 2007; Zucchermaglio, Alby, 2006). Local knowledge, tacit or explicit, will materialize in ideas and products of innovation only through the generative force inherent in the bonds built over the course of working time (and not only), through, for example, the ability to "look to the future without forgetting the past, combining the freedom of the self with the recognition of the value of the other" (Costa, 2012, p. 39).

In fact, whatever the business scenario, the feeling of strangeness experienced by subjectivity before the variability and complexity of the system, it is almost always the same and should be adequately accompanied with paths that encourage reflexivity (Schon, 1993; Scaratti, Ripamonti, 2009) and the possibility of finding alternative coping strategies in the face of unfavorable situations.

Working in a company, large or small, means cultivating a sense of belonging over time; feeling part of a larger whole, which sometimes protects, sometimes expels instead. All in the consideration that the essence of an organization lies in the values, emotions, beliefs, and assumptions learned together. In a word: in that joint learning process that leads to founding and consolidating the culture of an organization (Schein, 2000) on training and human resource management processes that take into account the increasingly fluid boundaries of today's business and its necessary openness to change processes based on creative self-efficacy (Zappalà, Massei, 2011) and the sense of community (Panzarani, 2013).

5. The political interest in entrepreneurship education

The origins of entrepreneurship education (EE) go back to the beginning of the last century; however, only around the Seventies EE establish itself in the USA as an integral part of the curriculum, initially at university level (GHK, 2011) and, between the Eighties and Nineties, in the rest of the world and at different levels of education. EE has only recently been included among the political strategies; however, it is now considered a very important mechanism to face the challenges posed by the globalized economy, since it can encourage innovation, the production of new jobs (van der Zwan et al., 2013) and social empowerment (Nicholls, 2006).

Several factors are useful to explain the exponential growth of the EE in the world: is pivotal the political consideration that producing more graduates with entrepreneurial skills "can unleash economic potential around the world" (Volkmann, 2009, p. 43) and stimulate regional competitiveness (Kitson et al., 2004; European Commission, 2009b).

If we wanted to briefly trace the recent stages of development in the world, in the 1990s the International Labor Organization (ILO) and the OECD launched initiatives and research for EE. ILO plans training activities aimed at developing entrepreneurship, initially tested in Kenya and then introduced in various countries around the world (especially in Africa, the Arab countries, Asia and Latin America), (see: Know about Business - KAB, www.knowaboutbusiness.org/).

Since the second Conference of Ministers responsible for small and medium-sized enterprises in 2004, OECD has supported the importance for governments of developing culture, attitudes and entrepreneurial values:

> "Education and training (including lifelong training) in entrepreneurship and creativity are the preferred instruments for encouraging entrepreneurial behaviour in societies, and evidence suggests that such programmes can have an impact on entrepreneurial activity and enterprise performance" (OECD, 2004).

In 2010 OECD reaffirms the role that EE can play in supporting economic development (OECD, 2010a). Above all, it returns to the central theme of rethinking education and training systems, at formal and informal level, to foster creativity and innovation. The issue of the change of training systems, under the pressure of strong economic forces, manifests itself into the need to provide students with the skills needed to innovate and update their skills in the face of a constantly changing job market, to allow live experiences that promote entrepreneurial attitudes, to support the development of entrepreneurial culture. Besides, OECD considers entrepreneurship also as an integral part of inclusive growth for disadvantage and under-represented groups (e.g. women, youth, seniors, immigrants, the unemployed) thereby fighting social and financial exclusion while stimulating economic growth (OECD, 2019).

"It is clear that people from many of these social groups are less likely to be new business owners than core-age males. For example, despite having similar levels of human capital, women were less likely to be a new business owner than men in the European Union between 2009 and 2013 (1.8% vs. 3.5%). Older people (50-64 years old) were also less likely to be new business owners over this period (1.6% for older people and 2.6% for adults). Youth (15-30 years old), however, were as likely as adults (2.9% for youth and 2.6% for adults) to be new business owners but their businesses have low survival rates.

Among the main barriers to business start-up for these population groups are access to finance and a lack of entrepreneurship skills. Youth in particular cite these barriers. Women are as likely as men to report these barriers but a gender gap emerges concerning difficulty reconciling self-employment with family responsibilities and a lack of business idea. Older people are much less likely to report barriers to self-employment than youth and core-age adults, but suffer from relatively low labour market participation" (OECD, 2016, p. 11).

In 2015, the OECD Local Economic and Employment Development (LEED Programme), aiming at offering best practice on how to create better quality jobs through effective policy initiatives, joined with the European Commission, DG Education and Culture, and developed a Guiding Framework. The Framework allows HEIs to provide self-assessment of their strategy and practices in supporting entrepreneurship. The HEInnovate guiding framework offers policy guidance and advice by identifying and analysing institutional and national practices, and by making information available at the international level, to help new initiatives evolve. The framework contains a self-assessment tool for HEIs, a series of country reviews, and a peer-learning network facilitating exchanges of experiences and best practices among stakeholders. The HEInnovate review provides several learning models contributing to the discussion in Europe and the OECD area on policy practices to support entrepreneurship in higher education. The self-assessment tool for Higher Education Institutions is aimed at assessing innovation and creativity in teaching, research and third missions (www.heinnovate.eu). It sets out a framework for governments and higher education institutions to assess themselves over the time in eight key areas relayed to: leadership and governance; organisational capacity; digital transformation and capability; entrepreneurial teaching and learning; preparing and Supporting Entrepreneurs; knowledge exchange and collaboration; the internationalised institution; measuring impact.

In 2003 the World Economic Forum (WEF) created a Global Education Initiative (GEI) designed to network business, government, HEIs, civil society, international and non-governmental organisations "to effect positive, sustainable and scalable changes in education at global and regional levels with a focus on innovation, quality, and relevance". The stated goal, as clearly highlighted, is to improve "global education by increasing the engagement of the private sector" (Picciano, Spring, 2013, p. 34). The World Economic Forum's Global Education Initiative promotes l'EE as a key element having a tremendous impact in economic growth, recovery and societal progress by fuelling innovation, employment generation and social empowerment (WEF, 2012). Hence the need to increase awareness of its importance, consolidating the knowledge of the EE and the best practices existing in the world. It also stresses the need to support the development of innovative tools and methodological approaches; to engage governments, universities and different stakeholders in the creation and delivery of educational programs for entrepreneurship; to encourage discussion at different levels (from global to local) with all stakeholders. It becomes fundamental to redesign education systems, from primary to university level, and rethink teacher training (WEF, 2009), to create an entrepreneurship ecosystem in which people have the opportunity to exploit the opportunities offered to them by contexts locals.

Schema 1. Key Calls to Action

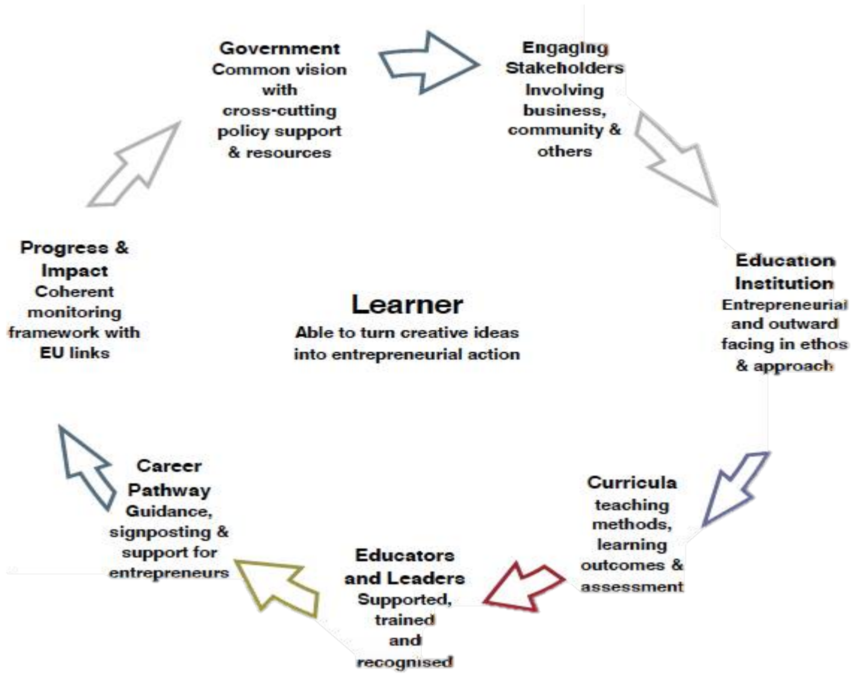
1. Transform the Educational System
It is not enough to add entrepreneurship on the perimeter – it needs to be at the core of the way education operates. Educational institutions at all levels (primary, secondary and higher education) need to adopt new methods and tools to develop the appropriate learning environment for encouraging creativity, innovation and the ability to think creatively to solve problems. Embedding entrepreneurship and innovation, cross-disciplinary approaches and interactive teaching methods will require new models and frameworks. It is time to rethink the old systems and "reboot" the educational process.
2. Build the Entrepreneurial Ecosystem
Entrepreneurship thrives in ecosystems where multiple stakeholders play key roles. Academic institutions are central to providing entrepreneurship education. However, actors outside of education systems are playing an increasingly important role in working with formal and informal educational programmes, as well as reaching out to target groups that have been underserved and/or socially excluded. A thriving entrepreneurship ecosystem requires collaboration and multi-stakeholder partnerships, particularly between academia and business.
3. Strive for Effective Outcomes and Impact
Greater clarity is needed on the purpose and goals of entrepreneurship education. Entrepreneurship education concerns the development of attitudes, behaviours, and capacities at the individual level. Inherently, it is about leadership and the application of skills and attitudes, which can take many forms during an individual's career, creating a range of long-term benefits to society and the economy. Developing and implementing a broader framework for assessing entrepreneurship education is necessary to capture a richer and more nuanced set of outcomes.
4. Leverage Technology as an Enabler
The parallel development of ICTs and media has changed the landscape, providing an opportunity to create greater access and scalability for entrepreneurship education. The ICT industry has been proactive in working with users, content developers, educational institutions, policy-makers, and others to frame a set of opportunities that can be disseminated to those who would benefit most from it. The full range of implications for enterprise and entrepreneurship education needs to be further investigated, particularly in developing economies where scaling is critical.

Source: WEF, 2012, p. 35.

What seems clear worldwide, however, is that EE can be a central element in supporting the immediate recovery of the economy and socio-economic development through the formation of appropriate mindsets, attitudes and skills. To do this, it is necessary to support the creation of the "entrepreneurship ecosystem", bearing in mind the diversity of the existing educational and training systems, to increase awareness of the importance of the entrepreneurial spirit among the various stakeholders (University, companies, NGOs, policy), underdeveloped in many countries. In a research based on international comparison on measuring some aspects of the entrepreneurial culture related to the image of entrepreneurs and the role of school education in creating this culture (OECD, 2013), there are significant cross-country differences in people's perceptions of the role that "school education" has in helping them to develop a sense of initiative and an entrepreneurial spirit. In many countries there is a clear distinction between the appreciation of the education's role in enhancing the entrepreneurial mindset and its role in giving useful competencies to run a business. "The opinions on the role that school had in forming a view on the role of entrepreneurs in society are also very diverse from one country to the other. Interestingly, the perceived image of entrepreneurs does not appear to be related to people's assessment of the role that education had in forming a view on entrepreneurs in society" (OECD, 2013, p. 82).

Two documents can be considered to witness the growing interest in the EE and the possibility of identifying reliable indicators, given the substantial gaps that emerged in the information and existing data relating to education for entrepreneurship (European Commission, 2009a). The final report on *Study on Support to Indicators on Entrepreneurship Education* of 2011 of the Directorate-General Education and Culture. It, through a comparative analysis of entrepreneurship education at school and in vocational training in 10 member countries, identifies some indicators to measure progress in EE. Therefore, the *Final report of the thematic working group on entrepreneurial education* (European Commission, 2014b) made up of representatives from the Member States, EFTA countries, partner countries and stakeholders identify success factors for entrepreneurship and exemplify these providing different examples of good practice worldwide. This report highlights that education systems in Europe also needs more effort in making learners understand which the role of entrepreneurs in society is. The number of Europeans who have attended an entrepreneurial course is equivalent to the respective levels for the other countries, formal education inspired to become an entrepreneur only one in three Europeans (p. 8). A coherent *ecosystem approach*, concentrating on the majority of the recognized policy success factors to maximize impact, still needs to be developed.

Figure 2. The Entrepreneurship Education Ecosystem



Source: European Commission, 2015, p. 13.

Consequently, reflection should invest how teachers and educators are trained: this commits universities in identifying new training methods, more based on "on experiential learning paradigm and economy" (Mariotti, Rabuzzi 2009, p. 32). Furthermore, the university is required to work in a network with the various stakeholders and, above all, with companies, to provide EE sharing knowledge, expertise, mentoring, social capital and financial support.

The interest in using university education to stimulate entrepreneurship receives a particular impetus especially in Europe, as a tool to face the economic crisis of 2008. In reality, since the Lisbon Agenda of 2000, the European Commission and the States Members have tried to develop entrepreneurial activity as much as possible, recognizing in entrepreneurship education the privileged tool to support this aim (European Commission, 2001). Following the adoption of the *Action Plan for Entrepreneurship* (European Commission, 2004), the *Oslo Agenda for Entrepreneurship Education in Europe* (European Commission, 2006a) is aimed at promoting entrepreneurial attitudes effectively in society. The Agenda is a comprehensive set of proposals, that stakeholders can use and adapt to the their specific realities. The Oslo Agenda is an outcome of the Conference held in Oslo on *Entrepreneurship Education in Europe: Fostering Entrepreneurial Mindsets through Education and Learning* – an initiative of the European Commission organized with the Norwegian government – (European Commission, 2006b), which followed the Communication from Commission *Fostering entrepreneurial mindsets through education and learning* (European Commission, 2006c).

"Sense of initiative and entrepreneurship" is defined as one of the eight key competences for *lifelong learning* in Europe, appropriate for all disciplines and to formal, non-formal and informal education and training (European Commission, 2006c).

> "Sense of initiative and entrepreneurship refers to an individual's ability to turn ideas into action. It includes creativity, innovation, and risk-taking, as well as the ability to plan and manage projects to achieve objectives. This supports individuals, not only in their everyday lives at home and society, but also in the workplace in being aware of the context of their work and being able to seize opportunities, and is a foundation for more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and promote good governance".

In the Europe 2020 strategy the European commission identifies entrepreneurship education as a key driver for growth and work, aiming at supporting countries to make entrepreneurship as a key point of national educational policy. The EC establishes an important connection of EE with the HEIs, because it recognizes the promotion of entrepreneurship as one of the strategic factors to enhance creativity, innovation, inclusive and sustainable growth. The 2014-2010 Multiannual Financial Framework strengthens this strategy by proposing to increase investment in education, research and innovation (Brennan et al., 2014).

Entrepreneurship education is therefore incorporated into the common objectives for education and training of the EU, in the *Education and Training 2010 Work Programme* (ET, 2010), (Council, 2004), and the *Strategic Framework for European Cooperation in Education and Training* till 2020 (ET, 2020), (Council, 2009)[1].

Education, especially university education, is considered capable of promoting the development of human capital and EE is vital for achieving the widest possible benefits from investment in training. This is what the Council argued in the Conclusions of December 2014, when it is highlighted how the development of entrepreneurial mindsets can have considerable advantages for citizens in all aspects of their lives. Consequently, Member States are invited to boost the development of harmonized approaches to entrepreneurial education involving all levels of education and training within their education and training systems. Particular attention is paid to university institutions, which are asked to deal with the institutional changes and organizational developments necessary for the promotion of a more entrepreneurial and innovative spirit (Council, 2015).

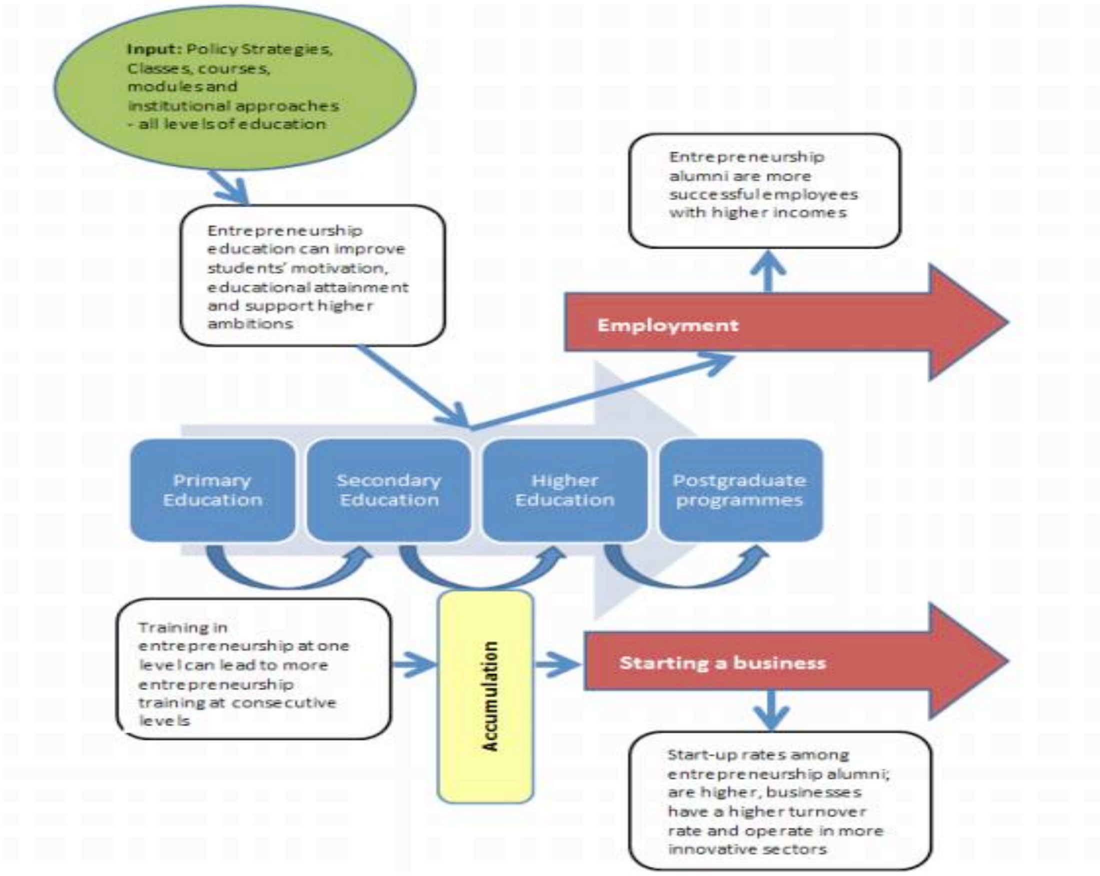
The request is also justified by the results of the Report commissioned in 2013 by DG Enterprise and Industry, aimed at mapping the research conducted on the impact of EE. The analysis of 91 studies from 23 countries, both nationally and transnationally, highlights how the EE functions as a support to students' employability.

> "Students participating in entrepreneurship education are more likely to start their own business and their companies tend to be more innovative and more successful than those led by persons without entrepreneurship education backgrounds. Entrepreneurship education alumni are at lower risk of being unemployed, and are more often in steady employment. Compared to their peers, they have better jobs and make more money" (European Commission, 2015).

[1] See http://ec.europa.eu/growth/smes/promoting-entrepreneurship/support/education/index_en.htm

The report highlights how positive effects tend to accumulate for countries that offer EE at different educational levels (such as Denmark, Norway and Holland) and for organizations that provide programs for different age groups. The positive effects concern the individual participants and the institutions - schools and universities - which become more attractive (see Fig. 2). Furthermore, this cumulative effect extends across society as new job opportunities are created and unemployment rates are reduced (European Commission, 2015, p. 87).

Figure 3. Accumulation of effects over time and educational levels



Source: European Commission, 2015, p. 88.

The European Commission manifests his interest in EE using the broad term of "modernization": it means reforming universities to optimize their services for societies. The Commission referred to a need to provide graduates with competences for highly-skilled occupations and criticized HEIs for being unprepared in answering to the need for reconsidering curricula, lacking to predict economy's requirements (Benneworth, Osborne 2015).

"Involving employers and labour market institutions in the design and delivery of programmes, supporting staff exchanges and including practical experience in courses can help attune curricula to current and emerging labour market needs and foster employability and entrepreneurship" (European Commission, 2011b, p. 5).

The EC's 2012 Communication, *Rethinking Education: Investing in skills for better socio-economic outcomes*[2] also reflects on HE's role in developing entrepreneurial skills, functional to the creation of new

[2] See COM(2012) 669 final, http://ec.europa.eu/education/news/rethinking/com669_en.pdf

businesses and the employability of young people. To increase the number of highly skilled jobs, the Communication stresses the need to develop soft skills, including "the ability to think critically, take initiative, problem-solve and work collaboratively" (European Commission, 2012b, p. 4). The Communication recalls the urgency – for all disciplines and all levels of education – to embedding real-life experiences, adopting problem-based learning approaches and linking education with enterprises.

Finally, the adopted EC Communication on the *Entrepreneurship 2020 Action Plan* (European Commission, 2013) declares that universities "should become more entrepreneurial". This statement recalls the EC's collaboration with OECD aimed at developing a support for facilitating university self-assessment and increasing their entrepreneurship capabilities. Several actions in the Commission's Action Plan are aimed at developing entrepreneurship in universities, including:

> "Disseminate the entrepreneurial university guidance framework in early 2013; facilitate exchange between universities interested in applying the framework; gradually promote it to the EU Higher Education Institutions; and
>
> Endorse successful mechanisms of university-driven business creation (spin-offs etc.) and emerging university-business ecosystems around key societal challenges. It also notably invited Member States to:
>
> Ensure that the key competence 'entrepreneurship' is embedded into curricula across primary, secondary, vocational, higher and adult education before the end of 2015".

Entrepreneurship is also part of the Erasmus+ programme, whose Key Action 2 interests "co-operation for innovation and the exchange of good practices" (European Commission, 2014a, p. 107). In particular, *Knowledge Alliances*, as part of the Erasmus+ programme, aim at strengthening Europe's innovation capacity and at fostering innovation in higher education and business. Objectives of these large scale programmes include developing "new, innovative and multidisciplinary approaches to teaching and learning; stimulate entrepreneurship and entrepreneurial skills of higher education teaching staff and company staff" (European Commission, 2014a, p. 128; Piazza, 2015).

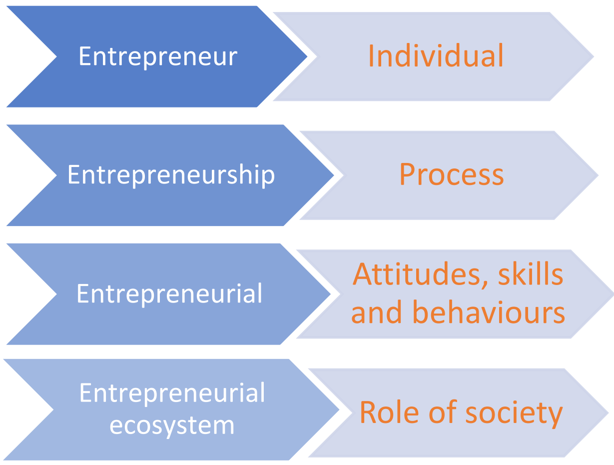
6. Entrepreneurship education in the University

Starting from the studies conducted by Vesper (Vesper, 1974; 1975; 1976), an increasing number of researchers have gone on to deal with EE in the university, based on 4 fundamental lines of research, aimed at 1) investigating nature and the structure of entrepreneurship training programs; 2) analyse the dynamics between educators and students; 3) assess the impact of the different EE programs; 4) analyse the learning climate favourable to entrepreneurship and the teaching methods at the university level.

However, based on the in-depth analysis (Béchard, Grégoire, 2005) relating to the literature on entrepreneurship in universities, what the authors called 'a curious paradox' emerges: most of the research on EE was anchored to theoretical references almost exclusively derived from the sciences of management, in opposition, therefore, to pedagogical theories. To the legitimate question of whether the research was based on inappropriate theoretical foundations, since "education should be of primary importance when investigating entrepreneurship education" (Gorman et al., 1997), the Authors could argue that the educational references of research on EE remained largely silent. At the same time a large number of relevant educational issues, theoretical and practical, were neglected, if not kept silent by researchers and experts.

Although there has been the impressive growth of literature in recent years (see: Rizza, Amorim Varum, 2011 for a review of the literature on EE), defining the focus of EE is still a challenging challenge today (Fayolle, Gailly, 2008), if we consider the singular purposes and the different approaches – from a theoretical and methodological perspective – distinguishing EE. It can be centered on entrepreneurship as an object of study, and deal with economic and social capital theories; it can solicit entrepreneurial initiatives and be focused on learning to support entrepreneurial behavior, stimulating nascent entrepreneurs to develop their ideas into concepts, models and plans. Finally, it can be aimed at acquiring entrepreneurial behaviours – seizing opportunities, being proactive/taking risks, being creative, having the ability to choose autonomously – useful not only for those who choose to start their own business but also for those whom they will work within organizations (in this case we speak of intrapreneurship), (Antoncic, Hisrich, 2003; Lans et al., 2013).

Schema 2. Forms and meanings of the word entrepreneurship



Source: WEF, 2009, p. 9.

The definition of EE is linked to multiple disciplinary contributions – economic, pedagogical, sociological, psychological and anthropological; however, the difficulties in constructing a coherent vision should perhaps be sought precisely in the difficulties in integrating the different disciplinary perspectives of the social sciences. Some analyses (e.g., Pittaway, Cope, 2007; Fayolle, Gailly, 2013) of the literature on EE highlight that many papers are focused on the way entrepreneurs can learn in the context of managing business ventures; however there is not adequate attention in the literature on psychology and educational approaches (Robinson et al., 2016). Many articles highlight their attempt to connect different social science perspectives, apparently without any intention in solving real-world policy or management problems. Such procedures have variously been described as "seeking to assemble an elephant from individual parts that have been studied in depth but never concerning the whole" (Gibb, 2007, p. 69).

According to Gibb, business schools have captured concepts of entrepreneurship in an almost exclusive way, as emerges from magazines and publications. This has meant that they "have attempted to deal with it within their conventional (and largely corporate cultures) dictating ways in which they have organized explicit knowledge". The legitimacy of the EE within the economic model would therefore be the result of the pressure exerted "to legitimize itself as a discipline by seeking to fit within (or add value to) established management functional paradigms" (Gibb, 2007, p. 69).

Yet, it seems difficult not to see the strong educational value of a path that, at least in terms of intentions, is aimed at acquiring "a range of essential skills and attributes, to make a unique, innovative and creative contribution in the world of work, whether in employment or self-employment" (Kozlinska, 2011, p. 208). In this perspective, it seems reductive to think of EE as the exclusive prerogative of the economics departments. Rather, it should be an integral part of all university courses (Greene, Saridakis, 2008; Hynes, Richardson, 2007; von Graevenitz et al., 2010), especially if we consider that resourcefulness, taking initiative (*to be enterprising*), which are aspects of entrepreneurship education, are educational objectives, closely connected to learning processes and, therefore, valid for multiple contexts (Gibb, 2005b).

If compared to learning processes, entrepreneurship does not refer in fact to a profession or a career, but rather to a cognitive, affective and conative process aimed at increasing the value of people (Kyrö et al., 2008, p. 2). Entrepreneurial skills, considered as important as their ability to manage life problems, should, therefore, be "the main target of all university faculties" (Schwarz et al., 2009), to be acquired through appropriate educational paths. In this way it is possible to strengthen the social role of the entrepreneur as a change agent, capable of acting creatively and perturbatively in society (Fargion et al., 2011, p. 966).

> "This would imply that the education system needs to produce not just people who can observe, describe and analyse, as has been traditional, but people who can see the opportunity, cope with uncertainty and ambiguity, make sense out of chaos, initiate build and achieve, in the process not just coping with change but anticipating and initiating it" (Kirby, 2007, p. 23).

Therefore, if EE is limited only or mainly to teaching the business model (as happens in most university courses), the most important aspect is neglected: helping students to acquire those skills that allow their successful insertion within the various organizations (public and/or private and/or third sector) in which they will work (Gibb, 2007). The objectives of a model oriented towards the construction and increasingly profitable use of individual skills, therefore, concern not only entrepreneurship as a career choice. Above all, they involve learning to think and act from a perspective that allows people to pursue their goals, to be creative, to identify offered opportunities and, generally, to face the uncertainty of today's society, characterized by constant processes of change and innovation.

Considering the levels of insecurity and complexity, if EE is mainly focused on business creation, it does not seem capable of fulfilling the task of making the subjects responsible for personal learning paths and aware of the internal locus of control.

Interesting is the suggestion of Jones and Iredale (2010), who, rather than entrepreneurship education, basically aimed at self-employment, prefer to use the expression enterprise education, whose purposes can be identified as follows:

- an active learning enterprise education pedagogy
- knowledge needed to function effectively as a citizen, consumer, employee or self-employed person in a flexible market economy
- the development of personal skills, behaviours, and attributes for use in a variety of contexts
- the person as an enterprising individual – in the community, at home, in the workplace or as an entrepreneur
- the use of enterprising skills, behaviours and attributes throughout the life course
- and how a business, particularly a small business works (Jones, Iredale, 2010, p. 11).

The main learning outcome should be sought in the person's ability to self-orientate (self-oriented entrepreneurship), thanks to the development of processes of self-regulation of learning and self-reflection on learning experiences. This ability should be emphasized from early school levels, although clear entrepreneurial activities on initial education are sporadic and on secondary and tertiary levels great part of the initiatives is business start-up focused, lacking references or connection to other teaching content (Lackéus, 2015). The self-oriented entrepreneurship skills support and nurture internal entrepreneurship – related to entrepreneurial and enterprising behaviors – and external entrepreneurship, which concerns the understanding of entrepreneurship and the opportunity to become an entrepreneur (Seikkula Leino et al., 2013, p. 151).

Self-oriented entrepreneurship focuses not only on motivation, self-awareness, creativity and personal responsibility in learning, but also on cooperation and interaction, fundamental for the development of internal entrepreneurship. Hence the attempt made in recent years to remove EE from the traditional ways of organizing knowledge that characterize economics courses. The aim is, instead, to focus more attention on learning processes and teaching methods. The pedagogy of enterprise education, by providing flexible, interactive learning situations based on the multidimensional development of knowledge, prefers non-traditional approaches, based on interaction, problem-solving, co-operative learning, teamwork, learning by doing, but also on the development of reflective skills, through the use of diaries, and on work experiences.

The real challenge for university institutions is to provide teachers with an orientation towards the use of innovative teaching/learning methods, focused on supporting the students' initiative. An *enterprising style of learning* (Gibb, 1993) requires overcoming the traditional didactic teaching modes (Schema 3 and the teacher's awareness of the different ways in which students learn to facilitate their processes.

Schema 3. From didactic to enterprising teaching modes

Didactic Learning Modes	Enterprising Learning Modes
• Learning from teacher alone • Passive role as a listener • Learning from written texts • Learning from 'expert' frameworks of teacher • Learning from feedback from one key person (the teacher) • Learning in well organized, timetabled environment • Learning without pressure of immediate goals • Copying from others discouraged • Mistakes feared • Learning by notes	• Learning from each other • Learning by doing • Learning from personal exchange and debate • Learning by discovering (under guidance) • Learning from reactions of many people • Learning in flexible, informal environment • Learning under pressure to achieve goals • Learning by borrowing from others • Mistakes learned from • Learning by problem solving

Source: Gibb, 1993, p. 4.

The skills needed require that teachers use participatory methods to engage their students in developing creativity and innovation. At the same time, learning outcomes, assessments and quality assurance methods at all educational levels should be designed to allow teachers to acquire those skills that are necessary for them to teach: "teachers cannot teach how to be entrepreneurial without themselves being entrepreneurial" (European Commission, 2014a, p. 9).

A final element of reflection concerns the request, also made by the political documents analyzed in the first part of this contribution, to increase relations with the community outside the university, developing and strengthening the links between educational contexts, economics and the world of work, in order to give coherence to the different activities and encourage mutual understanding (Jones, Iredale, 2010). Curricular and extracurricular internship experiences, simulations of interviews, research and consultancy projects, career talks (interviews with exponents of the world of work) and recruitment talks (to allow students to familiarize themselves with the procedures related to the recruitment and job processes application), mentoring, preparation of curricula vitae represent some of the areas in which entrepreneurs can make their contribution and constitute as many educational activities to be integrated into the various university curricula. Knowledge of the world of work and of the society of which students are a part are aspects not always adequately considered by academic educational paths. The university assigns inadequate attention to accompanying students to work (as entrepreneurs or as employees) and to the role they will assume beyond the university career as enterprising, committed citizens and members of the community.

The proposed University model, therefore, sees EE integrated and included in all departments, supported by a lifelong learning vision and enriched by innovative methodological approaches (the fully integrated and embedded model), (Schema 4).

Schema 4. Model 1: The Fully Integrated and Embedded (Optimum?) Model

The Optimum Fully Integrated Model, with the following characteristics:	
• University-wide application of entrepreneurship teaching. • Joined with office of technology transfer. • Innovative pedagogical support for every department. • Lifelong learning approach in all departments. • All departments and subjects covered. • Emphasis upon interdisciplinary teaching, degrees and centres. • Professorial status for Research and Development excellence. • 'Development' sabbaticals for staff wishing to commercialise IP. • Professors of Practice, Adjunct Professors, Visiting Development Fellows.	• Entrepreneur teams invited in to harvest ideas. • Social integration of entrepreneurs and status awarded to them. • Entrepreneurship as an office of the Vice Chancellor. • All activities academic led but in partnership with external stakeholders. • Research and development activity rewarded in all departments. • Active stakeholder participation with university staff in joint ventures. • Open approach to intellectual property and investment in university ventures. • Staff of departments trained to develop and offer entrepreneurship courses.

Source: Gibb, 2005a, p. 8.

If the university goes beyond the market model as the only reference framework, according to which "only market conditions are those capable of stimulating entrepreneurship" (Gibb, 2005a, p. 5), it can use EE as a tool – with a strong social impact – to emphasize critical and logical thinking, as main assets of the theoretical framework of EE (Béchard, Grégoire, 2005, p. 11).

7. Some remarks on entrepreneurship education in agricultural HEIs

Quite recently there has been an emergent agreement in the identification and supply of entrepreneurial learning chances in the agricultural area (Lans et al., 2017; Shane, Venkataraman, 2000). Since unemployment remains persistently high, many countries recognize entrepreneurship as one possible answers to the economic crisis and as a means to economic development and employment growth. Entrepreneurship can play a key role in reducing problems affecting businesses in agriculture, including the need for water conservation, packaging with lower environmental impact, and the protection of the natural environment. These problems requeste an increasing number of graduates with technical skills and creative ways of thinking (Higgins et al., 2018).

There is a debate if entrepreneurship in agricultural sector may be a special situation inside broad filed of entrepreneurship (Vik, Mcelwee, 2011), or students and graduates just need the same skills needed for all the students. In a recent study Dias et al. (2019) explore which are the main topics in 162 articles about agricultural entrepreneurship. Numerous studies show that agricultural entrepreneurs have poorer entrepreneurial skills compared to entrepreneurs in different economic activities. Other researches assume that entrepreneurs in agricultural sector have entrepreneurial skills that allow defining their entrepreneurial behavior (Pindado, Sánchez, 2017). The learning process can be considered fundamental to the development of entrepreneurial skills with particular regards to the development of an entrepreneurial identity, this is why the literature on agricultural entrepreneurship has been focused on understanding how to develop such skills (Seuneke et al., 2013) and behaviour (Dias et al., 2019).

Education is a pivotal factor of entrepreneurial characteristics, since individuals with a high level of education have stronger intrinsic motivation, self-motivated behaviours, and greater inclination to hight levels of attainment in entrepreneurship in general (Guzmán, Javier Santos, 2001), as well as in the agricultural area (Gurjar et al., 2017; Isiorhovojaq, 2013; Rosairo, Potts, 2016; Salau et al., 2017; Singh et al., 2013; Yadav et al., 2014 a, b). Education and training in the agricultural sector, more than age and gender (Rosairo, Potts, 2016), are essential for acquiring entrepreneurial capabilities (Kuratko, 2005). If we consider the development of entrepreneurship activities at tertiary level, several researches recommended the importance of attending entrepreneurship education programmes to let the agricultural students acquiring entrepreneurial skills. This is important in many developing countries (e.g. India - Lekang et al., 2017a, b; Lekang et al., 2016, or Iran – Mohammadinezhad, Sharifzadeh, 2017) but is clear in some developed countries (e.g.: Australia, United States, New Zeeland - Mehlhorn et al., 2015; or in Spain – Ortiz Medina et al., 2014). What research suggests is to incorporate entrepreneurship into HEIs educational curricula for students in agricultural sector (Pouratashi, 2015), and to include many different disciplines related do the economic field such as managerial economics, marketing or technology and computer sciences (Lekang et al., 2017a, b).

Becoming entrepreneurs in the agricultural sector requires acquiring new skills and knowledge, since the agricultural sector involves more and more new functions that agricultural education need to consider (Leeuwis, 2003) and that are essential for the agricultural staff training (Pouratashi, 2015, p. 468). Many programs in agribusiness have begun to respond to the request for including theories and ideas of entrepreneurship and innovation into their curriculum (e.g. Schroeter, Higgins, 2016); fewer courses have started to implement curricula to create entrepreneurs (Higgins et al., 2018).

However, there is a lack of studies on what are factors affecting intentions of agricultural students in starting economic activities (Knudson et al., 2004). There are many factors influencing entrepreneurial intentions: we should consider gender, risk-taking predisposition, need to feel independent, sense of realization, locus of control, income opportunities, positive models for understanding professional identity and characteristics of entrepreneurs and impact of entrepreneurship education. Many studies show that entrepreneurship education has the potential to support students in increasing their intention in entrepreneurship: educational activities can provide students with knowledge, competences, and mind-sets required for entrepreneurial duties (Wilson et al., 2007; Mueller, 2011; Mumtaz Begam et al., 2012; Rasli et al., 2013).

The findings of a study on the determinants of entrepreneurial intentions amongst agricultural students (Pouratashi, 2015) provide useful perceptions about factors affecting the entrepreneurial intents of students. Responses from 120 senior students at colleges of agriculture in Tehran University to a comparative test to identify differences in entrepreneurial intentions show that while there is no significant difference in entrepreneurial intentions if we consider gender, there is a significant differences if we consider students who attended entrepreneurship courses. Students who participated in entrepreneurship courses had considerably more intention for self-employment than students than haven't attended similar courses. This outcome indorses the importance of organising entrepreneurship courses in developing entrepreneurial purposes among students.

This is also confirmed in the study conducted by Mumtaz Begam et al. (2012) and by Wang et al. (2016). According to the findings, there is adequate evidence to sustain those agricultural colleges and universities should consider entrepreneurship education as integral part of their educational programs throughout the duration of the curriculum. Educational support is the most dominant factor determining entrepreneurial intentions, followed by personality traits and skills. It's possible to infer that if education and support on how to improve entrepreneurship intentions are integrated into curricula (Schema 5), students are more likely to start entrepreneurial activities autonomously.

Recommendations for agriculture HEIs are: to offer entrepreneurship courses for all students through the curriculum; to introduce entrepreneurship concepts and many different examples to students to help motivate them; to provide access to conferences, seminars, workshops focused on entrepreneurship to develop students' intentions toward entrepreneurial behaviour; to invite successful persons of the agricultural sector to provide lectures to students (Pouratashi, 2015), asking them to act as mentors for students. In addition to enhancing student intention toward agricultural entrepreneurship, business-plan writing and entrepreneurial competence development should be incorporate into the curriculum as main learning activities (Wang et al., 2016). It is also essential, as many researches suggest in this field, that agricultural colleges and faculties have a career guidance centre to offer students consultation about their future careers in agriculture.

The policy implications of these findings show that policy-makers should give priority to develop potential entrepreneurs from the first moments of students' academic career: this goal is possible only if entrepreneurship is recognized and supported at university level.

Schema 5. Criteria and good examples of entrepreneurship education

1. Entrepreneurship education is progressively integrated into curricula and the use of entrepreneurial pedagogies is advocated across faculties.
2. The entrepreneurship education offer is widely communicated, and measures are undertaken to increase the rate and capacity of take-up.
3. A suite of courses exists, which uses creative teaching methods and is tailored to the needs of undergraduate, graduate and post-graduate students.
4. The suite of courses has a differentiated offer that covers the pre-start-up phase, the start-up phase and the growth phase.
5. For certain courses active recruitment is practiced.
6. Out-reach to Alumni, business support organizations and firms are a key component of entrepreneurship education.
7. Results of entrepreneurship research are integrated into entrepreneurship education messages.

Source: OECD, 2010b, p. 15.

8. Conclusion

In conclusion, we can affirm that, although the trend of the new generations is to classify those that characterize the Hi-Tech sector or Social Networking as creative activities, this component of Human Capital becomes relevant and fundamental even in the most traditional sectors of work (agriculture , crafts). Sectors in which, in addition to the obvious need to update current training courses, the creative and decision-making aspect aimed at learning new practices for understanding the internal and external aspects of companies is still too little emphasized, and mostly aimed the acquisition of useful strategies to encourage better adaptability of the company to the needs of the global market.

In particular, two company processes intercept the main changes compared to the past: the use of new technologies that impose themselves forcefully on the organizational scene (respecting tradition); the possibility of connecting to precious production networks (Rullani, 1998) that disappear far beyond the boundaries of your business.

From this point of view, therefore, the uncertainty on the meaning to be assigned to entrepreneurship education, the lack of adequate training of university staff, the difficulties in involving entrepreneurs in training and evaluation courses, the traditional academic evaluation of knowledge rather than skills and behaviors are only some obstacles that limit the inclusion of EE pathways and experiences in universities. Although the political demand to increasingly include entrepreneurship in training courses is persistent, this educational model is substantially on the edge of university education, in fact still anchored to traditional research and teaching activities. Promoting entrepreneurial potential has become an additional task for higher education that adds to existing ones, rather than shared value. To become central, EE should instead be included in the institutional architecture of universities, as a contribution to the institutional objectives of quality teaching and research

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Appendix – Definitions of key terms

agent of change or change agent – someone who promotes and enables change to happen within any group or organization. In business, a change agent is an individual who promotes and supports a new way of doing something within the company, whether it's the use of a new process, the adoption of a new management structure or the transformation of an old business model to a new one.

enterprising person – a person who pursues entrepreneurial behaviours in many different contexts (Gibb, 1993).

entrepreneur – An entrepreneur is a person who is willing and able to convert a new idea or invention into a successful innovation, simultaneously creating new products and business models largely responsible for the dynamism of industries and long-run economic growth (Joseph A. Schumpeter quoted in WEF, 2009, p. 16). A person practising entrepreneurial behaviours in a business context (Gibb, 1993).

entrepreneurial – refers mainly to economic activity, to the ability to start a business and to deal with the risks that derive from it, over time has assumed meanings related to the conduct and attitudes of the entrepreneur, although fundamentally linked to business creation (Seikkula Leino, 2011).

entrepreneurial behaviours – seizing opportunities, being proactive/taking risks, being creative, having the ability to choose autonomously. These behaviours are useful not only for those who choose to start their own business but also for those whom they will work within organizations.

entrepreneurship – refers to an individual's ability to turn ideas into action. It includes creativity, innovation, and risk-taking, as well as the ability to plan and manage projects to achieve objectives (European Commission, 2012a, p. 7).

This supports individuals, not only in their everyday lives at home and society, but also in the workplace in being aware of the context of their work and being able to seize opportunities, and is a foundation for more specific skills and knowledge needed by those establishing or contributing to social or commercial activity. This should include awareness of ethical values and promote good governance (European Commission, 2006c).

entrepreneurship education – Entrepreneurship education concerns the development of attitudes, behaviours, and capacities at the individual level. Inherently, it is about leadership and the application of skills and attitudes, which can take many forms during an individual's career, creating a range of long-term benefits to society and the economy (WEF, 2012, p. 35).

Entrepreneurship education is about learners developing the skills and mind-set to be able to turn creative ideas into entrepreneurial action. This is a key competence for all learners, supporting personal development, active citizenship, social inclusion and employability. It is relevant across the lifelong learning process, in all disciplines of learning and to all forms of education and training (formal, non-formal and informal) which contribute to an entrepreneurial spirit or behaviour, with or without a commercial objective (European Commission, 2012a).

The primary focus of entrepreneurship education is on:

- how to start a business including the key processes of business start-up;.
- how to plan and launch a new business venture;
- how to grow and manage a business;
- enhancing the necessary skills and behaviours needed to run a business;
- the deployment of entrepreneurial skills and knowledge in a business context;
- imminent use of the knowledge and skills needed to start a business;

- and self-employment (Jones, Iredale, 2010, p. 10).

enterprise education – enterprise education assists, develops and improves links between education and business and brings greater coherence to their activities. One aim of enterprise education is to increase employer, especially small-medium enterprise involvement in schools, colleges and universities. enterprise education aims to maximise opportunities for the development of enterprising skills, behaviours and attributes (Gibb, 1993) in young people in the expectation that these will be utilised, deployed and developed at some future point whatever their career choice might be while entrepreneurship education is aimed more at encouraging people to start a business (Jones, Iredale, 2010, p. 9).

intrapreneurship – the process of uncovering and developing an opportunity to create value through innovation and seizing that opportunity without regard to either resources (human and capital) or the location of the entrepreneur – in a new or existing company (Churchill, 1992, p. 586). In general terms, it concerns the ability to develop new ideas from those who work within an organization; intrapreneurship is present in a company, for example, when it acts entrepreneurially in pursuing new opportunities; on the contrary, a non-intrapreneurial company mainly deals with the management of the existing one and makes decisions based on the resources in its possession (Antoncic, Hisrich, 2003). The entrepreneur acts independently, activates in his own organization, whereas the intrapreneur is only partially independent, activating within the company as an employee (Cadar, Badulescu, 2015, p. 662).

Ch. 3.2

INNOVATION AND SUSTAINABILITY OF BUSINESS MODELS: LEARNING, GENERATIVE PRACTICES AND SCHOOL (UNIVERSITY) - WORK TRANSITION IN THE ORGANIC AGRI-FOOD SECTOR

OBJECTIVES:

Learning objectives provided by chapter are:

- to approach users to the basic concepts of sustainability and related Business models, through a perspective that starts from higher education and up to the learning of practices applied to the agri-food sector
- to understand the development of entrepreneurial education in policy: to recognize the different purposes and the theoretical and methodological approaches that characterize entrepreneurial education; to identify which are the main aspect to consider in improving entrepreneurial education in HEIs

SKILLS: sustainability content - types of business models - EU policies on sustainability and higher education - learning methods - practical applications in agro-food.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

<u>Which of the following definitions correctly defines the concept of Corporate Sustainability?</u>

- ☐ The corporate sustainability is the way a company increases its value through the profit growth
- ☐ The Corporate sustainability is the way a company constantly creates shared value through economic development, good governance, the responsiveness of stakeholders and environmental improvement
- ☐ The corporate sustainability is the set of values and strategies of a company
- ☐ The corporate sustainability is a Business Model in which new products and processes provide value to customers and businesses but significantly reduce the environmental impact

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

What synonym can be used for the term Shared Economy?

- ☐ Green Economy
- ☐ Corporate Social Responsibility
- ☐ Collaborative Consumption
- ☐ Globalized Economy

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

Entrepreneurship refers to ……………

- ☐ an individual's ability to know how to transform ideas into actions
- ☐ long-term benefits to society and the economy
- ☐ ability to plan and manage projects to increase businesses
- ☐ leadership

QUESTION 4 (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

Define the fields of application better use of the Circular Economy Model

QUESTION 5 (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

You can list the main differences between entrepreneurship education and enterprise education?

PRACTICAL APPLICATION OF THE PREVIOUS CHAPTER (E.G. SOLVE THE PROPER TASK OR WRITE THE SIMULATION OF CERTAIN SITUATION/DESCRIBE THE NOTICED PROBLEM, ETC.)

If you were to strengthen the intention for entrepreneurship in students in the agriculture sector, what suggestions would you give to policy makers of your HEIs?

3.3. The impact of the European funds financial support on the organic production in the EU

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Abstract: The Common Agricultural Policy (CAP), managed and financed from the resources of the European Union (EU), supports the improvement of productivity in agriculture and maintains the vitality of the rural economy, also contributing to combating climate change, through three types of instruments: 1. direct payments to farmers 2. market measures to deal with difficult situations; and 3. rural development measures - with national and regional programmes that are responding to the challenges encountered in the rural areas. Direct payments and market measures are financed through the European Agricultural Guarantee Fund (EAGF) and rural development through the European Agricultural for Rural Development Fund (EARDF). The new Common Agricultural Policy 2014-2020 promotes a series of special measures to support organic farming, respectively 30% of direct payments are related to the compliance with some agricultural practices beneficial for the environment and at least 30% of the budget of the rural development programmes are allocated to agri-environment, to support organic farming or to projects related to investment or innovation measures in favour of the environment. This chapter presents how European funds allocated to (national) rural development programmes (NRDP), through a specific measure to support organic farming (M11), can contribute to the development of this sector, thus influencing the production and consumption of organic food. Romania will be presented as a case study, through a comparative analysis with the other EU member states. The chapter is also relevant from the perspective of the fact that European funding of organic farming contributes to soil protection, maintaining ecosystems that are linked to the use of sustainable agricultural practices, promoting the efficient use of natural resources and supporting the transition to an economy of low-emissions and adapted to the effects of climate change, while promoting a sustainable and balanced development of the rural area.

Keywords: organic farming; The CAP; rural development; financial support; organic products.

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1. Introduction

It is a certainty that the last three decades have been very prolific for research in the field of organic farming. Whether it was research in the economic, technological or social field, individually developed studies or multidisciplinary teams, their results have contributed both to scientific and technological progress in the field of organic farming and to the expansion of concerns of private organizations, public institutions, universities or research institutes. In this chapter, I will present the way in which the European funds allocated to the implementation of the Common Agricultural Policy (CAP) have supported the development of organic farming in EU member states, customizing the implementation and results in Romania, as a case study.

Watson et al. (2008) linked the number and frequency of these scientific concerns both to the existence of political support for organic farming in some countries and to the availability of government decision-makers to fund research in this field. It can also be seen that research aimed at comparing conventional and organic farming systems, using complex methods, predominates. Watson et al. (2008) considered research exclusively related to organic farming more useful for the development of production systems than comparative research and appreciated the important role of multidisciplinary research in understanding this type of agriculture. Field research is also highlighted by Barbercheck et al. (2012), who also make a series of recommendations in this regard.

Patil et al. (2012) show that organic farming has the potential to generate net profit and reduce environmental impact. Reganold & Wachter (2016) evaluated the performance of organic farming in relation to four dimensions: productivity, environmental impact, economic viability and social welfare. Although they identify a number of benefits of organic farming, compared to conventional farming, the authors admit that there is still no possibility that a single type of agriculture can provide food for the entire planet. The identified solution would consist of a mix of ecological and innovative systems that can be implemented through policies that would ensure their development and implementation.

While special attention has been paid to research on the behaviour of consumers of organic products and the factors that influence it, the factors that influence the attitudes of specialists in the field of organic agriculture have been investigated to a lesser extent. Ann Wheeler (2008) demonstrates, based on the interpretation of the results of a sociological study, that professionals who have both knowledge and experience in ecology are those who are in favour of the development of this type of agriculture.

There are a number of case studies, relevant to the particularities of the development of organic farming in the Member States of the European Union (EU), with the support of European funds. Mitev (2019) conducts an assessment of agriculture in Bulgaria through a SWOT analysis, stressing the need for financial support from European funds through the Rural Development Programme (RDP) and the possibility for farmers in organic farming to obtain bank loans. Otouzbirov et al. (2019) emphasizes that in recent years, as a result of CAP support and market development, organic farming in Bulgaria can be defined as upward and with good prospects. At the same time, it shows that there is a high dependence of farmers on PDR payments - subsidies playing an important role both for optimizing business costs and for maintaining income. Brožová (2011) found that subsidies have positively influenced the results obtained in organic farming in the Czech Republic. Pondel (2017) conducts a comparative analysis of rural development programmes in Poland (2007-2013 and 2014-2020) from a macroeconomic perspective.

The chapter is structured in three subheadings. In the first two subheadings we present aspects on the evolution of organic farming in the Member States of the European Union and aspects on the evolution of the organic products market. The third subheading refers to the concrete way in which the funds for the development of organic agriculture are used, presenting in a first phase the objectives of the Common Agricultural Policy for this sector and of the rural development programmes. Also, in the third subheading we present the case study on the use of funds for organic farming in Romania. We processed quantitatively and qualitatively the data provided by Eurostat and the European Commission, but also those from the IFOAM studies. The hypothesis we started from was that the positive trend of the growing of organic cultivated areas is influenced by the financial support provided by the European Union through rural development programmes and in turn, the organic cultivated area positively influences the European market of organic products.

2. Aspects of the evolution of organic farming in the European Union

The sum regarding the zone under transformation and the accredited zone symbolizes the total organic area. A zone can be vouched for as being an organic one only if it undergoes a transformation process which could last up to 2-3 years, revolving around the type of the crop. In pursuance of having plants and plant products accredited as organic, the production guidelines must have been used on the plot of land during a transformation period of at least two years before planting. However, there are different cases, for example when talking about grassland or perennial forage, the optimal period would be of at least two years before utilizing it as provisions from organic farming. Another example is in the case of perennial harvests, different from forage; the production rules should be applied at least three years before the first crop of organic goods. It is certainly shown by figures that the demand for organic products is constantly growing, which has led to both an increase in production in this sector and an increase in the number of producers. The highest demand for organic products comes from the USA and Europe.

In the EU-28 in 2018, 13.4 million hectares of agricultural land have been used for organic farming. If we were to convert in percentages, this means that 7.5 % of the total appropriated agricultural zone of the EU-28 was used for organic producing crops. The highest portions of organic land were enrolled in Austria, Sweden and Estonia, each of those having a percentage above 20% of the total agricultural land. Since 2013, there was a 31% increase of the agricultural properties in the EU-28 that were fully organic, in 2016 reaching 2%. For the period between 2012 and 2018, the increase in organic area was 34%, as shown in Table 1. Given this trend, in the upcoming years, the total organic area in the EU-28 is expected to grow even more.

Table 1. Total organic area (fully converted and under conversion), by country, in 2012 and 2018.

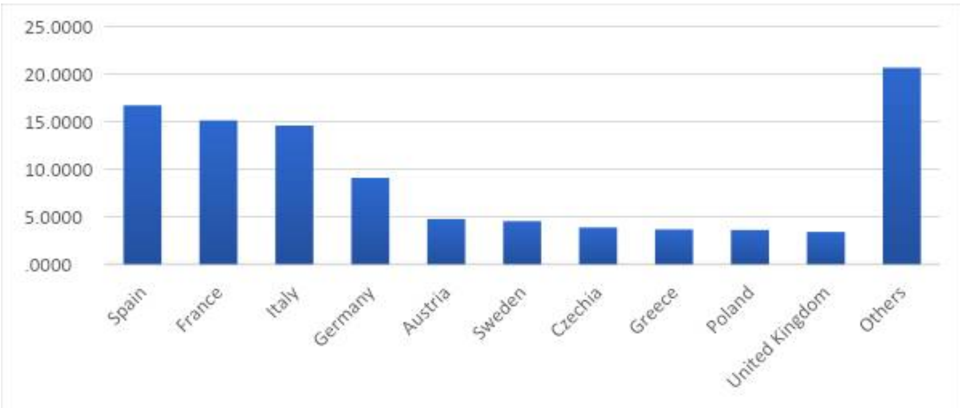
	Organic area (ha)		2012–18 (% change)
	2012	2018	
EU-28	**10.047.896**	**13.438.168**	**33,7**
Belgium	59.718	89.025	49,1
Bulgaria	39.138	128.839	229,2
Czechia	468.670	519.910	10,9
Denmark	194.706	256.711	31,8
Germany	959.832	1.221.303	27,2
Estonia	142.065	206.590	45,4
Ireland	52.793	118.699	124,8
Greece	462.618	492.627	6,5
Spain	1.756.548	2.246.475	27,9
France	1.030.881	2.034.115	97,3
Croatia	31.904	103.166	223,4
Italy	1.167.362	1.957.937	67,7
Cyprus	3.923	6.022	53,5
Latvia	195.658	280.383	43,3
Lithuania	156.539	239.691	53,1
Luxembourg	4.130	5.782	40,0
Hungary	130.607	209.382	60,3

Malta	37	47	27,0
Netherlands	48.038	57.904	20,5
Austria	533.230	639.097	19,9
Poland	655.499	484.676	-26,1
Portugal	200.833	213.118	6,1
Romania	288.261	326.260	13,2
Slovenia	35.101	47.848	36,3
Slovakia	164.360	188.986	15,0
Finland	197.751	297.442	50,4
Sweden	477.684	608.754	27,4
United Kingdom	590.011	457.378	-22,5

Source: Eurostat (2020) - Organic crop area by agricultural production methods and crops

According to data registered by Eurostat, Bulgaria, Croatia and Ireland were the countries that had a recorded growth of over 100% in the total organic area, between 2012 and 2018. The highest total organic areas calculated in hectares (ha) both in 2012 and 2018 were registered in Spain, France and Italy (see Chart 1).

Chart 1. Share of total organic area (fully converted and under conversion), EU-28, 2018.



Source: Eurostat (2020) - Organic crop area (fully converted area)

3. Aspects of the evolution of organic product market in the European Union

The analysis of the evolution of the organic products market is necessary in order to relate it to the evolution of the organically cultivated or converted areas. It is important that organically grown areas and production increase in direct proportion to market demand in order to meet its needs.

The European Commission suggests in its agricultural outlook 2019 to 2030, that the increasing demand for organic food could magnify the EU supply in the short term. In the long run, the growth of organic production could be slowed down by the changes made in society in order to try environmentally-friendly alternatives, along with the conversion to organic farming. (Executive summary, EC, 2019a, p.4).

In Europe, the organic market grew by 7.8% and in the European Union by 7.7%. From 2009 to 2018, the organic market not only doubled in size, but even exceeded it. (Willer et al., 2020, p. 251). France and Denmark had the highest increase with 15%, respectively 13%. Denmark also had the highest per capita consumption of organic food, with a sum of 312 Euros. The continual growth in consumer interest is well shown by the increase of per capita consumption (see Table 2).

Table 2. European Union – key indicators 2018.

Indicator	European Union	Top 3 countries Europe
Organic farmland in hectares	13.8 million ha	Spain (2.2 million ha), France (2.0 million ha), Italy (2.0 million ha)
Organic share of total farmland	7.7%	Austria (24.7%) Estonia (21.6%)
Increase in organic farmland 2017-2018 in hectares	1 million ha	France (+290'604 ha) Spain (+164'302 ha) Germany (+148'157 ha)
Relative increase in organic farmland 2017-2018	7.6%	Ireland (+60%)
Top arable crop groups	Green fodder: 2.3 million ha Cereals: 2.2 million ha Dry pulses: 0.4 million ha	*Largest arable areas*: France (l.l million ha) Italy (0.9 million ha) Germany (0.6 million ha)
Top permanent crop groups	Olives: 0.5 million ha Grapes: 0.3 million ha Nuts: 0.3 million ha	*Largest permanent crop areas:* Spain (0.6 million ha) Italy (0.5 million ha)
Wild collection area	13.9 million ha	Finland (11.2 million ha) Romania (1.8 million ha;2014)

Source: FiBL-AMI survey 2020 (Willer et al., 2020)

Nonetheless, the Commission affirms “that addressing the demand for organic produce has been met with obstacles, as very different production techniques must be enforced by farmers. Those techniques are characterized by a higher reliance on labour and stricter rules on animal care and medication. The production underdeveloped in the EU because of the high production fares for organic products, which do not balance the production and conversion costs. Even though it has met some difficulties, organic production has strongly increased in the past 10 years and it was shown by the high growth rates that the organic market has not yet reached its peak”. The threats for conversion may alter the annual growth of production in the second part of the period (2019-2030), as it could be lower than the one in the first half. Labelling such as “zero pesticide” present on the market could lower the growth of organic market. By 2030, the Commission expects that “the EU organic area could hit 18 million hectares or 10 percent of the total agricultural land, changing the growth in land use by 3% per year.” Permanent crops and pastures are expected to have a slower development because of organic products that have already had significant shares. These areas developed faster because they are easier to convert to organic systems. (Organic, EC, 2019, p.20).

4. The role of European funds in the development of organic farming

4.1. The implementation of the Common Agricultural Policy and measures dedicated to organic farming in the European Union

The Common Agricultural Policy (CAP) is one of the first Community policies, created with the aim of ensuring the necessary food supply within the Community. The CAP is a set of rules and mechanisms that regulate the production, processing and marketing of agricultural products in the European Union and pay an increasing attention to the rural development. (Ministry of Foreign Affairs in Romania 2016)

Since 1992, at EU level, the introduction of agri-environment programmes has been the common framework for supporting the maintenance and transformation of lands regarding the organic production. At that time, organic farming was not a policy itself and the financial support for its development was considered a means by which the environment was protected. According to the Community Strategic Guidelines for Rural Development, the support of organic farming is just one of the options for sustainable development. The study “Use and efficiency of public support measures addressing organic farming” (Sanders et al. 2011) points out that organic farming has been approached differently in the EU Member States, the degree and the type of the support that was received being linked to the policy of each state. An important role was played by the ecological action plans at national or regional level. At the level of 2007, there were 17 environmental action plans at national level and 10 at regional level in the EU. These were different and reflected the differences between national strategies and the levels of development of the green sector at EU level. The differences were given by the targets of the national policies, the period in which they were implemented, the expected types of actions, the financial resources and the previous plans. The quantitative and qualitative analysis of the study shows that the financial support from European funds has made the main contribution to the development of organic farming, appreciating that even if the financial support differs with the evolution of the organic sector, it remains essential.

The CAP reform began in 2013 and at the same time the European Action Plan for Organic Food and Farming (EAOP) aimed to support the development of organic farming by establishing the directions in which it can contribute to the implementation of CAP. (Sanders et al. 2011)

The CAP is currently built on two pillars: a) *common market organizations* (common measures to regulate the functioning of agricultural product markets) - Pillar 1 and b) *rural development* - structural measures aimed at balanced development of rural areas - Pillar 2. Rural development is

Chart 2. 2014 – 2020 EARDF funding / MS (€ million)*

*Envelopes in place after entry into force on the 23rd of May 2015 of the COMMISSION DELEGATED REGULATION (EU) No 2015/791 amending Annex I to Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for Rural Development by the European Agricultural Fund for Rural Development, i.e. after transfers between Direct Payment envelopes and the RDP envelopes; ** includes EU level technical assistance (239 mil. Euros). (European Commission 2020, Rural Development Programmes 2014-2020)

BE	648	HR	2 026	PL	8 698
BG	2 367	IT	10 444	PT	4 058
CZ	2 306	CY	132	RO	8 128
DK	919	LV	1076	SI	838
DE	9 446	LT	1 613	SK	1 560
EE	823	LU	101	FL	2 380
IE	2 191	HU	3 431	SE	1 764
EL	4 718	MT	97	UK	5 200
ES	8 297	NL	765		
FR	11 385	AT	3 938	EU	99 586**

funded by the European Agricultural for Rural Development Fund (EARDF). Each Member State receives a financial package for this period of 7 years. The total allocation of 2014-2020 programming period for all Member States (in 2011 prices) is 84.94 billion Euros for rural development, respectively 99.9 billion Euros in current prices from EARDF (Pillar 2), to which are added 50.9 billion Euros in national contribution of the Member States. The Member States and regions shall draw up their own rural development programmes according to the needs of the territory (Ministry of Foreign Affairs in Romania 2016). For the 2014-2020 programming period there are 118 national and regional rural development programmes (see Chart 2), co-financed from EARDF and the national contribution. (ENRD 2020, RDP Summaries)

A total of 20 of the 28 Member States have only national rural development programmes, while 8 Member States, respectively Portugal, Spain, France, the United Kingdom, Belgium, Germany and Italy, have rural development programmes also at regional level (European Commission 2020, Rural development programmes by country). At the same time, these programmes must address to at least four of the six EU's rural development priorities. The priority no. 4 finances measures for the conservation and development of ecosystems that are related to agriculture and forestry (Ministry of Foreign Affairs in Romania 2016). For the programming period 2014-2020 there is a separate measure to recognise the importance of organic farming in contributing to various rural development objectives and priorities, regardless of the fact that in the 2007-2013 period help for organic farming was part of the mandatory agri-environment measure (ENRD 2020, RDP analysis). Approximately 14% of the total funds are for Priority no. 4. From the total budget for EU RDPs (€99 billion), the total contributions regarding the organic farming payments (Measure 11), for 2014–2020, builds up to €6.3 billion or 6.4%. These numbers can be approximated to the percentage of total EU organic farmland (5.7% as of 2014). The available data refers to the allocation that can be used from 2014 to 2023, according to European regulations. Most likely, by the end of 2023, there will be definite data about the expenditures made for the development of organic farming in relation to the initial allocation. A further impact assessment will also be able to reveal the contribution that investments in the conversion of agricultural areas to organic farming or the maintenance of organic practices have had on increasing organic food production.

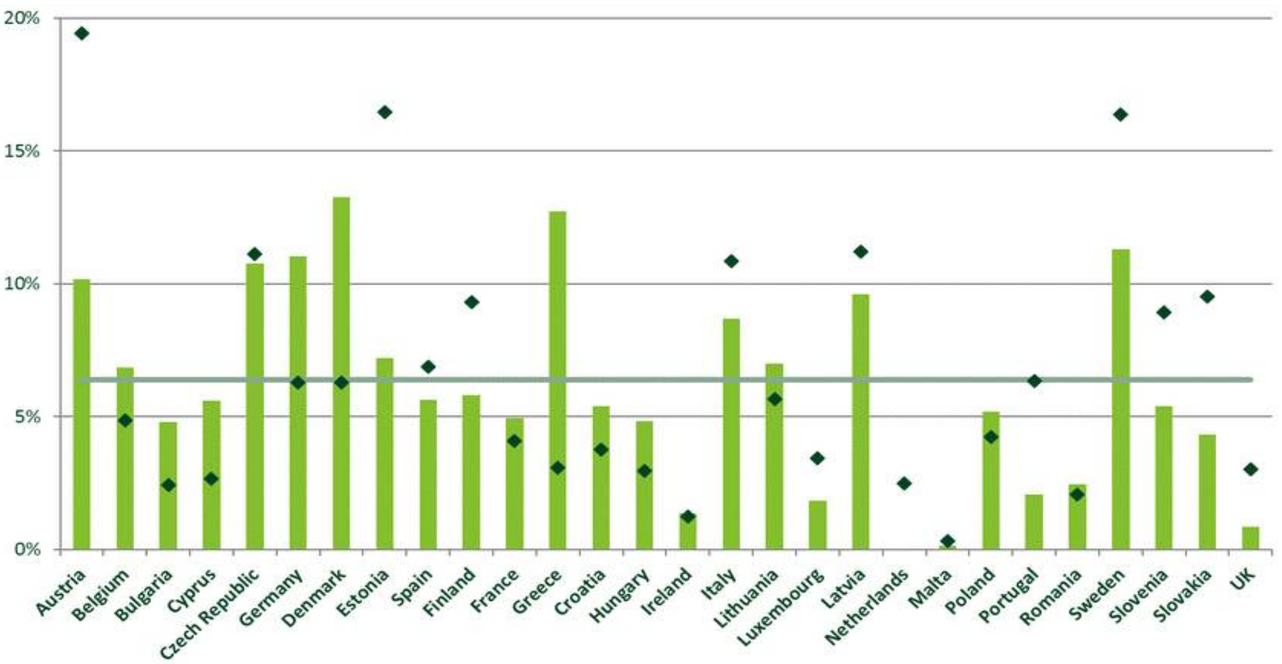
The farmers that convert to organic farming or keep their methods and practices, as defined in the Regulation (EC) No 834/2007 (organic regulation), receive support, per hectare of agricultural area through the organic farming support measure (M11). “Organic farming is predicted to establish and continue a tenable management structure for agriculture. The agricultural practices, that are advertised, help in improving the soil and water quality. Also, they mitigate and adapt to climate change and improve biodiversity (for example, by avoiding the use of synthetic plant protection products and synthetic fertilizers and by encouraging crop rotation, and also the use of organic fertilizers and soil improvement organic matter).” It is interesting to observe that M11 provides support for: “1. the conversion of traditional farming to organic farming (M11.1); 2. the sustenance of certified organic farming (M11.2).” (ENRD 2020, RDP analysis), being, thus, destined to the active farmer type. According to Article 9 of Regulation (EU) No 1307/2013, you can describe a farmer as “a natural or legal person, or a group of natural or legal persons, whose dominion is located inside the European Union, and exercises an agricultural endeavour.” Are also eligible different types of groups, like producer groups or factions of organic farmers that have a legal status. We have to take into consideration the possibility that the groups can receive higher grants for the transaction costs than the individual beneficiaries. In accordance with the following provisions contained in the Council Regulation (EC) No 834/2007, “an approved organic farming control body must certify the beneficiaries, in that sense of demonstrating that they meet the desiderata laid down in the EU organic farming regulation, or that they are registered for conversion.”

It is provided support for organic farming under the provisions of M11 for all RDPs except the Netherlands, Mayotte from France and the three National Programmes for France, Italy and Spain.

"Sub-Measure M11.1 was not put in place in three RDPs, such as Austria, Greece and Saxony-Anhalt from Germany. All the rest of the RDPs that have put in place Measure 11 are using both the conversion sub-Measure (M11.1) and the maintenance sub-Measure (M11.2)." (ENRD 2020, RDP analysis)

No clear model can be found in the relationship between the importance attributed to organic farming by the states and the size of their national organic sector. For example, with the scope of expanding the organic farmland area, they fluctuate all across the countries, from 0.2% (Malta) to 13.2% (Denmark) of the total EU spending for RDPs (see Chart 3).

Chart 3. EARDF contribution to organic farming support (Measure 11) under CAP 2014 2020 compared to the total organic farmland area in 2014 by Member State.



Source: Stolze et al., 2016, p. 16.

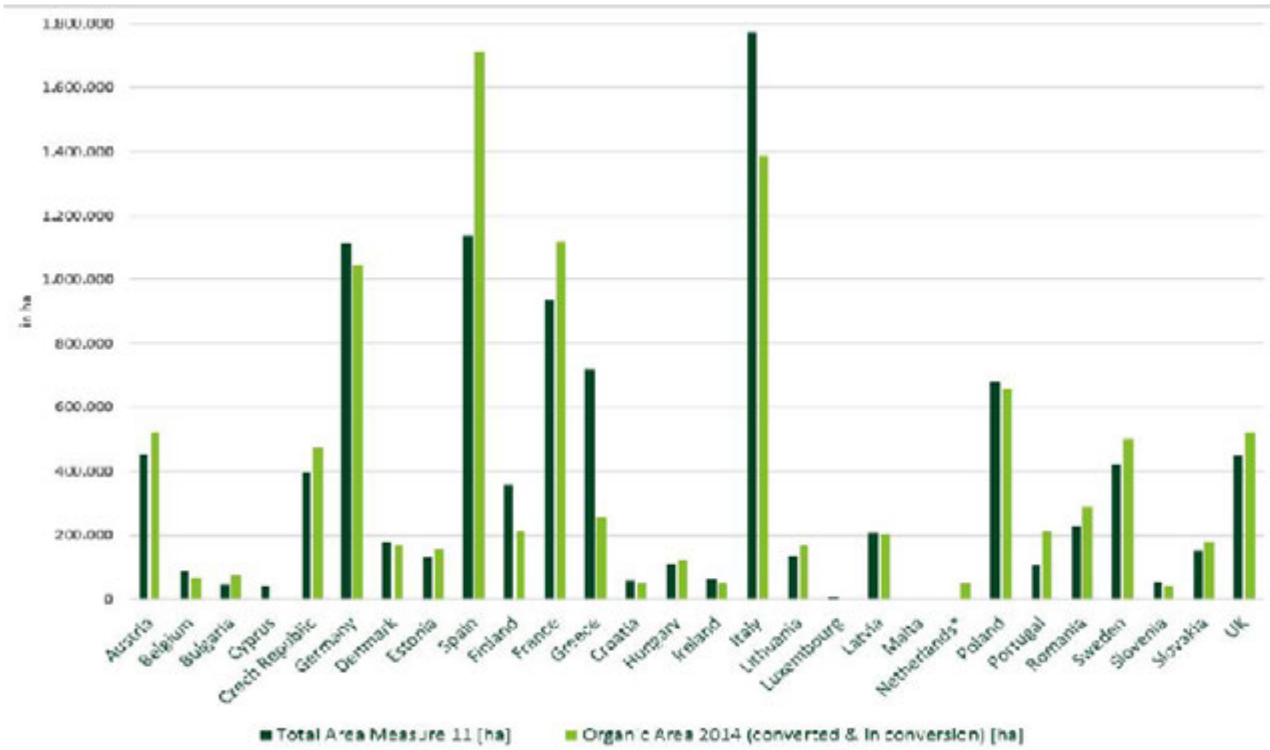
When comparing countries such as Finland, Portugal, Slovakia, Slovenia, Estonia and the UK with Cyprus, Bulgaria, Belgium, Denmark, Greece and Germany, the first set seems to give much less importance to organic farming support under the new RDPs than the second one.

However, the situation must be related both to the degree of development already existing in each Member State and to the share that the destined amounts for Measure no. 11 have in the allocation of the national or regional rural development programme. For example, Estonia allocates about 10% to Measure no. 11, and Slovenia and Slovakia allocate around 5% of the total amounts of the national rural development programmes. In the countries with regional programmes, the situation is different. For example, Belgium has two regional programmes, one for Flanders and one for Wallonia. If in Flanders, 1.09% of the allocation of the regional rural development programme is dedicated to the Measure no. 11, in Wallonia the respective allocation is of 15.3% of the regional programme. In Germany, within the 13 existing regional rural development programmes, the share of expenditure on organic farming differs, from 16% of the total programme amount in the Hessen, to non-allocation of amounts in Saxony or Thuringia, for example. Organic farming in Denmark is an important element. It is envisaged to double the area so that it covers 12% of the total agricultural area. The biggest measure under the area-based support schemes is support to organic farming. The support is provided for conversion to organic farming and for maintaining organic farming practices. The

Danish long-term objective is to double the organically farmed area from 150.000 ha in 2007 to 300.000 ha at the end of the present programming period. (ENRD 2020, RDP Summaries)

In Chart no. 4 can be seen that other member states of the EU estimated that, under Measure 11, it will be supported less organic farmland zone than was actually applied for and in-conversion in 2014 (Romania, Spain Austria, UK Portugal, Czech Republic, France and Sweden) (see Chart 4).

Chart 4. EARDF projected organic farmland area under Measure 11 (2014 2020) compared to the total organic farmland area in 2014; comparison by Member State.



Source: Stolze et al., 2016, p. 17.

Table no. 3 reveals that a 4% to 9% increase of organic farmland area under measure 11 was registered for Denmark, Germany and Poland, while Cyprus, Belgium, Greece, Croatia, Finland, Italy, Luxemburg, Ireland, Slovenia and Malta exceeded with higher growth rates, although, in some cases, it is a progress registered from an already low level of development. (Stolze et al. 2016).

There is no constant strategy for all Member States to follow, henceforth, each one prioritises differently organic farming development, the result being stagnation or decline in some countries, while others consider it a priority. The EARDF area projections for Measure 11, on an EU perspective, indicate that it cannot be expected that the implementation of the new RDP to achieve a high organic area growth only by 2020. Yet, from what EARDF numbers suggest, we must highlight that the situation may vary for each Member State. Also, the projections for Measure 11 of EARDF provide only a basic idea of how much support for organic farming is planned under the RDPs. It means that it is not a certain figure, only an approximation. Each Member State has the opportunity to change their RDP budgets during the period of the programme, however, the change does not need only to be desired, but also justified.

Moreover, Willer et al. (2020) sustain that the accurate reality in each Member States it is not shown by the data, due to the following:

1. "organic farming may be supported by national funding sources and not through EU co-financing under the RDPs (i.e. Netherlands);

2. organic land that is in conversion is not provided with EARDF support. If this were the case, the farmland area projection (Table 3) includes only the converted area under the EARDF support, not the farmland area in-conversion. Furthermore, the actual farmland that is organically managed area would be higher than the one indicated (i.e. Austria and Estonia);

3. both previous and current RDPs that may overlap in the organic farming support. Thus, an error would occur: a part of organic farmland might be supported within the framework of the previous RDPs while the other one could be supported under the new RDP;

4. some organic agricultural areas might not qualify for organic farming support."

Table 3. Comparison of EARDF projected organic farmland area under Measure 11 and the total organic farmland area in 2014 by Member State

Member state	EAFRD projected area			Organic Area 2014 (ha converted & in conversion	Difference area Measure 11 and organic area 2014	Share area Measure 11 of 2014 organic area
	Area Measure 11.1 (ha)	Area Measure 11.2 (ha)	Total Area Measure 11 (ha)			
Austria	0	456.000	456.000	525.521	-69.521	87%
Belgium	11.600	75.800	87.400	66.704	20.696	131%
Bulgaria	23.000	23.000	46.000	74.351	-28.351	62%
Cyprus	10.660	30.340	41.000	3.887	37.113	1.055%
Czech Republic	39.750	357.750	397.500	472.663	-75.163	84%
Germany	173.919	940.303	1.114.222	1.047.633	66.589	106%
Denmark	3.605	140.480	180.085	165.773	14.312	109%
Estonia	0	133.000	133.000	155.560	-22.560	85%
Spain	115.794	1.020.017	1.135.811	1.710.475	-574.664	66%
Finland	200	356.831	357.031	212.653	14.4378	168%
France	485.191	449.632	934.823	1.118.845	-184.022	84%
Greece	478.318	241.804	720.122	256.131	463.991	281%
Croatia	16.496	41.648	58.144	50.054	8.090	116%
Hungary	26.134	84.669	110.803	124.841	-14.038	89%
Ireland	16.000	46.880	62.880	51.871	11.009	121%
Italy	325.138	1.451.448	1.776.586	1.387.913	388.672	128%
Lithuania	25.000	110.000	135.000	164.390	-29.390	82%
Luxembourg	800	5.000	5.800	4.490	1.310	129%
Latvia	20.000	185.000	205.000	203.443	1.557	101%
Malta	45	13	58	34	24	173%
Netherlands*	0	0	0	49.159	-49.159	0%
Poland	138.000	543.000	681.000	657.902	23.098	104%
Portugal	2.045	85.290	105.335	212.346	-107.011	50%
Romania	136.550	89.400	225.950	289.252	-63.302	78%
Sweden	25.000	395.000	420.000	501.831	-81.831	84%
Slovenia	15.000	40.000	55.000	41.237	13.763	133%
Slovakia	15.000	135.340	150.340	180.307	-29.967	83%
UK	68.700	379.000	447.700	521.475	-73.775	86%
EU-28	2.225.945	7.816.645	1.004.2589	10.250.742	-208.153	98%

Source: Stolze et al., 2016, p.18.

The environmental benefits that come from organic farming practices are usually mentioned as justifications in support of organic farming by most of the RDPs. In many countries and regions, the application of the measure is associated to a regional or national organic production of crops action plan procedure (e.g. Croatia, Denmark, the French regions, or Bavaria and Baden-Wurttemberg in Germany). Some specific priorities are linked to organic farming support by some RDPs. For example, in Niedersachsen and Bremen regions from Germany, RDP acknowledges that it comes back to the increasing customer request for organic goods. In Bavaria region from Germany it is targeted in particular the transformation support to horticulture as response to the recognized market deficiency and customer request. In Madeira region, form Portugal, organic farming is thought-out as an asset because the tourists are very attracted to this type of sceneries. Most RDPs do not designate a distinct funding allocation norm for organic farming backing, except those defined in the rules. Regarding this they declare that some norms can be applied if it becomes critical due to abrupt budget cuts. A lot of areas have particular environmental first concerns for the distribution of favoured zones regarding organic farming support. Farms that are associated to Natura 2000 areas or farms within nitrate vulnerable areas, will probably receive support through some regional programmes in Spain or Italy. Italy has the National Action Programme to Combat Desertification and, regarding Lazio region, the areas that will probably receive financing are those defined in the action programme. In some countries and regions, specific sectors were decided to be funded regarding the organic farming. For example, "in Bavaria, Germany it is particularly targeted the conversion support to horticulture in response to identified market weakness and consumer demand. Organic bee keepings were explicitly financed by a few RDPs (e.g. Bulgaria and some regions from Spain). The proportion of the RDP total public budget allocated to M11 has a range from 22.2%, in Calabria region from Italy, down to 0.1%, in Madeira region from Portugal. 41 RDPs have assigned a proportion of their RDP budget to M11 that is above the EU average of 6.4% (of which 24 have allocated over 10% of their RDP budget). 66 RDPs have allocated a budget below the EU average. In Eastern Europe, all Member States except the Czech Republic have assigned a budget bulk below the EU average to the organic farming support quota." (ENRD 2020, RDP analysis)

4.2. The perspectives that European funds offer to the development of organic farming

In June 2018, a new proposal for the CAP was put in motion by the European Commission for the extend of time from 2021 to 2027. The new CAP is more flexible for each member state regarding the implementation of the policy objectives while presenting a New Delivery Model which is grounded on a results-based path. Organic farming contributes not only to obtaining sustainable food and strengthening the farming sector, but it also satisfies the citizens' preferences. However, the conversion to organic on an extended level is apart attainable if the CAP's strong desire for success is adjusted upwards, which means that it should grant more farmers to entrust and make the essential extra work. More farmers could contribute to the environment, climate, but also rural communities further than the year 2020, but only if the budget of the next CAP is balanced enough (IFOAM EU, 2018).

4.3. The main results of the use of European funds for organic farming in Romania in the period 2014-2020

The case study chosen exemplifies for Romania the way in which the funds allocated to measure 11 were used at the level of an EU member state, the information at the level of 2019 being provided by the Ministry of Agriculture and Rural Development (MADR).

The NRDP measures for 2014-2020 took into account several types of mechanisms to support operators: compensatory payments granted according to the surface, support for investments in farms, associations, producer groups and operational groups, support measures - training and knowledge acquisition, counselling, demonstration activities, information. Measure 11 - Organic farming supports active farmers registered in the organic farming system, both for the operations carried out for the conversion to organic farming (sub-measure 11.1) and for maintaining the certification in organic farming (sub-measure 11.2).

The support provided under these sub - measures shall be granted to active farmers, who shall voluntarily undertake to adopt or continue to apply the practices and methods specific to organic farming. Depending on the type of crop, the value of the support is between 78 and 620 Euro/ha/year (see Table 4). (NRDP 2014-2020).

Table 4. Situation of payments granted under Measure 11.

Compensatory payments cover additional costs and loss of income resulting from voluntary commitments for organic farming. The compensatory payments, calculated as standard costs for each of the 6 packages proposed for each sub-measure are:

Measure 11 - organic farming - packages	VALUE OF PAYMENT	
	Sub-measure 11.1 conversion	**Sub-measure 11.2 certificate**
Package 1 – agricultural crops on arable land (including fodder plants)	*293 €/ha/year*	*218 €/ha/year*
Package 2 – vegetables	*500 €/ha/year*	*431 €/ha/year*
Package 3 – orchards	*620 €/ha/year*	*442 €/ha/year*
Package 4 – vineyards	*530 €/ha/year*	*479 €/ha/year*
Package 5 – medicinal and aromatic plants	*365 €/ha/year*	*350 €/ha/year*
Package 6 – permanent meadows	-	-
variant 6.1 - applicable at national level on areas without commitment M.10)	*143 €/ha/year*	*129 €/ha/year*
variant 6.2 (applicable in eligible areas and only together with an M.10 commitment)	*39 €/ha/year*	*73 €/ha/year*

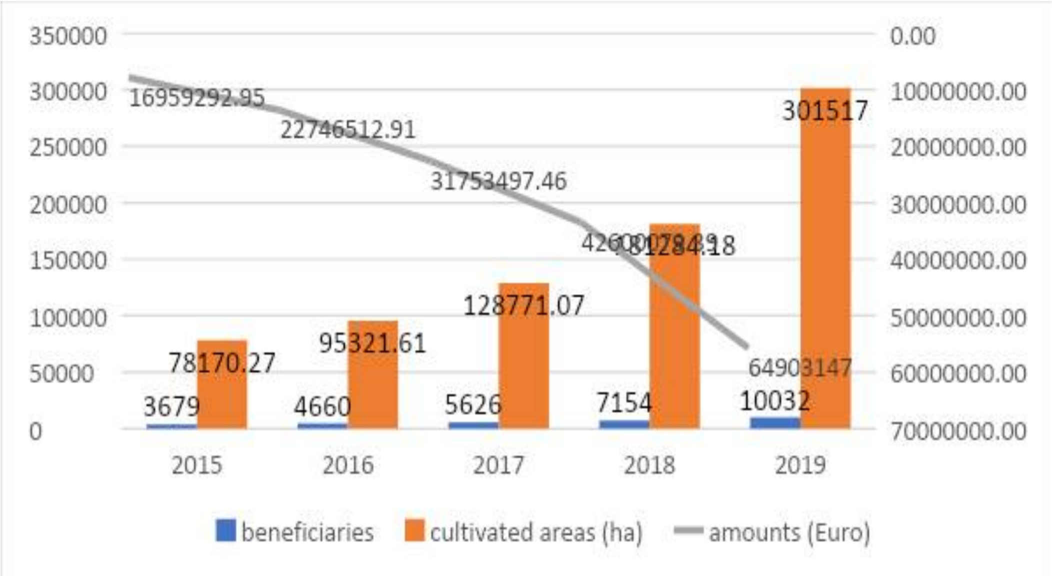
Payments granted under Measure 11 may be combined with other types of area payments: direct payments, payments granted under Measure 13 “Payments for areas facing natural or other specific constraints”. Package 1 of sub-measure may be combined with packages 4 and 5 of sub-measure 10.1 on agri-environment and climate, package 2 of sub-measure may be combined only with package 4 of sub-measure 10.1 on agri-environment and climate, and package 6 - variant 6.2 it can only be accessed together with packages 1, 2, 3.1, 3.2, 6, 9.2, 11.2 of sub-measure 10.1 on agri-environment and climate.

Source: own presentation based on National Rural Development Program for the period 2014 – 2020 (NRDP).

According to the information provided by MADR, the payments under the multiannual commitments requested by the organic farming operators during the 2014-2020 programming period are covered by the financial allocation of M.11 of 246.91 million Euros. Thus, at the end of 2019, 72% of the allocated funds were contracted with a higher share on Sub-Measure 11.1, in which almost the entire allocation was spent.

The infusion of European funds in organic farming in Romania did not only mean spending almost 200 million Euros, but also translated into supporting three times the number of farmers in 4 years and increasing the areas under conversion or maintaining organic farming practices 4 times higher.

Chart 5. Dynamics of beneficiaries supported by M.11, cultivated areas and amounts paid in Romania.



Source: Own calculation based on information obtain from the Ministry of Agriculture and Rural Development in Romania (2020).

5. Conclusion

The analysis presented in this chapter shows that the CAP reform, the implementation of which started in 2015, had an important role in the development of organic agriculture. The most important aspect was the individualization of Measure 11 within the National Rural Development Programmes (RDP's) 2014-2020 with funds dedicated to this sector for maintaining organically cultivated areas or for their conversion to cultivation by organic techniques, financial support from EARDF being one of the factors contributing to the development of organic farming in EU Member States. By investing a significant amount at EU level in the EARDF for organic farming, the expected results are an increase in the number of farmers in this sector and an increase in organically grown or converted areas. These two indicators could create the preconditions for increasing organic production, so that the quantity and quality of organic products in the EU meet the demand from consumers of organic products. An EU market that meets the requirements of the Member States' citizens would not only reduce imports of organic products into the EU, but would help increase incomes and create jobs in a sector such as agriculture that is acutely facing this problem.

The analysis in this chapter shows that the significance that Member States ascribe to organic farming and the magnitude of their national organic branch do not form an identifiable pattern. Member States also differ from each other because of the different rates of payment, due to fee distinction by land-use kind, economic supposition that do not meet the reality and payment loss due to costs and income of some components. Organic farming, along with the policy environment for development and the payment rates, is determined by which Member States prioritise organic farming and choose a fitting budget for both constraints and allocations.

Nevertheless, it is important to acknowledge that the EARDF numbers suggested might be different from the actual situation in Member States. The numbers shown for Measure 11 only provide a basic plan of how much organic farming is supported under the RDPs. The EARDF numbers are only an indication, not facts. The RDP budged of each Member State can be modified during the programming period, but only if it is justified. Furthermore, the reality of each Member State may not be contained in the data shown above. Both land use and the crop type influence the organic farmland area payments. Additionally, other criteria may influence the payment levels in many countries. Possible criteria may be the land use intensity, as some countries actually base payment level on it. Even though this chapter focuses on organic farmland area payments, it is worth mentioning that the major factor of the organic sector in the EU is public support for organic farming. The development of organic farming is due to different support measures, such as national and regional organic action plans, but also farmland area support payments. Public support is only effective if it is both embedded and supported by an industry that is completely functioning, which gained a public that regards organic methods as positive, henceforth creating a higher demand for organic products, a trustworthy environment and reliable policy. The development of the organic sector depends on the organic farmland zone payments, but as well on unlike public aid methods, some of them including conversation support, training, education and marketing support. In consequence, the organic farming policies that were developed with a one-range focal point on farmland zone support a way that not only contains require-oriented measures, but also informative policy means (i.e. knowledge, capacity building, study, instruction, training).

It is expected that the rural development framework planned for 2014-2020 will help develop organic farming, but also will showcase the benefits it has for the EU climate goals and for the environment.

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Appendix A – Definitions of key terms

financial support - financial resources provided to make some project possible;

organic farming - can be defined as a system of management and agricultural production that combines a high level of biodiversity with environmental practices that preserve natural resources and has rigorous standards for animal welfare;

organic products - a product originating from organic production. Organic production means the use of production methods in accordance with this Regulation at all stages of production, preparation and distribution;

the CAP - is a partnership between agriculture and society, and between Europe and its farmers;

rural development - is the process of improving the quality of life and economic well-being of people living in rural areas, often relatively isolated and sparsely populated areas.

Ch. 3.3

THE IMPACT OF THE EUROPEAN FUNDS FINANCIAL SUPPORT ON THE ORGANIC PRODUCTION IN THE EU

OBJECTIVES:

- Students will enrich their knowledge regarding the management of European funds and the implementation of the Common Agricultural Policy;
- Students will understand the mechanism for financing organic farming in the European Union and the stage of use of funds;
- Students will acquire the ability to analyse and synthesize information on the evolution of organically grown agricultural areas, the number of farmers in this sector and the demand for organic products from the market;
- Students will understand how to aggregate and report data on the organic farming sector.

SKILLS:

- Analysis regarding different issues;
- Question the arguments;
- Management of information.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

<u>What is the total organic area represented by?</u>

- ☐ The certified area, along with the area under conversion.
- ☐ The certified area.
- ☐ The under-conversion area only.
- ☐ The conventional farming.

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

How much does the land used for organic farming area represent from the total utilised agricultural area in the EU-28 (2018)?

- ☐ 27.5 %
- ☐ 7.5 %
- ☐ 17.5 %
- ☐ 7.5 %

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

During the period 2009-2018 the organic market in the EU

- ☐ only decreased;
- ☐ not only doubled in size, but even exceeded it;
- ☐ increased with 50%;
- ☐ increased with 10%;

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

The total contributes to organic farming payments (Measure 11) for the period 2014–2020 is:

- ☐ €20.3 billion, which represents 20.5% of the total budget for EU RDPs (€99 billion).
- ☐ €6.3 billion, which represents 6.4% of the total budget for EU RDPs (€99 billion).
- ☐ €8.3 billion, which represents 8.4% of the total budget for EU RDPs (€99 billion)
- ☐ €50.3 billion, which represents 50.8% of the total budget for EU RDPs (€99 billion).

QUESTION 5 (PLEASE WRITE THE CORRECT ANSWER WITHIN THE BOX)

Please describe which are the expectations of the European Commission concerning the evolution of the organic area and the demand for organic food by 2030.

PRACTICAL APPLICATION

Please, discuss with your peers and describe, in your own words, the charts no. 3, 4 and 5 and the tabel no. 3 from the chapter no. 4.

3.4. Organic farming and sustainable development of rural areas: A case study of Serbia

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Abstract: Organic farming is an integrated, environmentally sound, safe and economically sustainable agriculture production system and since the mid-1980s has it become the focus of significant attention from policy-makers, consumers, environmentalists and farmers. The aim of the paper is to present current state of organic farming development in global and EU market, and also ways how does organic farming contribute to sustainable development of rural areas. The case study has given an overview of the state of organic farming development in Serbia and its impact on Serbian sustainable development. Organic farming in Serbia has a potential to provide positive externalities not only on environmental protection, but also in economic and social aspects, contributing to rural employment and helping sustainability of small farms. However, there are number of major hurdles and problems in this sector needed to be overcome. One major impediment is financial constraint at all levels of the value chain, another is poor organization of players along this chain, and the third one is low efficiency of production, processing, and marketing. Only by overcoming these constraints organic agriculture can contribute to the sustainable development of rural areas in Serbia.

Keywords: organic farming, sustainable development, rural development, Serbia.

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1. Introduction

The term “sustainability” is derived from the Latin sus tenere, meaning “to hold”. It was first used in the field of ecology determining the ability of an eco-system to maintain a certain population over time. Later, the addition of the “development” context and formation of the expression “sustainable development” shifted the focus of this term from the environment to society. Today, the concept of “sustainable development” represents society and its need to include the environmental protection in the consideration of social changes, primarily through the changes related to economic functions (Baker & Mehmood 2015).

The first United Nations Conference on the Human Environment in Stockholm in 1972 recognized “the importance of using the environmental assessment as a management tool“. This was a huge step forward in the evolution of the sustainable development concept. Although the relationship between the issues of ecology and development was not strong at the time, there were some indications that the previous manner of economic development had to be altered. The second United Nations Conference on Environment and Development held in Rio de Janeiro in 1992 adopted a declaration which institutionalized the concept of sustainable development.

There is no unique and generally accepted definition of this concept, so it is often a subject of debate. In 1996, the United Nations published the "Human Development Report" which defines the sustainable development as "the integral economic, technical, social and cultural development adjusted to the requirements of the environmental protection and improvement and enabling the current and future generations to satisfy their needs and improve the quality of life" (Roljević et al. 2009a). Therefore, sustainable development does not essentially intend to limit but to direct human development towards reaching better and more favourable conditions for the long-term preservation of all necessary resources.

The invitation to change the production based exclusively on quantity and maximum exploitation of natural resources was the only manner to direct the actions towards the protection, preservation and sustainability of the environment (Roljević et al. 2009b). Various ecologically acceptable models of food production have been developed in the previous decades in order to alleviate the negative impact of agricultural production on the environment. During the 1980s, a successful form of agriculture with the aim of sustainable development of primarily rural areas appeared. It was the concept of organic food production. This production created the most favourable correlation between the dominant ecological principles and ecological demands.

According to FAO/WHO, organic agriculture represents a complete production and management system which preserves and promotes health of natural resources and ecosystem. In addition, firm standards followed by certification and control, as well as strong international support, represent the positive tendencies in the environmental protection.

According to the Council Regulation (EC) 834/2007, organic production plays a dual societal role – "on the one hand it provides for a specific market responding to consumer demand for organic products, while on the other hand it delivers public goods contributing to the environmental protection and animal welfare, as well as to the rural development".

Some research on organic production (Lobley et al. 2005, 15-16; Mzoughi 2011, 1536) indicates that farmer's commitment to organic farming far more depends of social, moral, and ecological elements, life philosophies and people's ideals, instead of economic concerns.

For the purposes of this research we used secondary data of the state of organic agriculture at the global and national level of the Republic of Serbia, and a desk method of research. As a source of data on organic agriculture worldwide we used the base of Research Institute of Organic Agriculture FiBL, respectively the Statistics.FiBL.org website. On the other hand, the Farm Structure Survey (FSS, 2018), provided by the Statistical Office of the Republic of Serbia, was used to show the basic characteristics of agricultural holdings in Serbia, while to assess to the state of organic agriculture in Serbia we used the base of Directorate for National Reference Laboratories (Group for organic production), which is part of the Ministry for Agriculture, Forestry and Water Management. The collected data were processed by descriptive statistics methods, and the obtained results are presented in tables and graphs.

The goals of the paper are analysis of the current state of organic farming development in global and EU market and presentation about how organic farming contributes to the sustainable development of rural areas. Also, through an overview of the state of organic farming development in Serbia, authors evaluate key potentials and problems in the sector and how this farming can contributes to the sustainable development of rural areas in Serbia.

2. Organic farming and sustainable development of rural areas

Since the greatest share of natural resources is in rural areas, the expansion of ecological systems of food production considerably contributes to the revitalization of villages and stimulates rural development.

The contribution of organic agriculture to the overall sustainable rural development is reflected in the promotion of the rural area diversity, preserving and protection the environment while producing quality and safe food, labor market development, and human capital development (Pugliese 2001, 124-125; Lobley et al. 2005, 15-16; Kilcher 2007, 32; Roljević et al. 2017, 324). Local food markets represent the centre of the organic sector development, which indicates the inclination of consumers to shorter supply chains and emphasizes the significance of small and medium-sized businesses in terms of food procession and distribution. More intensive marketing practices related to local products increases the local employment, growth of processing, market growth and farm diversification (Poláková et al. 2013).

Organic farming is a driving force for rural development, especially in marginalized areas, as it enables economic development, attracting financial resources, diversifying activities and social cohesion. Also, owing to the application of appropriate production standards and new agro-technological knowledge, organic farming favours young people in the local areas, thus decreasing brain drain and promoting the development of the human capital in rural areas.

2.1. Organic farming contributes to the environmental protection

Organic agriculture represents a complete system of managing farms, involving the application of the best practices which protect the environment, preserve soil and biodiversity, as well as the application of animal welfare standards (Roljević et al. 2009b). Organic agriculture can be successfully related to the concept of sustainable development which focuses on the biodiversity preservation. Biodiversity protection in the organic farming system implies the use and preservation of the genetic potential of indigenous species or old varieties, races and local populations, which are invaluable for each area. Old types and varieties of crops adapted to local agro-ecological conditions and are less susceptible to the influence of stress factors, which significantly contributes to the stability of the yield (Roljević & Grujić 2013).

Organic agriculture contributes to the preservation of soil as a key resource for food production. Research has shown that soil bulk density is lower in organic production, while soil porosity is higher in comparison with the soil in the conventional system of crop cultivation (Araújo et al. 2009). Namely, the introduction of crop residues and different types of organic fertilizers improves the soil characteristics and increases its fertility, thus alleviating erosion.

In addition, the crop cultivation system has an impact on the diversity of living organisms in the soil, particularly microorganisms. Years-long experiments comparing organic and conventional cultivation of different crops have shown that diversity, activity and biomass of microorganisms are higher in organic farming than in conventional farming (Grantina et al. 2011). A larger number and diversity of microorganisms in the organic cultivation system is a result of more shallow soil tillage, introduction of a higher level of organic matter and lack of mineral fertilizers than in conventional farming (Diepeningen et al. 2006).

The methods used in organic farming, such as more intensive crop rotation, introduction of polycultures, cover cropping and others, do not have a negative impact on the environment. On the contrary, they contribute to its preservation and improvement of agro biodiversity (Roljević & Grujić 2013). Alongside soil tillage and fertilizer change, crop rotation represents the most important agro technical measure in agriculture. Crop rotation represents changing of plant species in space and time, i.e. planned growing of different crops on the same plot over time. The introduction of a larger number of species in crop rotation, i.e. the increase in biodiversity on the arable land, enables creating the communities similar to natural ones and the interactions existing in such communities. Considering the environmental protection, crop rotation has a positive impact on soil structure, its moisture, air and temperature regimes, the balance of organic and mineral matter, as well as on the living organisms and their activities in the soil. From the economic point of view, crop rotation makes production more stable in the market, since it ensures the availability of a larger number of crops; if one fails, the next crop can have a good yield.

Introducing ***intercrops*** on the production areas leads to the improvement of crop rotation. An intercrop is a crop which is cultivated alongside the main crop in the inter-row spacing, and it can be successfully applied in the production of fruit, field and vegetable crops (for example, sowing maize and beans, summer barley and red clover, oat and vetch, maize and pumpkin, etc.). Intercropping leads to a more rational use of arable land, decreases the requirements of fertilizer addition and crop protection, maintains the soil moisture and improves its physical, chemical and biological characteristics.

Cultivation of ***stubble crops*** in field and vegetable farming can affect the general soil productivity with much lower investment. Cultivation of stubble crops most frequently requires only shallow soil tillage, which decreases work and energy consumption. Sowing stubble crops enables a more complete usage of the available farming resources, maintains soil fertility and decreases the need for agro technic measures for protection from weeds, diseases and pests.

One of the measures to establish balance in agro-ecosystems is to increase the diversity of cultivated plants. This can be obtained by cultivating ***polycultures, i.e. intercropping***. Intercropping represents the cultivation of two or more crops at the same time and place. Polycultures enable optimal use of available soil resources and its protection from erosion processes, improvement of physical-chemical and biological properties of soil, increase of agro-biodiversity, alleviation of damages caused by weeds, diseases and pests and creation of socio-ecological advantages (diverse nutrition, stable production, secure income).

Cover crops represent a bioagritechnical measure and a typical example of introducing useful interrelations into the agro-ecosystem. Cultivating cover crops decreases the need for additional introduction of nutritive matter in the soil and instruments for crop protection. It also reduces the use of mechanization. These are the crop cultivars cultivated as pure crops or as a combination of several cultivated crops, with the aim of protecting the soil from the influence of agrometeorological factors, as well as from weeds.

The application of the mentioned and numerous other agri-environmental measures in organic farming enables the conservation of agro biodiversity and genetic resources, as well as the stimulation of natural processes and relationships in ecosystems (Roljević et al. 2014).

2.2. Economic and social impacts of organic farming

There are numerous and significant links between organic farming and socio-economic aspects of rural development (Table 1), but in the following text authors will analyse only aspects of organic farming to employment and generating of values in the rural economy.

Features of Rural Development	Farm Aspects and Examples
Employment	Employment of the farm family Other employees in the farm business Employment created off the farm
Generating and retaining value in the rural economy	High value products; On-farm processing; On-farm retailing; Co-operative processing/selling Diversification
Skills, knowledge and networks	Fostering of innovation; Specific product knowledge; New networks; Human capital
Community	Solidarity; Social capital; Social networks; Vibrant community life;
Environmental goods	A high quality farm environment; Aesthetic aspects of landscape

Table 1. Possible connections between characteristics of rural development and organic farming.

Source: Lobley et al. 2005, page 36.

Organic farming stimulates employment. Organic farming has a positive impact on employment in rural communities, but this issue is certainly complex and depends on many factors, such as farm size, size of organic production, degree of farmers' diversification, development of rural communities, development of the organic market products, etc. (Lobley et al. 2005, 40; Offermann & Nieberg 2000, 18-19). Additional employment in agriculture, as a result of the expansion of organic production, very often is linked to the part-time work, additional or seasonal work, which does not imply job security and sustainable rural employment, and also farms in organic farming, as well as other conventional farms, tend to increase the efficiency, and by applying modern mechanization and technology, these farms tend to reduce the amount of human labour required (Lobley et al. 2005, 22; Offermann & Nieberg 2000, 18).

How does organic farming generate value? It is important to distinguish between the two terms that are often used together, namely "processing" and "added value". "Processing" involves changing the shape of the product and transforming the raw material, while "adding value" involves adding to the product other values for which the consumer is willing to pay a higher price. Value-added products are advanced quality products, certified organic products, products with protected designation of origin, protected geographical indication, branded products, etc. (Roljević Nikolić & Paraušić, 2019; Alonso & Nortcote 2013; De Chernatony et al. 2000). Value-added projects can help farmers to stand out from the crowd, fill a specific demand and increase profits. But farmers has to note that not all products or practices are right for every farm, and farmers have to be sure that have the space, time, capital and commitment to add a specific value-added product or activity to their daily workload. Investing in organic certification make contributes product recognition, but it must be implemented systematically and throughout the entire chain of production and sales. In this way, a more secure placement is achieved, making it easier for consumers to make choices, shorten purchase time and provide greater assurance in product quality. Organic farms achieve greater sales values for their products, and the source of higher revenues is the purchasing power of upper-middle class consumers who are willing to pay a premium for organic foods (Mansury & Hara 2007, 220). Box 1 shows an example of successful organic farm in England, and their market routes.

Box1. Whiteholme Farm in England

"Whiteholme Farm is situated on the River Lyne in the North East of Cumbria (England) and is a remote upland organic livestock farm run by Jon and Lynne Perkin. As a Soil Association registered organic holding the Perkins produce beef, lamb and pork from rare breeds that are particularly suited to the upland environment of the farm, processed products such as sausages, and they also offer accommodation at the farm. There are a number of routes through which the produce of Whiteholme Farm reaches its customers. The first is the meat box scheme that the Perkins run, which parallels the more familiar vege-box scheme, except that rather than weekly deliveries, members can order to suit their needs and support the farm through regular payments. The benefit for the scheme members is priority of supply and a lower price than they otherwise might pay. Secondly, Whiteholme farm also sells its meat through farmers' and council markets in the area. Finally, there is the facility to order meat boxes through the Farm's website. Whiteholme offers an example of the integration of high quality food production, with environmental protection and outreach to a wide group of people who can become involved in food and farming in a new way."

(Source: Lobley et al. 2005, 109-110)

Is organic farming more profitable than conventional farming? Organic farming has to be profitable to generate higher and new value in rural economy and contribute higher employment and overall development of local rural communities. See box 2.

Box 2. Organic farming in UK: financial motivations

"The organic farming sector in the UK has undergone a period of rapid expansion in the 1990s, followed by growing uncertainty regarding prices, markets and its future. There has been a significant outflow of farmers from organic farming from 2000 onwards, especially amongst smaller farmers. From the interviews with those leaving the sector authors discerned that economic reasons have been paramount; these have been compounded in some cases by difficulties associated with the certification process. Financial motivations to enter organic production were the most prevalent amongst the respondents, and indeed it was the failure of the farm businesses to achieve a sustainable financial position through organic production that was the principal reason why the majority of respondents left organic certification. The key financial issues were being unable to find a market for their organic produce and not being able to find price premiums sufficient to make the organic system viable".

(Source: Harris et al. 2016, 109-110)

Although many studies show that organic farming can be as profitable as conventional, the success of each individual organic farm depends on many factors in micro and macroeconomic farm environment, as well as on numerous factors of natural, historical and cultural heritage of rural communities (Klonsky & Livingston 1994; Offermann & Nieberg 2000; Nieberg & Offermann 2003; Nemes 2009). However, in general, it can be pointed out that the profitability of organic farms depends on measures in agricultural and rural development policies, high market prices of organic food, consumer demand in the organic food market and their willingness to pay more for such food.

3. State of organic farming development in global and EU market

Although conventional farming represents the key basis of the agro-industrial sector, organic farming is increasingly becoming its significant part. According to FiBL Statistics, in 2018 globally organic production encompasses the total of 71.5 million hectares, which represents 1.5% of the global agricultural land, with the tendency of constant growth of this share (Table 2).

The global number of organic producers amounts to around 2.8 million (Table 2). Although Oceania has 50% of organic farmland, the lowest number of organic producers and processors are found in this region (Table 2). On the other hand, the largest number of organic producers (75%) was recorded in the regions of Asia and Africa.

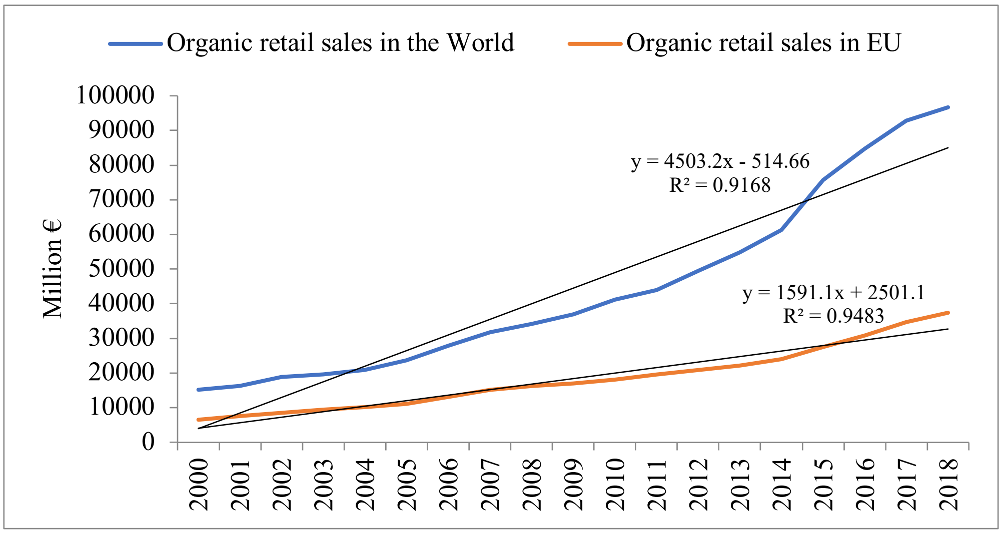
Table 2. Key indicators of organic agriculture worldwide, 2018.

Regions	Organic area, ha	Organic area, % of total farmland	Organic producers, number	Organic processors, number	Organic retail sales (million €)
Africa	1,984,132	0.2	788,858	1,693	17.1
Asia	6,537,226	0.4	1,317,023	12,787	10,070.6
Europe	15,635,505	3.1	418,610	75,569	40,729.3
EU28	13,790,384	7.7	327,222	71,960	37,412.2
Latin America	8,008,581	1.1	227,608	1,540	809.7
Northern America	3,335,002	0.8	23,957	1,720	43,677.4
Oceania	35,999,373	8.6	20,859	2,492	1,378.4
World	71,494,739	1.5	2,796,404	95,732	96,682.6

Source: FiBL Statistics. The Statistics.FiBL.org website https://statistics.fibl.org/world.html.

According to FiBL Statistics, globally organic retail sales is growing significantly and reached a value of € 96,682 million in 2018, which is six times more than in 2000 (€ 15.156 million) (Graph 1, Table 2). The United States (41.2%) and the EU (38.7%) account for the largest share of the organic retail sales in 2018, accounting for almost 80% of the global market. At EU level, in 2018 countries with the largest organic food market were Germany (€10,910 million), France (€9,139 million) and Italy (€3,483 million) (FiBL Statistics). The other regions witness high prices of organic products, limited availability, inadequate quality, scepticism, and lack of understanding of organic product values, which makes consumers unable to buy organic products and limits the growth of the organic product market.

Graph 1. Organic retail sales (million €) in the world and EU, 2000-2018.



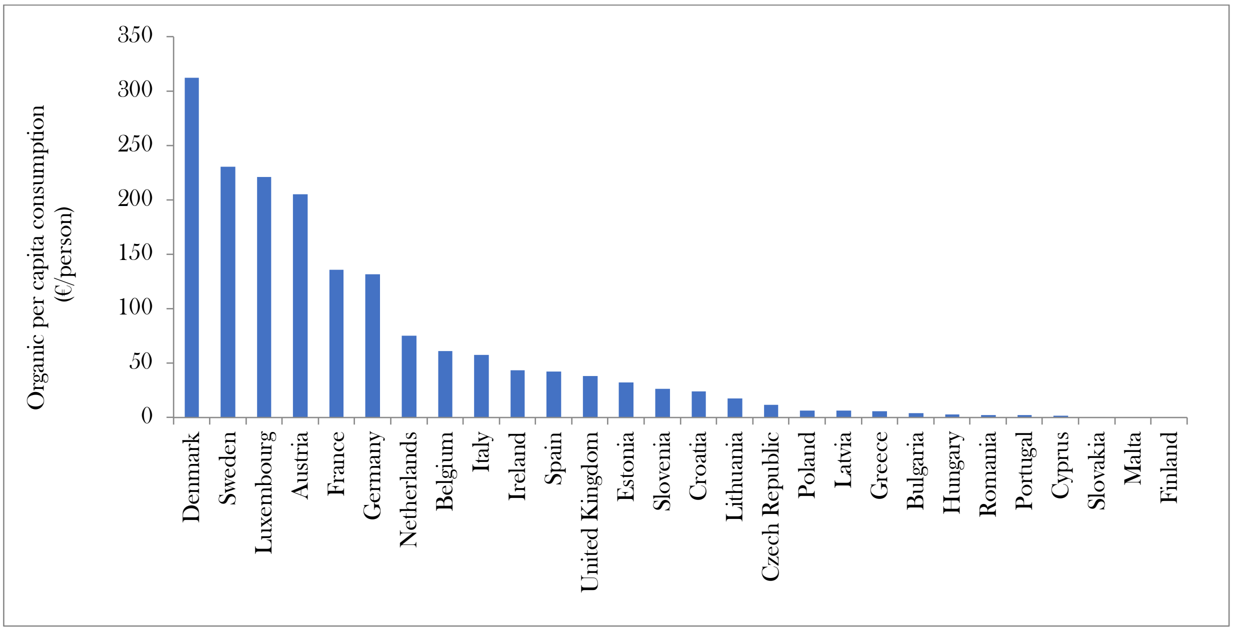
Source: FiBL Statistics. The Statistics.FiBL.org website https://statistics.fibl.org/world.html.

Consumers' awareness of healthy nutrition and environmental protection, the high standards, application of new agro-technological knowledge and availability of technical and technological resources have all led to the fact that the highest concentration of operators in the processing sector is in the region of Europe (Table 2). The EU countries include as much as 95% of organic processors recorded in the area of Europe (Table 2).

The organic market is gradually developed from a niche market to the mainstream and global agricultural market (Hamzaoui-Essoussi & Zahaf 2012). Statistical data show that the demand level does not represent an obstacle in the development of the organic food market, although there are significant regional differences. The demand for organic products is mostly based on the consumers' perception that organic agriculture is sustainable and that it contributes to the protection of the environment, biodiversity, animal welfare, as well as the improvement of quality and health safety of food products when compared to the intensive conventional farming (Baranski et al. 2017). Some studies have indicated the positive impact of organic food on human health. It has been determined that people who regularly consume organic food have a considerably lower risk of being overweight (Kesse-Guyot et al. 2013), and that the consumption of organic dairy products is correlated with the lower eczema risk in children until the age of two (Kummeling et al. 2008).

Regarding the average per capita consumption, the inhabitants of Denmark spent most on organic food in 2018 (312 €/person), followed by Sweden (230.7 €/person), Luxembourg (221.0 €/person) and Austria (205.2 €/person). The inhabitants of France and Germany spent more than 100 €/person. From 50 to 100 €/person was spent by people in Norway, the Netherlands, Belgium and Italy, while in the remaining countries 50 €/person was allocated for organic products (Graph 2).

Graph 2. Organic per capita consumption (€/person) in EU28, 2018.



Source: FiBL Statistics. The Statistics.FiBL.org website, https://statistics.fibl.org/europe/retail-sales- europe.html.

Although Spain is among the four countries with the largest organic farming area, a large share of the products is exported. Therefore, the per capita consumption in this country is lower than in some other EU countries and it amounts to €42.2.

4. Organic farming in Serbia: an experience and practice

4.1. Serbia: basic facts and figures

Serbia is situated in central Balkans, with population of round 7 million people. The country has a long tradition in agricultural production, the necessary knowledge of agricultural producers and support institutions, favorable natural resources, which all provide great opportunities for sector's restructuring in the direction of its profitability and sustainability (Roljevic et al. 2017).

Agriculture is an important sector of economy. According to SORS database (The Statistical Office of the Republic of Serbia, database), agriculture accounting for 6.3% of GVA (Gross value added, 2018), 15.4% of total employment (Labor force survey, 2018) and 17% of export value (2019, including food products and beverages).

On the other hands, the biggest constraints for Serbia's agriculture are: current farm structure, low productivity, low level of technological progress and knowledge, low investment and high market uncertainty. First census of agriculture in Serbia, based on EU methodology, was realized in 2012, and statistical data showed that Serbia's agriculture is dominated by mixed and small farms in terms of their physical size (5.4 ha UAA/farm), and economic size (5,939 EUR/farm) (SORS database). Farm structure survey was implemented in 2018 by SORS, and the new data also confirm previous (Table 3).

In 2018, small farms with less than 5 ha of UAA make 71.7% of total farm number, and they farmed 23.2% of total UAA. On the other side, there are only 0.25% of large farms (with more than

100 ha of UAA) but they farmed almost same area of UAA, precisely 20.2% of total UAA (Farm Structure Survey, 2018).

Table 3. Basic characteristics of agricultural holdings in Serbia, FSS, 2018

Characteristic	Number/Value/ha/%
Total number of farms	564,541
Average economic size of farm (in SO, EUR)	8,610
Average physical size of farm (UAA, ha)	6.2
Farm with less than 5 ha of UAA, % of total number	71.7
Farm with more than 100 ha of UAA, % of total number	0.3
Specialized farms, % of total number	46.8

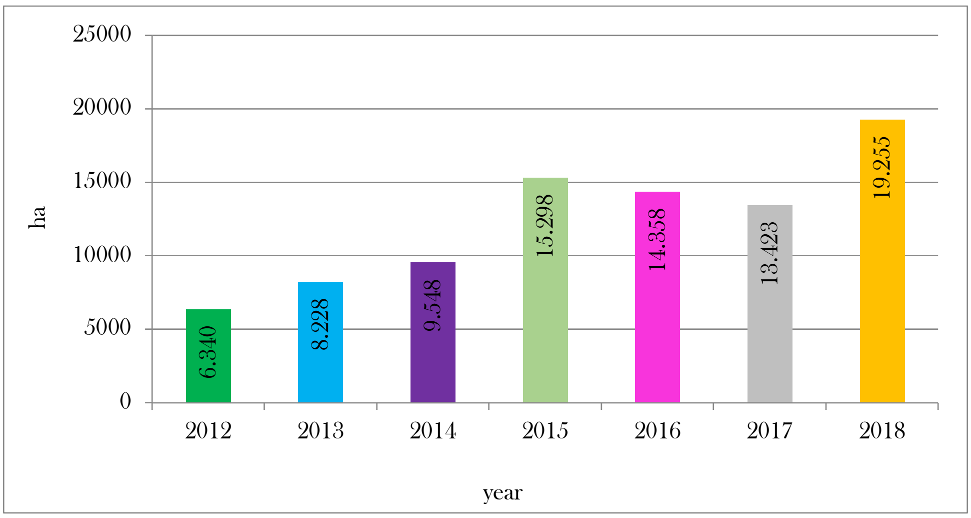
Source: Farm Structure Survey, 2018, SORS database.

4.2. Current state of organic farming development in Serbia

Law on organic production (Official Gazette RS, No. 30/10), adopted in 2010, provided the institutional framework and conditions for the operation and development of the organic farming sector in Serbia. The competent authority for organic farming is the Directorate for National Reference Laboratories (Group for organic production) which is part of the Ministry for Agriculture, Forestry and Water Management. It is obliged to keep comprehensive records on organic production, establish and maintain an efficient control system, verify organic farming methods and rules of processing in organic farming, provide expert support for making regulations and perform other jobs in the field. Also, national association "Serbia Organica" has gathered participants in organic sector and systematically improves this sector by numerous activities.

The organic farming area in Serbia covers 19,254.6 ha (Graph. 3) or 0.6% of total UAA, which is low compared to the EU, where the area under organic farming takes 7.5% of total UAA (2018). However, area under organic farming in Serbia has a continuous and hight growth (more than three times in the period 2012-2018).

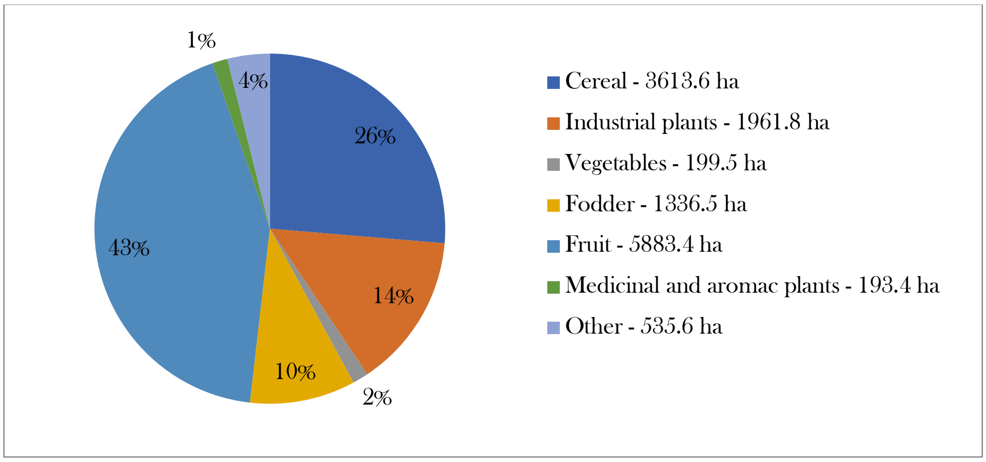
Graph 3. Area under organic farming in Serbia (ha), 2012-2018.



Source: Directorate for National Reference Laboratories, Group for organic production, Republic of Serbia Ministry of Agriculture, Forestry and Water Management, http://www.dnrl.minpolj.gov.rs/en/o_nama/organska/organska.html.

In 2018, ***fruit organic production*** has the largest share in total arable land (43%), followed by the production of ***cereals*** (26%) and ***industrial crops*** (14%) (Graph 4).

Graph 4. Organic plant producon in Serbia, arable land, 2018.



Source: Directorate for National Reference Laboratories, Group for organic production, Republic of Serbia Ministry of Agriculture, Forestry and Water Management, http://www.dnrl.minpolj.gov.rs/en/o_nama/organska/organska.html.

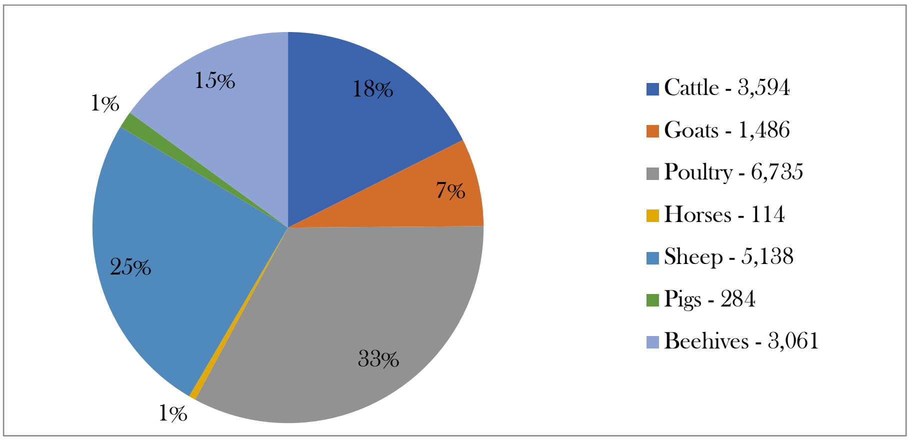
Considering the cereal production, in 2018 the most significant share of areas are the ones growing ***wheat*** (41.39%), while in the sector of industrial crop production it is the production of ***sunflowers*** (50.1%) (Directorate for National Reference Laboratories, Group for organic production).

As many as 49 vegetable cultivars are grown on the organic land, which indicates the favourable position of Serbia for growing a large number of cultivars, even without the intensive production and crop protection systems. When it comes to the organic production of vegetables, the cultivation of pumpkin is dominant, occupying 27.3% of the total area.

The areas with raspberry account for 40.5% of the areas growing organic fruit. In addition to raspberry, there is a significant production of organic apples (24.5%) and plums (14.6%).

Organic livestock production accounts for the largest number of poultry (33%), followed by sheep (25%) and cattle (18%) (Graph 5).

Graph 5. Organic animal producton in Serbia, 2018.



Source: Directorate for National Reference Laboratories, Group for organic production, Republic of Serbia Ministry of Agriculture, Forestry and Water Management, http://www.dnrl.minpolj.gov.rs/en/o_nama/organska/organska.html.

In order to obtain a clear image of a country's interest in organic farming, the dynamics of the growth of organic farming areas should be analyzed along with the changes in the number of subjects included in the organic farming sector (Roljević Nikolić et al. 2017). According to the unified register of the Directorate for National Reference Laboratories, Group for organic production, for the period 2013-2018 the number of organic producers increased from 259 to 500, i.e. by 93%. The largest number of producers are in the plant production sector (359), while a significantly smaller number dealt with cattle breeding (55) and beekeeping (12). The largest number of participants in the organic food supply chain in Serbia are physical persons (about 71%).

Value of organic product export from Serbia in 2018 amounted to € 27,419,347.7, which is 2.7 times higher than in 2013 (€ 10.090.801,4). Serbia exports the largest share of organic products to the EU countries, i.e. to Germany (27%), the Netherlands (12%) and Austria (11%). Frozen raspberries account for 58% of the total organic product export in 2018, which indicates the strong potential of this fruit species in organic farming (Directorate for National Reference Laboratories, Group for organic production).

In Serbia, like in other countries, there are two sertificaton options:

- Single producer (certificate holder is a agricultural producers/farmers), and
- Group certification, where certificate holder is a company, usually export companies (Simić 2007, 18).
- According to the farm size and type of farming, organic farms are divided into three categories:
- Small family farms;
- Specialized farms, and
- Large companies that combine plant and animal production on bigger area, and often dealing with processing, which is the best bussines model (Ibidem, 18).

For the example of the third category of organic farm see Box 3 (An example of good practice "Global Seed" company, Vojvodina).

Box 3. An example of good practice "Global seed" company, Vojvodina

In Serbia today, organic agriculture mostly relies upon small farmers. It is still a rare thing to see larger agro-companies joining the "Green Revolution". That is why an example of a large agro-system accepting green agriculture as their general model is a significant one. Under the motto "a thousand cows on a thousand hectares" company "Global seed" from Čurug (Vojvodina) completes a full circle – they grow the crops needed for feeding the cows themselves, they have built a plant for organic feed, and organic dairy, a unique one in Serbia. Company's vision is "to become a regional leader in the production of organic milk, meat and organic cattle feed as the largest organic cow farm in Europe".

Source: Global seed company, Serbia, http://www.globalseed.info/en/about-us.php

The organic product market in Serbia is still insufficiently developed, with insufficiently purchasing power of consumers, although it has witnessed a significant growth in the last few years. This growth is a consequence of raising the awareness of not only consumers but also producers regarding the significance and advantages of organic production. Organic products are the most represented in large urban areas due to the higher users' purchasing power and the availabilty of information regarding the advantages of these products. A significant impact on the production growth and consumption of organic food in Serbia was enabled by the avaliability of organic products on the shelves of retail shops of large supermarket chains.

Ministry of Agriculture Forestry and Water Management guarantees for each product bearing symbol “Organic food" (Image 1) that it’s produced in line with organic farming principles.

Image 1. “Organic food” symbol on the packaging

Source: Serbia organica. The national association for development of organic production. website: https://serbiaorganica.info/

Today, several business associations, clusters and NGOs participate in Serbian organic sector (Simić 2017, 25). The most important national association is "Serbia organica", Belgrade, which is umbrella association. It was founded in 2009 as a non-governmental organization with the aim of developing the organic sector, supporting all participants and with the mission "to make organic farming stable and competitive on both the national and international markets" (Serbia organica. The national association for development of organic production, website https://serbiaorganica.info/).

4.3. Financial support for organic farming

Organic farms need financial support to raise production, productivity and competitiveness on the national, regional, and EU markets.

The systematic and structural reformation of the agricultural sector in the Republic of Serbia started after 2000. Since then, agricultural and rural policies have passed through several phases. The passing and adoption of the Law on Subsidies on Agriculture and Rural Development (“Official Gazette RS”, No. 10/2013, 142/2014, 103/2015 and 101/2016) enabled a systematic organization of the field of subsidies in agriculture and rural development, i.e. the regulation of the types of subsidies in agriculture and rural development, requirements for exercising the rights to subsidies and using the subsidies.

Table 4. Incentives in agriculture and rural development in Serbia, 2013, 2019 and 2020.

Support measures	2013	2019	2020	2020/2013 (%)
Direct payments	242,216,864.5	162,597,659.0	155,478,986.8	- 35.8
Rural development	10,491,100.4	40,202,291.3	51,556,834.5	391.4
Organic farming, amount	1,744,559.8	918,423.6	2,969,277.3	70.2
Organic farming, % in rural development measures	16.6	2.3	5.8	
Credit support	4,361,399.5	3,401,568.8	2,545,094.8	- 41.6
Special support	4,849,876.3	1,955,902.1	1,951,239.4	- 59.8
IPARD	-	51,648,570.3	33,374,677.0	-
Total	261,919,240.7	259,805,991.5	244,906,832.6	- 6.5

Source: Regulation on the allocation of subsidies in agriculture and rural development in 2013, 2019 and 2020; the exchange rate of euro formed on March 25, 2020, December 31 for the year of 2020, 2019 and 2013, according to the author’s calculations

In 2020, comparing with 2013, state incentives in organic sector are higher, but share of organic farming support in total rural development funds is less (Table 4).

The currently valid Rulebook on use of subsidies for organic crop production ("Official Gazette RS" Nos. 31/18 and 23/19 and 20/20) and Rulebook on the use of subsidies for organic livestock production ("Official Gazette RS" Nos. 41/2017, 3/2018, 31/18) provide the following types of incentives to farmers in Serbia:

- Subsidies for organic plant production are higher for 400% in comparison with the amount of the basic subsidies for plant production;
- Subsidies for organic cattle production are higher for 40% than the amount of the corresponding type of direct payments in cattle breeding;
- The right to the subsidies can be exercised by: a legal entity, an entrepreneur or a natural person – the owner of a commercial family agricultural holding fullfilling specific requirements related to dealing with organic production.

Additional support for agriculture and rural development is IPARD fund. These resources are gradually increasing, and the support for agro-ecological measures will have a significant share in them.

4.4. Current problem and challenges

In general, "the greatest constraints faced by poor farmers on the road to organic agriculture are lack of knowledge, access to markets, certification, agricultural inputs, and lack of organization" (Kilcher 2007, 48).

In Serbia "organic agriculture finds it hard to achieve a satisfactory level of growth despite great potential and steady growth of main parameters" (Simić 2017, 9), especially, seeing some attitudes that "organic sector itself is industrializing and globalizing at a rapid pace" (Guthman, 2014, 2).

Obstacles for organic sector development in Serbia are numerous (Simić 2017; Roljević et al. 2017; Djelić et al. 2019), and some of them are:

- lack of financial resources to start a business or increase investment at the all levels of the value chain;
- disorganization of participants in the value chain;
- insufficiently developed activities of sales, marketing, and processing;
- insufficiently purchasing power of consumers;
- low level of productivity;
- lack of effects of economies of scale and high production cost;
- high cost of certification;
- insufficient knowledge of the market, and
- incomplete market supply with seed and planting material, biological plant for protection products, organic fertilizers and compost, etc.

Also, there is also lack of resources required for work of associations and national NGOs. In general, there are numerous agriculture associations and clusters in Serbia, but they are all insufficiently developed and faced with many problems in their functioning, related to the sources and amount of financing, knowledge, management, etc. (Paraušić et al. 2017, 295; Paraušić 2018, 44; Paraušić & Domazet 2018, 1163; Simić 2017, 23).

Serbian government and donators intend to continue supporting of Serbian organic farming through the financial, institutional and educational support in production and processing on the level of farm, as well as on the level of associations and cooperatives (Simić 2017). At the same time, Serbian producers have to find opportunities to development organic sector in products like GMOfree soybeans, and sectors of fruits, vegetables, oilseeds and cereals (Ibidem, 56).

5. Conclusion

Since the greatest share of natural resources is in rural areas, the expansion of ecological systems of food production considerably contributes to the revitalization of villages and stimulates rural development. The contribution of organic agriculture to the overall sustainable rural development is reflected on several way: (1) in the promotion of the rural area diversity, preserving and protection the environment, while producing quality and safe food; (2) in labour market development (organic farming has a positive impact on employment in rural communities, but this issue is complex and depends on many factors); (3) in generating of values in the rural economy (certified organic products are also value-added products). Organic farming has to be profitable to generate higher and new value in rural economy and contribute higher employment and overall development of local rural communities. Although many studies show that organic farming can be as profitable as conventional, the success of each individual organic farm depends on many factors in micro and macroeconomic farm environment, as well as on numerous factors of natural, historical and cultural heritage of rural communities. However, in general, it can be pointed out that profitability of organic farms depends on measures in agricultural and rural development policies, market prices of organic food, consumer demand and their willingness to pay more for organic food.

In case of Serbia, the organic farming area is only 0.6% of total UAA (2018), which is low compared to the EU (7.5% of total UAA, 2018), but area under organic farming has a continuous and high growth. Fruit organic production has the largest share in total arable land (43%), followed by the production of cereals (26%) and industrial crops (14%).

Even though the organic product market in Serbia is still insufficiently developed, this is growing sector of the Serbian agriculture. A significant impact on the production growth and consumption of organic food in Serbia was enabled by the availability of organic products on the shelves of retail shops of large supermarket chains. Organic products are the most represented in large urban areas due to the higher users' purchasing power and the availability of information regarding the advantages of these products.

Obstacles for future organic sector development in Serbia are numerous, and some of them are: lack of financial resources to start a business or increase investment at the all levels of the value chain; disorganization of participants in the value chain; insufficiently developed activities of sales, marketing, and processing; low level of productivity; lack of effects of economies of scale and high cost of production; high cost of certification; incomplete market supply with seed and planting material, biological plant for protection products, organic fertilizers and compost, etc. Also, there is also lack of resources required for work of associations and national NGOs.

Serbian government and donators intend to continue supporting of Serbian organic farming through the financial, institutional and educational support in production and processing on the level of farm, as well as on the level of associations and cooperatives. At the same time, Serbian producers have to find opportunities to development organic sector in products like GMOfree soybeans, and sectors of fruits, vegetables, oilseeds and cereals.

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Appendix – Definitions of key terms

sustainable development – Modern society is already confronted with a responsibility to bring its development in line with the needs of humans and nature and with the awareness that the Earth must be preserved, for both the present generation and future generations. The obligation of today's generation to give offspring at least as much chance of development as it has, so that all people have equal rights to the broadest basic freedoms. The concept of sustainable development implies balanced economic, social and cultural development without endangering the environment. The Sustainable Development concept gained full recognition at the UN Conference on Environment and Development in Rio de Janeiro in 1992, where it was clearly emphasized that environmental protection must be an integral part of overall human development. Accordingly, every activity must, when planning and making decisions, take the utmost account of environmental requirements in order for its development to be sustainable.

rural development – The term of "rural development" means the integral and cross-sectoral development of rural areas, which in itself contains the connotation of "sustainable". First of all, it involves improving the quality of life in rural areas, primary by investing in overall infrastructure, and also the economic well-being of people living in those areas. An integrated and cross-sectoral approach of rural development is very important. With that being said, these areas face several problems, such as depopulation, population aging, landscape fossilization and generally deteriorating of almost all socio-economic indicators, which make rural areas passive and undesirable, especially for young people. Hence, the diversification of rural population activities outside of the primary agricultural production is a generally accepted model of sustainable socio-economic growth and development of rural areas. Having in mind that rural areas are significantly different in terms of natural, historical, economic and cultural heritage, it is necessary to develop local, regional and national rural development programs adapted to the needs and development goals of each area.

organic farming – The need for a healthier environment and the many negatives caused by conventional agriculture have led to alternative directions for agricultural development, among which are ecological systems such as organic farming. Organic agriculture combines the principles of ecology and agriculture and ensures the sustainability and efficiency of agroecosystems. It is based on ethical principles such as health, ecology, equity and care while effectively addressing environmental issues, all for the better quality of life of people and the development of a rural economy. According to FAO/WHO, organic agriculture represents a holistic production management system which enhances the ecosystem health, including biological cycles and soil biological activity. Organic agriculture relies on creating and maintaining the conditions which have a positive impact on the ecosystem health and encouraging natural processes instead of using artificial inputs.

organic market – It is a place where stakeholders, first of all, food retailers, farmers, and buyers (consumers), gather to exchange goods and services in sector of organic food production. The market also brings together numerous associations in the organic production and consumption, certification bodies, research and marketing organizations, suppliers of key inputs, technology and services, policymakers, etc. It can be in form of shops or markets in the physical sense, or online market in the virtual case. Also, it can be local, regional and global. The main characteristics of the market that are most often examined are: size or capacity of supply and demand, market prices, trends and growth rates of production and consumption, etc.

practices which protect the environment preserve biodiversity and natural resources – Organic agriculture significantly reduces the use of synthetic pesticides and fertilizers. In this way, it allows natural laws to spontaneously increase the yields and resistance of cultivated plants to diseases and pests, and as a final product healthy food is obtained. This type of production is based on the proper rotation of crops, soil fertility is increased by fertilizers of animal origin, legumes, fertilizers, waste materials from livestock production, mechanical processing, microbiological fertilizers, and crop protection against pest infestation, disease and severe weeds are dealt with by biological pesticides. All these components help to maintain the natural productivity of the soil and secure the supply of the plant with nutrients.

Ch. 3.4

ORGANIC FARMING AND SUSTAINABLE DEVELOPMENT OF RURAL AREAS: A CASE STUDY OF SERBIA

OBJECTIVES:
The purpose of this chapter is introducing students to all implications and impact of organic agriculture to sustainable development of rural communities.

SKILLS: Students have acquired knowledge in organic farming, sustainable rural development, and market challenges in organic sector on the level of Serbia, EU and world.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

How does organic agriculture contribute rural areas development?

- ☐ By using incentives designed for organic production
- ☐ By reducing consumption of fertilizers and pesticides
- ☐ By promoting the diversity of rural areas, diversifying activities, employing and developing of human capital in rural areas
- ☐ By introducing traditional knowledge and modern agro ecological research

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

How does organic farming contribute diversity in agro-ecosystems?

- ☐ By reducing the use of agrochemicals
- ☐ Growing crops on small areas
- ☐ By preserving and improving the quality of the land
- ☐ By using more species and old varieties adapted to the local ecosystem, as well as introducing agro-ecological measures in the production process

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

What does determinate economic viability of organic farms?

- ☐ Support payments only
- ☐ Consumer demand and market prices
- ☐ High yields
- ☐ Design of agricultural support, consumer demand and market prices and existence of an adequate marketing structure for organic products

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

What are constraints for organic farming development in poor countries?

- ☐ Because of the dominance of small farms, there is no ability to use advantage of the economy of scale effects
- ☐ Lack of knowledge, agricultural inputs and organization; access to markets; certification; financial constraint
- ☐ Unfavorable agro-ecological conditions
- ☐ Climate changes

QUESTION 5 (PLEASE CHECK THE CORRECT ANSWER)

To generate sustainable rural development organic farming has to be:

- ☐ Profitable (able to covers costs and gives the producer a favorable return that allows him a decent living standard)
- ☐ In a line with ecological principles of farming
- ☐ It must covered high percent of utilized agricultural area
- ☐ It must be export oriented

PRACTICAL APPLICATION OF THE PREVIOUS CHAPTER (E.G., SOLVE THE PROPER TASK OR WRITE THE SIMULATION OF CERTAIN SITUATION/DESCRIBE THE NOTICED PROBLEM, ETC.)

IS IT POSSIBLE TO DEVELOP THE ORGANIC PRODUCTION SECTOR AND INCREASE EMPLOYMENT IN RURAL COMMUNITIES ONLY BY HIGHER AGRICULTURAL INCENTIVES IN THE ORGANIC SECTOR?

FOURTH SECTION: Business and economic development

- Ways of supporting the development of agricultural organic production in EU
- Evaluation of economic efficiency of investments in organic production at the family farms

4.1. Ways of supporting the development of agricultural organic production in EU

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Abstract: Organic agriculture seems to be the most suitable approach to achieving sustainable food systems. Many efforts have been made at the European level, including development of principles and rules for organic production**,** certification and use of indications, legislative and financial support and even research and innovation programmes for knowledge development. The organic farming is an important topic for close collaboration between farmers and researchers with different knowledge and expertise, working together and exchanging innovative ideas. The main ways of supporting the organic agricultural production are presented at the EU level, by considering the financial support provided within the CAP regulatory framework and the knowledge base development provided by the implementation of the research and innovation programmes.

Keywords: organic agriculture, financing, CAP, greening payments, research, innovation.

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1. Introduction

Improvement of the EU's natural capital ensuring long term provision of natural resources and services is the key aim of the modern and prosperous society. Agriculture sector could be a healthy and environmentally friendly food provider in a sustainable future. The negative effects of the conventional agricultural production system on the environment have stimulated the demand for more sustainable production systems (Berentsen & van Asseldonk, 2016). Analyzing by unit area, organic farming has, in general, a smaller negative impact than conventional agriculture. (Tuomisto et al., 2012). One main challenge for future agroecological systems is thus to encourage the co-occurrence of multiple services both to agriculture and from agriculture (Chabert & Sarthou, 2020).

The comparative assessment of the organic and conventional agricultural production shown that average yields are lower in the ecological system by 8-25% (Reganold & Wachter, 2016). While the organic food chains are well organized in developed markets, the organic farming is still germinal in most developing countries (Niggli, 2015).

Between 1999 and 2018, there was a more than double increase in the number of organic producers, from 77 countries to 186, and three-quarters of producers (75%) were in Asia and Africa, specifically in India, Uganda, and Ethiopia. Regarding the largest areas of organically cultivated land, these are in Australia, Argentina, and China. Wild organic collection areas are found in Finland, Zambia and Tanzania (FiBL, 2020a). There is an annual tendency to increase the consumption of products obtained from organic agriculture compared to traditional agriculture although there are higher production costs and lower productivity. At the same time, organic products are considered more natural and implicitly healthier and more environmentally friendly by consumers, who are willing to pay higher prices for this type of product. (Hurtado-Barroso et al., 2019).

In the US, the demand for organic products has registered a strong growth since 1990. Organic products usually have a higher price than conventional products and can be found in nearly 75% of grocery stores. The organic agricultural land and the livestock sector experienced a strong development in recent years, especially for sectors such as vegetables, fruit, poultry, and dairy products. In 2011, the United States added trade codes for organic products, thus registering increases in the value of organic trade. (USDA ERS, 2020).

Organic farming is expected to be a future solution for sustainable agri-food systems, but this solution is still disputed in terms of feasibility (Muller et al., 2017). There is a real challenge for policy makers, namely to develop an environment conducive to sustainable production by developing existing organic systems, but also other innovative systems (Reganold & Wachter, 2016). Agricultural practices need to change to meet The United Nations Sustainable Development Goals require significant changes in agriculture by 2030 (Eyhorn et al., 2019).

In this context, the main aim of this chapter is to present the key ways of supporting the organic agricultural production for a competitive, resource-efficient and modern economy in the EU. An extensive analysis of the EU agriculture regulatory framework and other relevant scientific literature allowed to identify the most important tools, respectively the financial support for environmentally friendly farming. Also, the EU's research programmes have been deeply questioned in order to identify the most relevant achievements and knowledge base. Specific data managed by the key EU institutions have been analyzed and used for reasoning the research, as well as the financial incentives allocation. The chapter starts by discussing the organic production in terms of EU statistics and labelling. Then, the ways of supporting the organic production are described, by focusing on legislative framework, financial instruments, and research and innovation at EU and Romanian level. Finally, the main conclusions of this chapter are presented.

2. Organic products and production

According to the organic agriculture definition of FAO (1999), the production management must consider tools that assure biodiversity and soil biological activity and cycles. In these conditions, the production system will be adapted to regional conditions, through utilization of agronomic, biological and mechanical techniques, where is possible.

EU is an important player in terms of organic agricultural land. The European Union accounts for a quarter of the world's organically cultivated area (EIP-AGRI, 2020; FiBL, 2020b; IFOAM, 2020). Products covered by EU organic rules include wide varieties, such as: seeds and propagating material, live or raw products, feed, and multi-ingredient products or processed agricultural products for use as food (European Commission, 2020a).

In 2018, the UE organic area was 13.4 million hectares, with an increase of 33.74% compared to 2012. From a percentage point of view, it is noteworthy that Bulgaria registered the largest increase of the surface destined to organic agriculture during 2012-2018. In terms of value, it is noted that 6 countries made 82.06% of this increase, respectively 2.78 million hectares, namely: France, Italy, Spain, Germany, Sweden and Austria. In table B1, we can observe the dynamic areas under organic farming in the EU level. It can be seen that, for almost all EU Member States, the percentage of the areas occupied with organic farming increased in the interval 2000 and 2018. In 2018, Romania registered one of the lowest shares of the area under organic agriculture in the total utilized agricultural area, namely 2.43%.

If we refer to the number of producers registered for organic farming, table B2 indicates an increase of 21.35% of this indicator during 2012-2017. In 2018, it is noted that the largest number of producers is registered in Italy (69,335).

Imports of organic food products have a significant share in the total resources of the EU. Thus, if we refer to 2018, the total volume of imports was 3.25 million tons, of which: commodities (1.86 million tons), other primary (1.14 tons), processed products including wine (0.196 million tons), food preparations (0.034 million tons), non-edible products (0.014 million tons), non-agricultural products (0.006 million tons). If we refer to the source of imports of organic food products, in terms of volume, it is worth mentioning that China is in first place (12.7%, respectively 0.41 million tons), followed by Ecuador (8.5 %, respectively 0.27 million tons), and Dominican Republic (8.4%, respectively 0.27 million tons). In terms of value, commodities and other primary products hold the highest values, respectively 40.4% and 40.1% of the total value of imports. By product categories, it is noted that tropical fruit, nuts and spices have the highest value of imports, respectively 27.2%. Also, it is worth mentioning that Peru and China are in first place (7.8% of the total) when considering the value of imports of organic food products, followed by Turkey and the Dominican Republic (European Commission, 2019a).

An important role in the organization of the market for organic agri-food products is the control and certification process, because all producers, processors and traders are obliged to be evaluated and to be registered by such an organism. In this sense, each Member State decides the type of organization empowered (public or private) to carry out this control, considering the EU rules in this regard.

Currently, Romania has private inspection and certification bodies to control and certificate organic products. These are designated by MADR (Ministry of Agriculture and Rural Development), according to certain criteria, such as: competence, independence and impartiality established under the Order no. 895/2016 (MARD, 2020a).

Following the inspection and verification procedures, operators will obtain the organic product certificate with the condition to comply with the rules. Finally, they will be able to label the product as an "organic product". This label must bear certain particulars: the logo, the reference to organic production, the code and the name of the inspection and certification agency.

Since 1st July 2010, the application of the EU logo to prepacked foods is mandatory. For imported products, the use of this logo is optional. It is useful to use this logo together with the mention of the place where the agricultural raw materials were produced. This statement may be in "EU" or "non-EU" form, together with the name of the EU Member State or non-EU Member State, where the product or raw materials were obtained.

The Community logo offers the recognition of environmentally certified products throughout the EU. The use of this logo on the labels of organic food products can be found in the specific user manual. The national logo “ae”, specific to organic products, together with the Community logo, are used to complete the labelling for organic identification by consumers.

The “ae” logo, owned by MADR, indicates that the product labeled in this form comes from the organic farming system, and the product is passed through the inspection and certification procedure by an authorized agency. Also, there are several usage rules for the “ae” logo (MARD, 2020b).

Also, the manufacturers, processors and importers registered with the MADR have the right to use the “ae” logo on organic products depending on how they are presented, on the packaging, label or even on the product, by complying with the same rules mentioned above. Previously, they also need to write the application forms.

Consumers who purchase products bearing the national logo and the Community logo can be sure that at least 95% of the product's ingredients are from organic production process. (MARD, 2020b).

3. Ways of supporting organic agriculture

Given the increased focus on the relationship between agriculture and the environment, decision-makers have had to focus on agri-environment and organic farming policies, in order to develop innovative and sustainable strategies among farmers, and at the same time support them. (Niggli, 2015). The organic agriculture contribute to achieving sustainable food systems. Many efforts have been made at the European level, including development of principles and rules for organic production**,** certification and use of indications, legislative and financial support, and, even, research and innovation programmes for knowledge development.

Based on the extensive analysis of the EU documents and policy actions, it has been identified three key directions, as it is shown in figure A:

- Legislation and regulatory framework
- Financial instruments
- Research and innovation

3.1. Legislation and regulatory framework

3.1.1. The Common Agricultural Policy (CAP)

Since 1962, the EU's CAP represents a consistent partnership between agricultural system and the farmers, which are supported thorough income increases and market measures for ensuring both food security, by improving the agricultural yields, and food safety, by better regulating the EU agri-food market, while tackling the dysfunctions of the rural economy, the agri-food market, the climate change and other environmental challenges (European Commission, 2020b).

3.1.2. CAP 2014-2020

For the 2014-2020 period, the European Parliament approved the Regulation No 1311/2013 regarding the new multiannual financial framework, the Interinstitutional Agreement on sound financial management (OJ C 373, 20.12.2013), as well as the Regulation (EU) No 1306/2013 regarding the financial management and monitoring of the CAP and Regulation (EU) No 1305/2013 regarding the support for rural development by the EAFRD (OJ L 347, 20.12.2013) (European Parliament, 2020).

The main documents targeting the legislative framework of the CAP in the period 2014-2020 are the following:

1. Proposal for a Regulation of the European Parliament and of the Council establishing rules on support for strategic plans to be drawn up by Member States (CAP Strategic Plans) and financed by the European Agricultural Guarantee Fund (EAGF) and by the European Agricultural Fund for Rural Development (EAFRD);
2. Proposal for a Regulation of the European Parliament and of the Council regarding the financing, management and monitoring of the CAP;
3. Proposal for a Regulation of the European Parliament and of the Council amending Regulations (EU) No 1308/2013 establishing a common organization of the markets of specific agricultural products, (EU) No 1151/2012 regarding the quality schemes for food and agricultural products, (EU) No 251/2014 regarding geographical indications of aromatized wine products, (EU) No 228/2013 regarding specific measures for agriculture in the outermost regions and (EU) No 229/2013 regarding specific measures for agriculture favoring small Aegean islands;

4. COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT accompanying the document Proposals for all the previously mentioned Regulations. (European Commission, 2020c)

3.1.3. New CAP 2021-2027

On the 1st of June 2018, the Commission presented the first legislative proposals regarding the future period of the CAP, 2021 - 2027. The main objectives of the proposals are keen on transforming the CAP into a more responsive policy, able to comprehend and adapt to current and future challenges regarding the environment and the society, while continuing to offer support for the EU farmers towards a sustainable and competitive agriculture.

The changes that took place in the EU structure have left a mark on the budget of the future CAP programming period, 2021 – 2027, this budget being reduced by 5% compared to the current period. (European Commission, 2020d)

3.2. Financial instruments

The CAP is responsible for ensuring food security and safety in all the member states, while promoting sustainable development in rural areas.

This policy has three interconnected components through which it contributes to meeting these objectives, namely:

- the "direct payments" or income support for the farmers – it represents more than 70% of the total CAP budget; The average for „direct-payments" is EUR 266 per eligible hectare.
- market measures
- rural development measures.

Direct payments support the basic income of farmers, depending on agricultural area or livestock. These guaranteed payments, averaged at around 266 euro per eligible hectare in EU in 2015, are complemented by the following European Commission, 2020e):

- "green" direct payments for environmental-friendly agricultural practices;
- payments dedicated to young farmers;
- redistribution payments to improve support offered to small and medium-sized farms;
- payments for naturally constrained areas (mountainous areas, protected areas etc.);
- schemes for small farmers;
- optional support coupled with production for sectors facing difficulties.

Mandatory schemes for direct payments are in EU as follows:

- Basic payments;
- Green payments;
- The young farmers scheme;

Optional schemes for direct payments are as follows (at the choice of every member states):

- Coupled support;
- Support for natural constraints areas;
- Redistributive payment;
- Small farmers schemes.

3.2.1. Basic payment scheme (BPS) or Single area payment scheme (SAPS)

The basic payment provides a basic income for farmers who carry out agricultural work. The basic payment is applied in the form of the basic payment scheme or the single area payment scheme (SAPS), depending on the member state.

This type of payment is given to active farmers on the basis of the activation of the payment rights they own and are calculated in relation to the eligible land they own.SAPS is practiced in some Member States which joined the EU in 2004 or 2007.

3.2.2. Greening

Since the 2013 reform, the implementation the new green direct payment as a share of 30% of direct payments allocation has represented another suggestive step for environmental sustainability.

Farmers need to comply with three mandatory practices with beneficial effects for the environment (especially for soil and for climate):

- diversification of cultures: growing a larger variety of crops can increase soil and ecosystem resilience; also, it helps to stop soil degradation and erosion, and therefore contributes to the development of production capacity.
- maintaining existing permanent grassland, especially for their effective carbon capture.
- maintaining the ”ecological focus area”, which means that at least 5% of 15 hectares or more should be ensured by farmers for the purpose of protecting and developing biodiversity on farms.

All of these measures aim to ensure environmental sustainability in agriculture while tackling climate change.

3.2.3. Young farmers scheme

Encouraging those who start an agricultural activity is required for the future of agricultureand rural communities, especially under the conditions in which the EU population in this sector is aging. This scheme is granted for a five years’ maximum since the young farmer assumes the position of head of a farm. Payment for young farmers can represented up to 2% of the total national allowances for direct payments.

3.2.4. Coupled payments

Following the 2003 CAP reform, the link between receiving a direct payment and producing a particular product has been progressively eliminated ("decoupled"). Yet, some Member States may still couple a limited volume of direct payments for certain products with the purpose of maintaining the production levels in the regions or sectors that are experiencing difficulties and which are especially important for economic, environmental or social reasons.

3.2.5. Areas with natural constraints/less favored areas (ANCs/LFAs)

The surfaces facing natural constraints are areas where agriculture is hampered by certain limitations or disadvantages. These areas are delimited by each Member State according to certain criteria, usually biophysical. Such areas usually include mountainous areas, but they do not are limited to these.

3.2.6. Schemes for the redistribution of basic payments

Member States may allocate up to 30% of the national budget to redistribute support to small farmers, which is the redistribution payment. Thus, the support is limited by the competent authorities at usually around 30 hectaresor at the average physical size of farms. The amount per hectare cannot exceed 65% of the average payment per hectare and it is the same for all farmers in the country where it applies.

3.2.7. Small farmers scheme

Over three quarters of EU farms are small (below 10 ha), most of them having even less than 5 ha. To support these specific farms, Member States may implement the scheme for small farmers, a simplified scheme which pays farmers willing to participate. The maximum amount is set and limited at national level and it cannot exceed 1250 euros. The scheme benefits from a simplified administrative procedure and the participating farmers are safe from sanctions and controls regarding greening and cross-compliance measures.

All Member States are responsible for implementing and controlling of payment schemes to farmers. To this end, they created the Integrated Administration and Control System (IACS), a network of interconnected databases used to receive and process requests for help and related data (European Commissions, 2020e).

3.2.8. National financial support

In Romania, the following forms of support are used:

I. Direct payments scheme from FEGA funding:

a) Single area payment scheme (SAPS): granting the payment on the eligible hectare declared by the farmer, totally decoupled from production.

b) Payment schemes for environmental-friendly agricultural practices (greening): these are granted to farmers who are entitled to the single payment on the area applied on all their eligible hectares for the following agricultural practices useful for reducing the climate change and the environmental damages:

- the diversification of crops;
- the maintenance of the existing permanent grasslands;
- the presence of an area of ecological interest on the agricultural area.

c) Payment scheme for young farmers: involves granting an annual payment to young farmers who are entitled to unique payment on the surface and which:

- are established for the first time on an agricultural holding as chief executives of the holding or who have already been established in one of the five years prior to the first submission of an application under the single area payment scheme.

- they are not more than 40 years old in the year of filing the single payment application.

d) Redistributive payment scheme is an annual payment for farmers who are entitled to the single payment and are granted gradually for the first 30 ha of the farm, regardless of its surface.

e) Coupled support for soybean, lucerne, beans for industrialization, hemp for oil and fiber, rice, seed potato, hops, sugar beet, tomatoes for industrialization, cucumbers for industrialization, greenhouse crops (tomatoes, cucumbers, peppers and cabbage), sunflower crops (tomatoes, cucumbers, cabbage, eggplant and pepper), plums for industrialization, apples for industrialization, cherries / cherries for industrialization, aprons / logs for industrialization, early, semi-early and summer potatoes, sheep, goats, meat bulls, milk cows, milk calves, silkworms.

In order to benefit from coupled support, active farmers must accomplish the general conditions for granting of the payments provided in Chapter II and by the conditions of art. 33 of the Order of the MARD no. 619/2015, with the amendments and subsequent additions, to which are added the conditions specific to each type of support (APIA, 2017).

II. Measures from The National Rural Development Programme 2014-2020 (NRDP 2014 version) with European Agricultural Fund for Rural Development (EAFRD) and National Budget support, as presented in table B3.

The measure 8 - Investments in forest area development and improvement of the viability of forests - Sub-measure 8.1. Support for afforestation and creation of forested areas - had a budget of

126,801,631.83 euros during 2014 and 2020. Sub-measure 8.1 is based on art. 22 of Regulation (EU) no. 1305/2013. It aims to increase the area occupied by forests at national level for contributing to the promotion of carbon sequestration, adapting to the effects of climate change, reducing soil erosion, improving retention capacity of water, as well as the restoration and conservation of local biodiversity.

The measure 10 - Agri - environmental and climate - had a budget of 1,069,002,273.62 euros during 2014 and 2020. The support provided under this measure supports farmers in applying agricultural methods compatible with environmental protection, natural resources and genetic diversity, including traditional farming. The beneficiaries of this measure are farmers who are committed to comply with the agri-environmental and climate requirements.

The measure 11 - Organic farming - had a budget of 235,716,227.72 euros during 2014 and 2020. The support allocated under this measure is granted to farmers who are committed to use methods and practices specific to organic farming. Support is given in a fixed amount per hectare as compensation for the income losses incurred by the beneficiaries.

The measure 13 - Payments to areas facing natural constraints or other specific constraints - had a budget of 1,317,643,913.76 euros during 2014 and 2020. The support granted under this measure is a compensatory one. The compensations are paid annually, as a fixed amount, granted on the surface unit (hectare) and represents a compensation for the losses of income and additional costs incurred by farmers who conclude annual voluntary commitments for continuation of agricultural activities in the designated areas.

The measure 14 - Animal welfare payments – had a budget of 776,408,605.58 euros during 2014 and 2020. This measure aims to ensure superior standards for animal welfare in farms, responding to related needs for food safety and food quality assurance.

The measure 15 - Forest- Environmental and Climate Services and Forest Conservation - Sub-measure 15.1 - The payment for forest-environmental and climate change commitments – had a budget of 70,147,753.83 euros during 2014 and 2020. Under this measure, payments have been granted to the owners of forest lands from the National Land Fund who are committed to respecting the forest-environment requirements.

3.3. Research and innovation

Research and innovation are the driving forces for developing a competitive and sustainable organic farming sector which is fit for the future societal requirements. The organic farming is an important topic for close collaboration between farmers and researchers with different knowledge and expertise, working together and exchanging innovative ideas.

Since the 1980s, several types of funding programmes have aimed to support research projects on organic farming including technical activities and theoretical research (Schmid et al., 2009).

Horizon 2020, the current EU research and innovation programme for period 2014-2020, is the financial tool for implementing innovation. It generates the most ambitious ideas for strengthening the Europe's global competitiveness. Among the key themes of the Horizon 2020, it can be found the food and drink themes, such as bioeconomy, circular economy, food security, sustainable agriculture, healthy ecosystems and food, sustainable food and drink production and consumption, IT integration, genetic innovation, international cooperation, blue growth, rural renaissance, value chains reorganization, digital revolution in agriculture and food industry, efficiency of using the natural resources and no-impact agriculture (European Commission, 2020f).

Moreover, the main topics of this programme researched under the societal challenges, food related subtopic, were investigated in the 790 projects funded until 2020 and they discuss topics such as various crop and human diseases, developing innovative networks of private and public stakeholders, biorefinery processing technologies, organic production systems, monitoring systems and tools for the bioeconomy, insect-based and algae-based food, arctic and marine technologies, food safety partnership, pollution and waste solutions (European Commission, 2020g).

The Horizon 2020 programme represented an investment way for our future, for smart, sustainable and inclusive growth. Many projects have been funded under different calls and added value and improved knowledge base about the benefits of organic production and products as follows:

- The RELACS project aims to advance the development and adoption of environmentally sustainable and economically sustainable tools and technologies to mitigate the use of external inputs in agricultural systems. It covers all key sectors of organic farming, including horticulture, arable crops, and the production of sheep, cattle, chickens and pigs. A multi-stakeholder approach is the essence of the project, which involves actors and stakeholders from research and industry, organic farmers and advisers;
- OK-Net Arable project had a very innovative approach in all stages of the project, farmers playing a prominent role. The project has synthesized the scientific and practical knowledge available about organic arable farming and identified the best methodologies for exchanging this knowledge;
- SUSCHOICE project, developed during 2018-2021, aim to develop sustainable food strategies by analyzing the main challenges and topics related to this issue, especially among young European adults.
- SOLMACC is a LIFE-co-funded project, which aimed to prove that by using optimized agricultural practices, organic farming can be organic.

The new EU Framework Program for Research and Innovation, Horizon Europe, will be implemented between 2021 and 2027 for ensuring the continuity with the Horizon 2020 Programme. It will follow the principles of innovation, simplification, harmonization, optimizing program access, inclusiveness, synergies and coordination with other programs, more effective co-design management and more accurate input monitoring, effective referral and data management systems (European Commission, 2020h).

The projected budget of 100 billion euros for the entire duration is one of the largest in the EU financial allocation for a Research and Innovation programme, so it is expected to provide highly valuable outcomes. The programme has three main pillars related to complementary issues, respectively the excellence in science, through frontier research, infrastructure and human resources enhancing, the close cooperation with societal challenges, and, not the last, innovation and SME growth.

As it is shown in figure A3, the second pillar supports research in the field of societal references, strengthens technological and industrial potential, while conducting EU-wide missions with demanding objectives related to the following key problems: health, security, digital, materials, clean energy, mobility, climate change, food, agriculture, environment and natural resources (European Commission, 2019b).

Under the Pillar 2, the work programme will be designed on different clusters, the one related to Food, Bioeconomy, Natural Resources, Agriculture and Environment being the best opportunity to support knowledge development for an effective and healthy agricultural organic production.

The Horizon Europe was designed as an investment opportunity rather than a funding tool. Thus, the programme will facilitate the EU transition towards a sustainable and prosperous future. Also, it promotes synergies with other EU programmes, including the CAP.

4. Conclusion

The focus of organic farming on the environment is obviously specified in European Union policies. Therefore, the new EU production rules on organic farming that have emerged have to be considered in order to produce labeled organic products. (Berentsen & van Asseldonk, 2016).

The organic sector responds to a growing aspiration for sustainable food production. As such, it falls ideally in line with the objectives of the CAP. At the same time, it presents higher prices to farmers, which contribute to their increase of living standard, achieving in this way one of the objectives of CAP. In the coming years, the optimization of agricultural practices and the increased application of technology and digitization have the effect of reducing production costs, with positive impacts on agricultural incomes and consumer prices. Significant growth rates in both production and consumption show that the organic market has not yet reached maturity and further growth can still be expected.

Organic farming is already honoring growing consumer trends, such as veganism and the demand for locally produced food, by turning these challenges into opportunities. (European Commission, 2019c).

The main ways of supporting the further development of the organic agricultural production are the financial support provided within the CAP framework and the knowledge development provided by the implementation of the research and innovation programmes. Also, research funding aimed at innovation in agriculture and food systems are a valuable complementary form of support developing the organic agriculture.

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Appendix 1 – Definitions of key terms

cap - the Common Agriculture Policy represents the European Union's guiding policy in the field of agriculture, which supports different actors (e.g. farmers, industrial producers) through various measures for ensuring food security and safety, as well as environmental protection across the EU's states.

coupled support - production-linked payments for supporting the farmers.

direct payments - income support for farmers based on the farmed agricultural land.

organic production - in EU, it refers to the production of goods to at least 95% compliance with the sustainable rules.

small farmers - farmers who own less than 10 hectares in their agricultural holding.

Appendix 2 – Figures

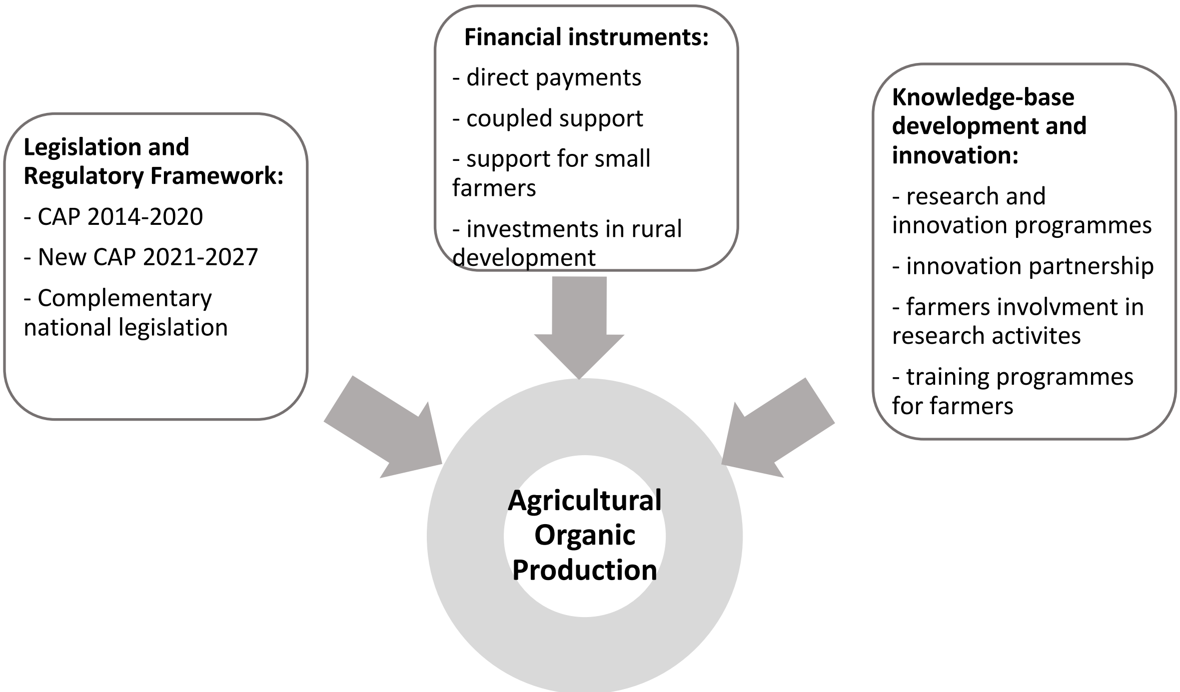
Figure A1. The EU organic logo

Source: MARD, 2020a

Figure A2. The Romania organic products logo

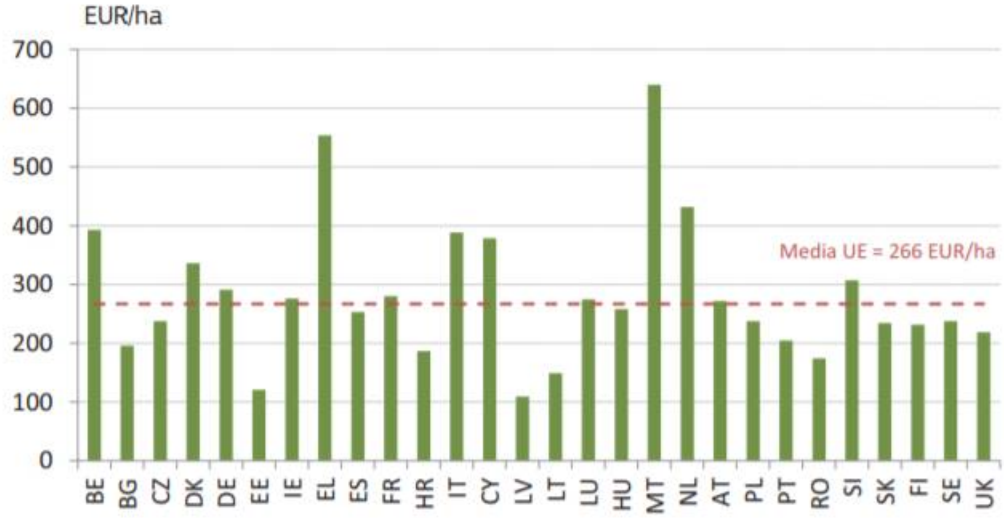
Source: MARD, 2020a

Figure A3. Ways of supporting agricultural organic production



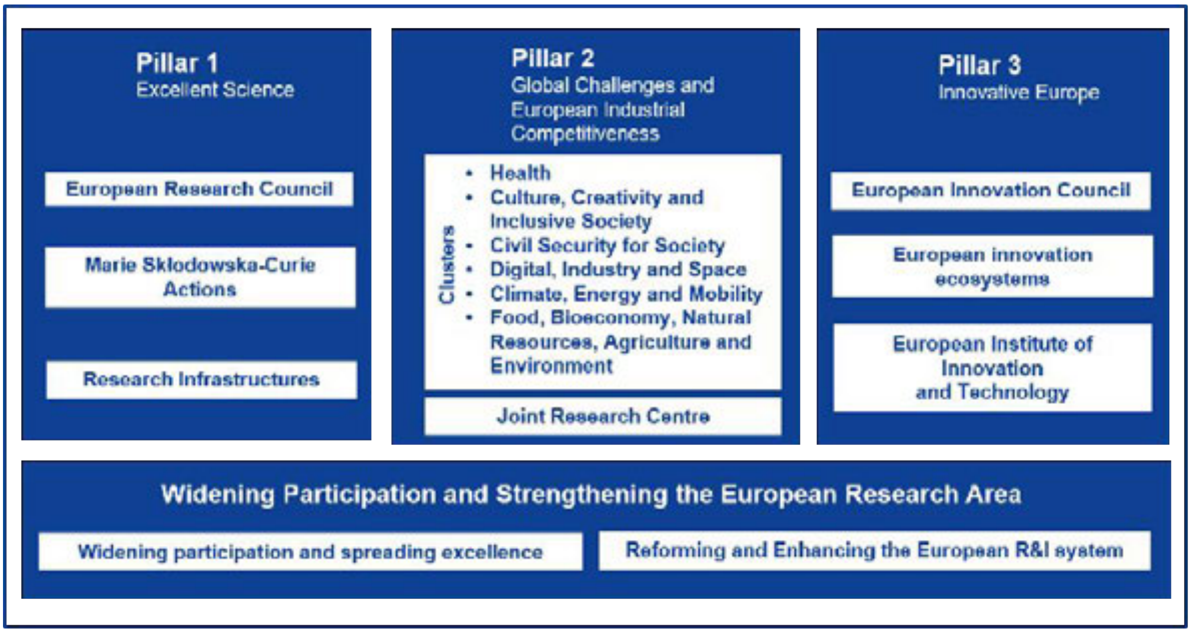
Source: Authors' conceptualization

Figure A4. Direct payments in EUR / ha, average values for 2015



Source: European Commission, 2020e

Figure A5. Preliminary structure of Horizon Europe



Source: European Commission, 2019b

Appendix 3 – Tables

Table B1. Area under organic farming in EU (Percentage of total utilised agricultural area)

TIME	2000	2005	2010	2015	2016	2017	2018
European Union - 28 countries (2013-2020)	:	:	:	6,2	6,68	7,03	7,5
Belgium	1.5	1.7	3.6	5.17	5.8	6.28	6.56
Bulgaria	:	0.2	0.5	2.37	3.2	2.72	2.56
Czechia	:	7.1	12.4	13.68	14	14.09	14.76
Denmark	5.9	4.9	6.1	6.33	7.81	8.6	9.75
Germany	3.2	4.7	5.9	6.34	6.82	6.82	7.34
Estonia	:	7.2	12.8	15.68	18.02	19.6	20.57
Ireland	0.6	0.8	1.1	1.65	1.72	1.66	2.63
Greece	0.7	7.6	8.4	7.7	6.51	7.96	9.32
Spain	1.5	3.1	6.7	8.24	8.48	8.73	9.28
France	1.2	1.9	2.9	4.54	5.29	5.99	7.01
Croatia	:	:	:	4.94	6.05	6.46	6.94
Italy	6.7	7.3	8.6	11.79	13.99	14.86	15.24
Cyprus	:	1	2.8	3.72	4.94	4.61	4.56
Latvia	:	6.8	9.2	12.29	13.42	13.92	14.47
Lithuania	:	2.3	5.2	7.11	7.5	7.98	8.13
Luxembourg	0.8	2.4	2.8	3.21	3.47	4.15	4.39
Hungary	:	2.2	2.4	2.43	3.48	3.73	3.92
Malta	:	0.1	0.2	0.25	0.21	0.35	0.41
Netherlands	1.6	2.5	2.5	2.67	2.91	3.14	3.18
Austria	13.8	16.7	19.5	20.3	21.25	23.37	24.08
Poland	:	1	3.3	4.03	3.72	3.41	3.33
Portugal	1.2	6.2	5.8	6.52	6.75	7.04	5.93
Romania	:	0.7	1.3	1.77	1.67	1.93	2.43
Slovenia	:	4.6	6.4	8.85	9.12	9.6	10.01
Slovakia	:	4.6	9.1	9.47	9.75	9.9	9.85
Finland	6.7	6.5	7.4	9.91	10.47	11.41	13.09
Sweden	5.9	7	14.3	17.14	18.3	19.16	20.29
United Kingdom	3.3	3.5	4.1	2.89	2.82	2.85	2.64

Source: Eurostat. 2020a

Table B2. Organic operators by status of the registration process in EU - Agricultural producers (number)

TIME	2012	2013	2014	2015	2016	2017	2018
European Union - 28 countries (2013-2020)	:	257.123	257.641	271.349	295.577	:	:
Belgium	1,435	1,656	1,602	1,733	1,946	2,105	2,264
Bulgaria	2,754	3,854	3,893	5,919	6,964	:	6,213
Czechia	3,907	3,910	3,866	4,121	4,271	4,426	4,601
Denmark	2,651	2,563	2,538	2,984	3,306	3,631	:
Germany	23,032	23,271	23,717	25,078	27,636	29,764	32,366
Estonia	1,478	1,553	1,542	1,629	1,753	1,888	1,948
Ireland	:	1,351	1,275	1,710	1,765	1,725	:
Greece	23,448	21,986	20,186	19,604	20,197	27,808	29,594
Spain	30,462	30,502	30,602	34,673	36,207	37,712	39,505
France	24,425	25,467	26,466	28,884	32,266	36,691	:

TIME	2012	2013	2014	2015	2016	2017	2018
Croatia	1,413	1,608	2,043	3,061	3,546	4,023	4,374
Italy	43,831	45,965	48,662	52,609	64,227	66,788	69,335
Cyprus	719	746	743	1,032	1,174	1,175	1,249
Latvia	3,496	3,490	3,475	3,634	4,145	4,178	:
Lithuania	2,511	2,570	2,445	2,672	2,539	2,478	2,476
Luxembourg	:	83	79	88	93	103	103
Hungary	1,560	1,682	1,672	1,971	3,414	3,642	3,929
Malta	12	9	10	11	14	13	19
Netherlands	1,658	1,650	1,457	1,475	1,557	1,696	:
Austria	21,843	21,863	22,184	23,070	24,213	24,998	25,795
Poland	25,944	26,598	24,829	22,295	22,451	20,276	19,224
Portugal	2,833	3,029	3,329	4,103	4,246	4,674	5,213
Romania	15,280	14,553	14,151	11,812	10,083	7,908	8,518
Slovenia	2,680	3,045	3,293	3,412	3,513	3,627	:
Slovakia	362	343	403	420	431	439	:
Finland	4,316	4,284	4,247	4,328	4,493	4,665	:
Sweden	5,599	5,584	5,406	5,605	5,741	5,801	5,804
United Kingdom	4,273	3,908	3,526	3,434	3,402	3,479	:

Source: Eurostat. 2020b

Table B3. Measures from The National Rural Development Programme (NRDP 2014-2020)

No.	Measure	Applicable Contribution rate FEADR 2014-2020	Total contribution European Union scheduled for 2014 - 2020) euros	Submitted projects number	Selected projects number	Terminated projects number
1	M 8 – Sub-measure 8.1	85%	126.801.631.83	88	68	0
2	M10	85%	1.069.002.273.62	-	-	-
3	M 11	85%	235.716.227.72	-	-	-
4	M 13	85%	1.317.643.913.76	-	-	-
5	M 14	85%	776.408.605.58	-	-	-
6	M 15 - Sub-measure 15.1	85%	70.147.753.83	328	328	0

Source: MARD. 2020c. The National Rural Development Programme 2014-2020

Ch. 4.1 WAYS OF SUPPORTING THE DEVELOPMENT OF AGRICULTURAL ORGANIC PRODUCTION IN EU

OBJECTIVES:

- to understand the general context and the arguments for supporting organic agriculture;
- to identify the most important pathways for supporting organic production;
- to enhance knowledge about identified supporting tools.

SKILLS: The students acquire skills about managing information on different instruments for supporting the development of organic production, like regulation tools, financial support and science-based sustainable investments.

QUESTION 1. WHY ARE DESIGNED THE ORGANIC PRODUCTION RULES?

- ☐ To maintain the biodiversity of Europe
- ☐ To build consumer trust in organic products
- ☐ To maximize the agribusiness profit
- ☐ To protect the environment

QUESTION 2. WHICH REGULATORY FRAMEWORK DOES NOT SUPPORT THE ORGANIC AGRICULTURAL PRODUCTION?

- ☐ Policy Framework for Climate and Energy
- ☐ Waste Management Law
- ☐ Water Framework Directive
- ☐ Common Agriculture Policy

QUESTION 3. WHICH EUROPEAN COUNTRY HAS THE HIGHEST AREA UNDER ORGANIC FARMING EXPRESSED AS PERCENTAGE OF TOTAL AGRICULTURAL LAND?

- Romania
- Hungary
- Austria
- Sweden

QUESTION 4. MANDATORY SCHEMES FOR DIRECT PAYMENTS INCLUDE?

- Scheme for young farmers
- Investments associated with cultural heritage protection
- Green payment
- Investments in creation and development of non-agricultural activities

QUESTION 5. IN ORDER TO MAINTAIN AN ”ECOLOGICAL FOCUS AREA”, FARMERS MANAGING OVER 15 HA OF ARABLE LAND MUST ENSURE:

- 5% of their land for the purpose of protecting and improving biodiversity on farms
- 25 % of their land for the purpose of protecting and improving biodiversity on farms
- 1% of their land for the purpose of ecotourism
- 95% of their land for multifunctional farm

PRACTICAL APPLICATION. WHAT ARE THE REASONS FOR SUPPORTING AGRICULTURAL ORGANIC PRODUCTION?

4.2. Evaluation of economic efficiency of investments in organic production at the family farms

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Abstract: Investments have important role in development of agriculture, both at macro or micro level. The main goal of chapter is to present the basic methods (static and dynamic) used for evaluation of economic efficiency of investments in agriculture made at farm level.
Economic advantage for small family farms to enrol the organic production system would be presented within the chapter throughout the comparative analysis of the economic justification of investment in organic or conventional vegetable production organized in protected area (purchase of plastic greenhouse and necessary equipment). Assuming the identical production and market preconditions, the initial presumption has been proven, i.e. better value of indicators of economic assessment of investments would be achieved if investment object is implemented in organic system of production.

Keywords: investment, evaluation, static and dynamic methods, organic production, plastic green house, vegetable.

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1. Introduction

1.1 Relation between sustainability, agriculture and farm

Starting from core definition of the terms sustainable, or sustainability, it describes certain object as capable of being sustained. In natural sciences it usually refers to the method of harvesting or using a resource so that it's not depleted or permanently damaged, i.e. it's able to last or continue for a long time, while in social sciences it more often relays to the use of sustainable methods (Merriam-Webster, 2020).

Sustainability is primarily environmental (ecological) determinant, and its use was firstly recorded in 1924. In last several decades, it has come to interconnection between the terms sustainability and development. As global definition for sustainability is deriving from the scientific reconsideration of relations between nature and society, it could be determined as a meeting of essential human needs while preserving the life-support systems of the planet Earth (Kates et al., 2001).

Nowadays, the concept of sustainable development (primarily focused to sustainability of economic activity) is based on the principle of moral justice and the tendency that our descendants must inherit the identical development opportunities available to us (the need for controlled environmental degradation and the highly efficient use of available natural resources). Likewise, it's relied on fact that the man is only a fragment of nature that does not have a right to change it irretrievably by its economic activity, endangering the survival of other living beings (Subić et al., 2017).

As a set of economic activities, agriculture represents the usage of biological processes (involves the generation of organic matter) on agricultural holdings in order to produce several products (primarily food, but also biofuels, fibre, raw materials for the industry, etc.) needed by human population. Based on science and practical principles, agriculture is generally turned to land cultivation, as well as growing, breeding and use of crops, mushrooms and domestic animals. Nowadays, it encompasses "way of life" and "means of life" for the people engaged in this sector of economy (USDA, 2020; MCE, 2020).

Agriculture is an economic activity as old as human society. Initially, it emerged from the tendency to meet the basic human needs towards food and self-preservation. Later, during the development of civilization, agriculture has been transformed throughout the few stages from strictly natural (food production in volume that overlaps with basic needs of farm members) into commodity production (produced surpluses at the farm are exchanged for other goods or services). Further, with expressed specialization (favouring of certain production lines within a particular branch of agriculture) it is expected to provide global food security respecting the basic food safety principles (Đurić, 2015).

Over the centuries agriculture has been the leader within the processes of rural areas evolution, i.e. in boosting of their economic growth and changing the rural landscapes. Currently, although the agriculture stays for the number of rural territories the main initiator of economic activity, while generating the several positive effects on local rural communities, its economic impact is continuously weakening. Rural communities are changing their expectations more intensely toward the main output of agriculture. Besides the food production, they require from agriculture certain level of involvement into the so called "local public services", as are environmental and landscape services, water management and flood control, social care, etc. In line with mentioned, rural areas are transferring from directly productive (based on agriculture) to some extent consumptive areas (Van Huylenbroeck et al., 2007).

Coming closer to the field of agriculture, one of officially adopted definitions interprets the term sustainable development as the management and conservation of natural resources (primarily land, water, plant and animal biodiversity, etc.), together with technological and governmental modifications towards ensuring and permanently serving the needs of current and future generations. In its essence, it does not endanger the environment, technically is relevant, economically viable and socially suitable (Hodge, Hardi, 1997; Hardaker, 1997).

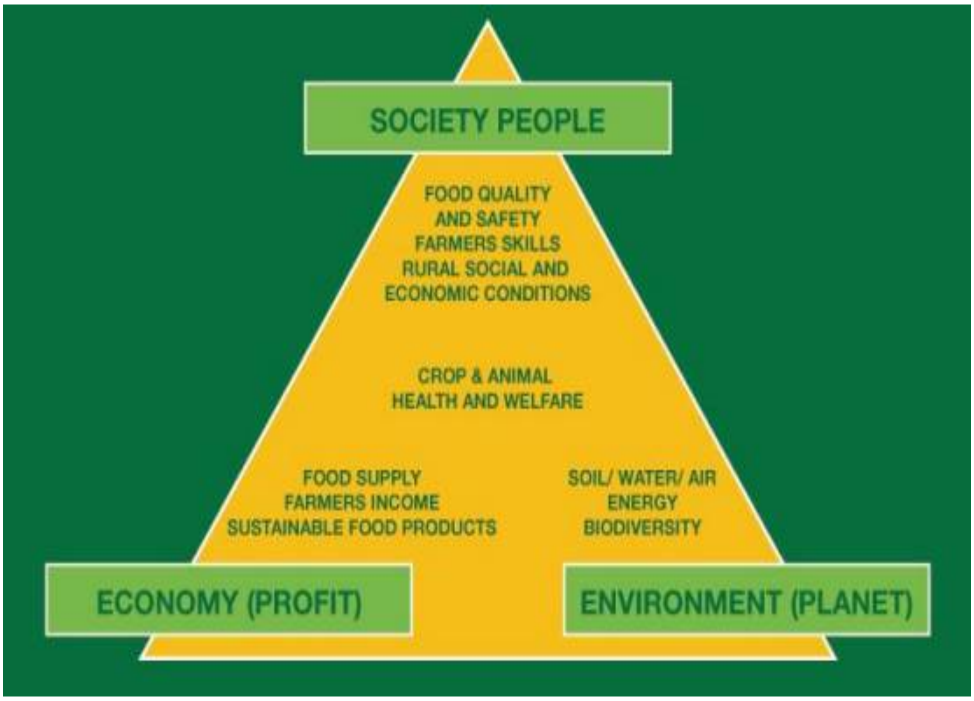
Considering the macro aspect (global agriculture), sustainability is introduced through the integrated system of activities and procedures primarily related to crop and animal production conducted at wider rural area. In long distance they have to provide: a) food security for local population (by quantity, quality and structure of offered agro-food products); b) preservation of natural environment; c) adequate valorisation and efficient utilization of available agro-resources; d) boosting of agricultural competitiveness and complete realization of produced surpluses; and e) stabilization of farm income and growth of the living standard of the local rural community (Subić et al., 2012).

Sustainable development of agriculture targets and mutually connects the interests of all stakeholders primarily active in sector of agriculture in certain rural area, such as: agricultural holdings (family farms or companies of different size, both smallholders and large producers), agro-business companies and manufacturers, cooperatives, associations of producers, local population, agricultural extension offices, etc. In regard to territorial scope, character and significance, developmental needs and actions in agriculture and rural areas could be initiated and supported locally or by state managing authorities (Vorley, 2002; Subić et al., 2013).

Regardless to the authority level (from local to regional, or global), official approach to sustainable agriculture has to be followed by well established strategic framework (adequate legislation, strategic documents, normative and codes, clear and realistic vision, etc.). Reaching of the desired level of sustainability (in pre-defined timeframe and prioritised areas of agriculture and rural development) has to be driven by the fulfilment of previously set strategic goals, measures and reform activities. List with strategic measures created by any authority usually involves intensification of production, change in system of production, or increase and modernization of available production capacities, while achieving each of them requires certain level of investments and pre-investment analysis.

It’s underlined again that although the term sustainability is usually associated to environmental issues of natural resources, sustainable agriculture is multi-dimensional approach (Picture 1.).

Picture 1. Aspects of sustainable agriculture



Source: Ore, 2015.

In line with the formal intention to preserve global wealth inheritance of available natural resources to upcoming generations, adequate functioning of sustainable agriculture is based on three interdependent, overlapping and equally important pillars: a) ecological sustainability (requirement that direction and level of development should be consistent with the maintenance of ecological processes, i.e. driving the applied practices into the course of preserving or improving biophysical productivity of accessible natural resources); b) economic sustainability (agro-development should be economically feasible and efficient, i.e. agro-output and costs of production and marketing have to be capable for easy adjustment to unstable environmental, social and economic circumstances); and c) social sustainability (agro-development should be socially responsible, i.e. it has to fit the global needs for quality agro-food products affecting their fair and efficient distribution, as well as appropriate technology transfer, etc.), (Yunlong, Smit, 1994; Smith, McDonald, 1998; Bachev et al., 2017).

Principally, sustainability assessment of agriculture or some sub-sector of agriculture (within the specified territorial unit), as well as evaluation of certain farm, or group of farms usually represents challenging issue as it considers very complex analysis of many case-specific variables (it involves different processes and systems of production, inputs/outputs, technology, logistic and marketing activities, support tools, stakeholders, climate conditions, etc.), (Picture 2.). In line with the above, there is no established yet standardized methodological approach for measuring sustainability of agriculture or any individual farm (Andreoli, Tellarini, 2000; Lampridi et al., 2019).

It should be noted that by its definition organic farming is strongly directed to ecological pillar, as it uses inputs (primarily fertilizers and pesticides) and techniques (e.g. crop rotation, green manure, compost, biological pest control, etc.) proven to be environmentally friendly. It eliminates or strictly limits the application of certain inputs such as synthetic petrochemical fertilizers and pesticides, plant growth regulators, antibiotics, GMO, etc. Orientation to other pillars could be found in fact that this system of agricultural production is globally spread, while surfaces under several production lines are constantly and sometimes rapidly increasing. From the farmer's point of view, expansion is justified by strong public support related to reduction or prohibition of "dirty" technologies used in conventional agriculture, along with the opportunity to approach the higher profits in emerging market niches (increase in consumers' concerns for the use of healthy and safe food products), especially for farms that are stuck in saturated bulk markets, or economically weak farms that cannot compete the economy-of-scale or technologically modern agricultural production (Jeločnik et al., 2015).

Picture 2. Variables engaged in assessment of the agricultural sustainability

Source: Lampridi et al., 2019.

Having in mind previously described general (macro) approach to the concept of sustainability (reliance on ecological, social and economic pillars of sustainability), it is possible to define the sustainability at micro level, i.e. the concept of farm sustainability. It could be defined as the ability (its internal potentials) of certain farm to operate, survive and grow within the particular socio-economic and natural surroundings (rural territory), while keeping up in longer period its administrative, economic, ecological and social functions at satisfactory level. Concepts mutually differ in additional pillar added to the farm sustainability: a) managerial sustainability (its level of efficiency towards the organization of activities and establishment of relationships inside/outside the estate, along with level of adaptability to changing surrounding, in line with main affinities and abilities of the farm owner); b) economic sustainability (its level of productivity in use of available resources, economic efficiency and financial stability); c) social sustainability (its accountability for preserving and advancing the welfare of farm members, other stakeholders involved in agro-business and whole rural community); d) ecological sustainability (its level of responsibility and behaving towards the natural environment), (Bachev, 2016).

Although the farm sustainability should harmonize all segments that influence the preservation or increase of entire farm capital (economic capital – incomes, savings, production assets, available elements of physical infrastructure, etc.; social capital – existence and quality of available social services to farm members; natural capital – quality of air and available water resources, existence of specific landscape, biodiversity, etc.), in practice, it's usually related solely to economic aspect (Pingault, Preault, 2007).

Above could be explained on one, somewhat, common example. Under the world-wide pressure of economy of scale, in order to secure their short-term competitiveness farmers are "forced" to ignore certain aspects of sustainability. So, in this internal conflict among the pillars, usually guided by pure striving to reach the high profitability, farms generally cannot compensate caused ecological and social costs derived from agricultural production, services and processing organized at the estate. Over-intensified production that relies on excessive use of agro-inputs has to lead to higher yields and farm incomes, but in same time it initiates endangering of natural (in and out of the farm) and social capital (unduly use of fertilizers, pesticides or mechanization, i.e. fossil fuels, directly increases the harmful emission of pollutants at certain farm threatening in long-term the quality of surface and ground water, soil complex, safety of produced yields, health of consumers and local population, boosting the climate change effects, etc.). It is very hard (being pricy or nearly futile), even for big and economically powerful farms, to optimize the structure and intensity of production that will perfectly balance the sustainability pillars. Equalization of their importance at current stage of civilization and under universal ethics is normally directed by scientifically generated norms and tech-tech knowledge converted into the principles of good agricultural practice, as well as certain instruments of public support, constant rising of producers' awareness, requirements from the market, etc.

Some estimations show that in the upcoming period, at this level of agricultural knowledge and practice, further growth of productivity would certainly lead to decline in quality of used arable land and environment. This means that the next step of intensification would probably miss the component of sustainability of applied practices and used varieties (the crops have already come to about 80% of their yield capacity, reducing the manoeuvring space for advancement of currently used agricultural production systems), (Ewert et al., 2005).

Besides, in line with the certain specificities of agriculture primarily that it's based on biological processes and mechanisms regulated by nature, production is applied under the law of diminishing returns. In other words, farmers have to be aware that the constant increase in intensification of production is not fully proportional to gained yields, i.e. profits. In one moment, any additional investment in certain input will be absurd, leading to losses and fall of overall farm profits (Hallam, 1991; Drummond, Goodwin, 2004). Simple example is represented in specific relation between the crop (gained yields-profit) and used mineral fertilizers (incurred costs). Under the normal conditions of production, crop can absorb only a limited volume of some mineral element (e.g. nitrogen) that will influence the yields growth. After that level, any additional increase in fertilization will affect less and less volume of nitrogen utilized by crop, while the rest will directly leach into the soil complex and water resources causing at the same time the economic loss and environmental accident. In other words, there is no economic logic for farmer to additionally invest in used inputs if they are not providing optimal outputs, while pushing the production over the limits of profitability will surely lead the farm to the weakening of its economic and ecological sustainability.

Accordingly, good solution that will reconcile conflicting pillars of sustainability (principally economic and ecological aspects), or balance expectations of farmers and other stakeholders active within the agro-business sector (including the expectations of state and local authorities, consumers and global society) could be found in practicing of organic agricultural production as a huge step in returning to the primordial laws of nature (Tomaš Simin et al., 2019). Otherwise, slight changing of devastating scheme of pure conventional agriculture could be done with introduction of ecologically oriented agricultural practices (e.g. integral production) based on principles of good agricultural practices (GAP or some other common production standards) and frequent formal control of applied production and post-production activities, used natural resources (e.g. soil and water quality) and produced agro-food products (Subić, Jeločnik, 2013).

Factors that define farm sustainability are usually grouped towards the certain pillar of sustainability, while following could be highlighted: a) managerial factors - include characteristics of farm members, their production experience, knowledge, skills and aspirations, practicing of non-agricultural activities, used marketing and supply channels and strategies, engaged labour, etc.; b) economic factors - describe introduced production system and established production lines and activities, level of specialization, economic power, farm size and level of used capital assets, capital turnover, financial dependence, economic capability to achieve profit, presence of tech-tech innovations and openness for tech-tech innovations, etc.; c) social factors – include reliance on public support and policies, relation to agricultural extension and local community, access to social infrastructure, impact on rural dynamics, etc.; d) environmental/ecological factors – encompass the level of biodiversity at estate, type and volume of used or produced energy, impact of climate change accidents, practicing of water, soil and fertilization management, type of pest control, etc. (Subić et al., 2012; Subić et al., 2013; Subić, Jeločnik, 2014; Baccar et al., 2019; Friedman, Morris, 2019).

1.2 Creation of value-added at the farm

Farm sustainability is highly correlated with creation of additional value at the farm estate. In current economic theory value-added could be defined as a strategy in order to gain certain level of competitive advantage towards the increasingly pronounced market competition.

Possible reconsideration of the term value-added differs according to perceptions of the sub-term value (exchange value or use value). Observing the exchange value, i.e. total costs and relation between the inputs and gained products and services, the value-added is determined as products' value reduced for the value of used inputs (e.g. one of the best options is costs reduction followed by the growth in production efficiency). On the other hand, use value is associated just to the final product or service ignoring the production activities, so in this case the value-added is determined as any improvement on product that leads to greater business' effectiveness (e.g. gained products must be labelled as superior, leading to consumers' over-satisfaction in compare to the use of competitors' products). At the end in both cases value-added is referring to a change done during the certain period (De Chernatony et al., 2000; Jensen et al., 2012).

Related to confrontation of organic and conventional food products, more appropriate is the definition for value-added focused to use value. Although it could be considered as economic category, value-added has many relations with other pillars of sustainability. Value-added is something that makes the product more attractive to consumers. It relates to increase in quality, value or volume that farmer incorporate into his products or services expecting to initiate upward trend in selling and farm incomes gaining.

Value-added is, under the given circumstances, the best possible portfolio of farm activities and agricultural practices created by farmer in order to adjust the farm output (primarily agro-food products and services) to the consumers' preferences. It usually affects the change in shape, form and structure, appearance of specific characteristics, as well as permanent availability, or emerging the new identity and quality level that was not apparent in previously offered farm products and services.

Value-added is typical for farmers who want to change their position within the supply chain or at nearby markets by direct approach to the end consumers. They are modifying applied production processes with main goal to shift, stress or preserve certain characteristics of their products and services. Value-added could be observed as a farmer project that is succeeding in synergy with other stakeholders involved in agri-business. In initial stage, it should deal with gathering of basic market information related to consumers and competition. Further, it requires development of adequate vision and strategic approach, and finally if being estimated that idea will contribute to empowering of farm sustainability, it should be followed with development of operational plans, estimation of economic efficiency of planned investment, coming up with the adequate financing opportunities, etc. General suggestion could be to begin with basic commodities and services, while adding later a certain amount of inventiveness towards the creation of upgraded or new products, highly competitive and desired by local consumers that will boost the total farm revenues (Coltrain et al., 2000).

As a wider concept, agricultural value-added initiative was established in order to support the farmers in absorbing the frequent shocks (decrease in net farm income caused by price volatility of the primary products) derived from globalization. It represents a strategic response to highly competitive global market and fast commoditization in agro-sector (Amanor Boadu, 2003). Representing the dominant part of mentioned concept, i.e. establishing economic relationships between consumers' preferences, farm practices and rural communities, creation of the value-added at the farm estate is usually observed as (Royer, 1995; Feenstra, Lewis, 1999; Fleming, 2005; Evans, 2006; Tangermann, 2011; Lu, Dudensing, 2015):

1) processing of raw agricultural products (e.g. from pure mechanic cleaning, cutting, weighing, packing and storing of raw fruits and vegetables, to producing the food products of higher degree of processing, such as juices, jams or pickled veggies), or even implementation of vertical integration as specific marketing approach towards the produced quantities, usually linked to specialized farms, which includes engagement of part or all activities characterized for transfer of certain raw agricultural products into the final food products (e.g. transfer of grains into the flour and later into the bakery or pastry products);

2) collection and market realization of locally-produced agricultural products tagged with preserved specific characteristics and identity, or preparing of local food products from locally produced raw material under the traditional recipe, additionally labelled with certified local designations;

3) production of agro-food products in a manner that increases their value (e.g. establishing of organic, eco, integral or some other system of production, or production in protected area – greenhouses, or production with the use of irrigation or certain innovative technological solution, or simple realization of crop products throughout the livestock products – feeding of animals, etc.), introduction of quality schemes and products certification, or production of farm based renewable energy from own agricultural resources (e.g. production of biofuels);

4) diversification of farm activities with introduction of certain non-agricultural activities (e.g. offering of agro-tourism or recreational tourism services, production of handicrafts, running the grocery shop, etc.).

Related to establishing the direct relation between the production of value-added products and generation of additional farm incomes, it should be noted that orientation to organic agriculture could be a reasonable solution for farmers. Above arises from the production of agro-food products with suitable market identity, that could capture the price premium buyers who would like to pay extra for the higher quality and safer products than their generic version. Some surveys at EU level show that organic food-products prices have upward trend and could be at least 10% (usually some livestock products) to even 500% (potatoes) higher than the conventionally produced products (depending on the type of product, its seasonality and used market channel), (Simin et al., 2019). Similarly, direct insight in sauerkraut production shows that compared to conventionally produced and processed cabbage, although it requires approximately identical level of investment in production facility and equipment, production of organic sauerkraut could be for 20% more profitable (Jeločnik et al., 2019). On the other hand, reaching the higher prices could be a possible limitation for producers or retail chains during the recession period, when due to their budget contractions consumers more often have been opting for the cheaper conventionally produced substitutes.

Except direct benefit for the farmers (maximising the potential of farming operations, full employment of farm members and increase in farm income), creation of farm value-added products also has certain effects on the strengthening of rural communities, especially those in which the local offer is too modest or the value chain is commonly ending with the transfer of primary products to the processors located out the community. Farm could improve the community well-being through the advancement of its image, creation of new jobs and engagement of local labour, slowing-down of the migration, enlargement of community budget, etc. (Alonso, Northcote, 2013).

Considering a constantly growing gap between the incomes per capita in rural and urban areas, many governments are interested in developing policies that will support creation of farmers' income or establishment of nonfarm jobs in rural areas. In that context, they are also supporting the formation of value-added at the farm level. For example, in USA principally following supporting measures are in use: agro-food products promotion, marketing and state labelling, operational and technical assistance, offering of favourable loans and grants, conduction of market research, organization of different trainings, legal issues support, etc. (Kilkenny, Schluter, 2001).

1.3 Investments as a factor of farm sustainability

From the aspect of farm sustainability, whether being focused on enlargement of existing primary production, change of the system of production, introduction of processing or non-agricultural activities at the farm estate, engaging in additional farmers' work or one of external labour, purchasing of new or additional machinery, equipment and supplies, (re)building and equipping of certain facilities, use of more energy, etc., i.e. making of proper investments in all cases is required.

The most often, investment considers the transfer of financial assets into the purchase and up-building of capital goods (facilities, land, livestock, machinery, tools, equipment, etc.), which are not the subject of current consumption but they are in function of production of consumer goods and services in long-term period. Size of investment in capital goods has to be proportional to previously determined volume of production based on potential use of consumer goods (Hayes, 2006). Investment could be seen as a complex process of interconnection of several economic and financial elements into a practical activity of advancement and enlargement of social legacy, i.e. the purchase of assets with hope that they will enable creation of profit and broader well-being (Stiglitz, Walsh, 2006). Nowadays the term also refers to any investment in human capital such as acquiring of knowledge, specific skills or experience (Wolla, 2013). Investment supposes making of a sacrifice in current moment hoping that certain benefits will derive in upcoming future. So its significant characteristics are current sacrifice and future benefit, as investment considers giving up from present values towards the uncertain future reward (Rawal, 2015).

Investments could be grouped according to many factors. In regard to sector of agriculture, the most proper division is, according to their purpose, to real and financial investments. Prior contribute to the establishment of new or improvement of existing production at the farm (by its structure, quality and quantity), leading the farm to decrease the current costs of production, as to enlarge the volume or increase the quality of produced goods and services, i.e. influencing the growth of total farm's profit. They could appear as new investments (investments that are done at once usually during the purchase of new machinery, production facilities, land, equipment, livestock, establishment of plantations, etc.), or current investments (such are investments in reconstruction, renovation or replacement of obsolete capital goods, investments in rationalization of production, investments in technological transfer, investments in environmental protection, or protection of human and animal welfare, etc.). Financial investments relate to acquisition of property rights of already existing highly liquid assets (e.g. investment in securities). Besides, according to the used sources of financing, they could be realized by own funds (from farm accumulation), or by external funds (e.g. bank or public loans and grants). Regarding the level of dependence, investments could be mutually exclusive (they cannot be simultaneously implemented), complementary (implementation of one investment increases the cash flow of another investment), or substitute (implementation of one investment decreases the cash flow of another project). Towards the level of labour involvement, they could be labour-intensive or capital-intensive. In regard to the number of subjects involved in their realization, investments could be individual (done by one farmer) or group investments (require more participants). According to their size (i.e. value or significance), small investments are usually internally analysed and approved, while larger usually require external analysis and objectiveness. Focusing the object of investment at specific farm, there are investments in fixed assets (in land, livestock, machinery, production and processing facilities, equipment, etc.) and intangible assets (in research, patents, licenses, etc.), as well as investments in permanent working capital (e.g. financial assets constantly required for the maintaining of minimal level of key inputs, wages and rents), (Carter et al., 1997; Cicea et al., 2008; Subić, 2010).

In practice, each individual investment is described by following elements: object of investment (e.g. land, plantation, machinery, property rights, etc.), investor (e.g. physical person or legal entity that invest), investment process (activities related to transfer of financial assets into the investment object), and process of financing (activities related to obtaining of financial funds required for investment realization), (Sredojević, 2011).

It should be underlined that investments in agriculture are usually affected by its specificities (primarily impact of natural and climate conditions, reliance on biological processes, mismatch of production and working period, expressed seasonality, etc.). Generally they are considered as investing in: land and land improvement (e.g. enlargement of estates, spatial arrangement, cleaning of forest, improvement of physical and chemical characteristics of soil complex, implementation of drainage system or irrigation channels, etc.), establishment and maintaining of plantations (e.g. perennial crops, windproof and anti-erosion belts), basic herd (enlargement of existing herd or replacement of unproductive animals), production and processing facilities (e.g. farm building, greenhouse, cold storage, stables, warehouse, fencing, well, etc.), equipment and mechanization (e.g. replacement of obsolete or purchase of new units), (Novković et al., 2015).

Investments are the factor of development, both at micro and macro level. Without investments previously set developmental goals could not be realized. They are the tool for maintaining the sustainability of farms and rural communities, as they shape business and social environment within the agricultural sector and rural areas. Investments are prerequisite for tech-tech development of agriculture, proper infrastructural equipping of rural areas, or further increase in efficiency of agriculture (primarily efficiency of used fixed assets and labour). Also, they result in additional diversification of (non)agricultural activities, presence of entrepreneurial initiatives and general improve of people's wellbeing within the certain rural territory.

There are several motives why is reasonable to support investing in agriculture and rural areas: agriculture should satisfy continually increasing need for food; it's a significant provider of jobs and powerful tool in poverty reduction; by settled and used surface rural areas dominate over the urban areas; agriculture is highly related to the most of economy sectors, providing them needed raw materials used as inputs; generally agriculture attracts a lower number of investors although it does not require large initial capital; usually agriculture is the most subsidised and supported sector of economy; although is limited resource, land could be observed as inexhaustible factor of production; etc. (Deininger et al., 2011; Lowder et al., 2012).

One of key attributes of investment is its irreversibility, as once is done, there are usually limited number of alternatives for which investment object can be used. This is especially evident in agriculture, e.g. it is assumed that previously purchased dairy cows will be just in function of milk production, or established greenhouse will be probably used just for the growing of veggies, rarely for medicinal herbs, flowers and spices. On the other hand, tractors could be used for land cultivation or crop care in many lines of crop production, as well as for transport of agro-inputs or agro-products, etc. So, beside the intensity of farm need towards the investment object, farmer's relation to investments is mainly caused by their risk aversion. Usually economically weak farms rather will accept lower level of investments and returns in exchange to face lower risks, while well-to-do farms with more diversified incomes are more likely to accept higher risks while expecting the higher returns. In line with expressed uncertainty and slower adjustment to changes in production circumstances, one of characteristics of agriculture is that farmers are generally unwilling to invest in required equipment, land improvements, advancement of their knowledge and skills, etc., or they make just "sub-optimal" level of investments. By this they additionally aggravate the state of available capital assets and natural resources (Zepeda, 2001). Simultaneously with the growth of farms' economic power mentioned limitations become the subject of the certain level of changes in farmers approach.

In order to avoid making bad investment, decisions that could cause absence of expected profits, occurrence of possible risks and unwanted events, additionally burden farm finances, even brings to farm bankruptcy, each investment has to be preceded by adequate investment analysis. Analysis has to avoid farmer subjectivity, and has to be turned to commonly used assessment approach (based on use of scientific and analytical methods).

Main goal of this chapter is to present economic logic and general steps in investment analysis related to the use of basic models and indicators for evaluation of investment decision at farm level. Previously given theoretical background (introduction of selected indicators) will be followed by suitable case study. It will assume practical demonstration of evaluation process of economic efficiency of investments made at small family farm, i.e. evaluation of economic advantage for farmer to enrol the system of organic agricultural production (comparative analysis of the economic justification of investment in organic or conventional vegetable production organized in protected area under the identical production and market preconditions - purchasing of plastic greenhouse and required equipment).

At the end, some prior analysis that compared level of economic effectiveness reached in organic and other systems of production has showed that there is no strict conclusion which system is more profitable. It is usually influenced by distinct characteristics of used crops and animals (varieties) or production location, marketing and supplying possibilities, labour and management quality and skilfulness, disposed tech-tech solutions, available micro-climate conditions, economic status of the farm, present level of public support, etc. (Klonsky, Livingston, 1994; Nemes, 2009). But there is no doubt that from the sustainability aspects organic production sounds more complete, as it's primarily based on agro-inputs minimization and greater use of manual labour and renewable resources. Besides, as mentioned above, generally level of profitability reached in organic farming (especially in early transition period) largely relies on size, structure and awareness of demand (consumers quality), as well as consumers' readiness to pay certain level of price premium (their paying capacity).

2. Methodological approach and used data sources

Used methodology considers the application of static and dynamic indicators in order to assess and compare justification of investments done in establishment of conventional or organic vegetable production organized in protected area (plastic green-house).

All data used for the development of given chapter context and structure is previously consulted with appropriate scientific and practical literature. Although case study presented in chapter has hypothetic character, all used data (technical elements of investment, organization of production, supply and marketing channels, etc.) are quite realistic, as were obtained from in-depth interviews with the conventional and organic vegetable producers located in green belt (suburb) of Belgrade during the 2019-2020.

Better understanding of given case study and introduced mechanism for investments evaluation will be provided by tabularly presentation of obtained data and derived results. Besides, high level of comparability of prepared investment calculations will be assured by presentation of all financial values in EU currency (EUR), (used exchange rate is 1 EUR = 117.5894 RSD).

Steps in investment calculations development

Investment calculation is analytical method used for determination of the economic effectiveness of investments, i.e. economic effects that will arise from the entire production process conducted over the life of investment. It represents a fundamental base for decision making towards the farm enrolment in previously planned investment process (whether financing of certain farm investment should be done or not, or which among suggested projects' alternative should be implemented).

Decision making summarizes the whole complexity of investment problem, as it has to consider adequate selection of considered investment alternatives, the best possible farm capital allocation and perfect timing for investment realization, towards the main purpose of investment, fair returns it gives and tolerable risk level for the farm. According to this, development of investment analysis supposes a prior chronological determination of all cash receipts from the investment (value of production that will be realized out of the farm) and all cash expenditures needed for investment utilization (expenditures required for purchase or establishment of investment object, as well as expenditures related to its use, maintenance and liquidation minus the costs of depreciation and interests) for the entire period of its exploitation, expressed in annual amounts, i.e. determination of cash flow. Besides, for the purpose of investment evaluation, it should estimate possible prices of final agro-food and other products and production costs that will occur within the investment life (Hargitay, Yu, 1993; Ćejvanović et al., 2010).

In order to obtain quite realistic results and implement right investment alternative, the investment analysis during its development should pass through several steps and analytical procedures, such as (FAO, 1993; Subić, 2017):

- collection of basic investor data, i.e. farm data (e.g. administrative data, size of used land complex, number of animals, structure of farm members, available mechanization, facilities and capital equipment, total and structure of economic output, practiced production lines, used supply and marketing chain, etc.);
- drafting technical description of planned investment (e.g. main characteristics of object of investment, expected price, method and time of purchasing or phase of establishing, available financial resources, etc.);
- development of financial plan (forming of total annual incomes and costs (including their structure) that appear during the life of investment);
- evaluation of expected investment project effects (creation of cash and economic flows for entire period of investment exploitation[1] and use of selected evaluation methods and indicators);
- verification of investment analysis, reporting and adequate recommendation for selection of the best possible investment alternative.

Evaluation of investments could involve many methods, which mutually differ in relation to the fact whether they consider or not the time value of money (division on static and dynamic methods). Main advantage of static methods is their simple use and easiness to calculate, while main disadvantage is insufficient reliability of the obtained results, since they are usually based on business results from one (representative) year of investment exploitation. They could be a good solution for pre-investment studies, assessment of low-value investments with short life cycle, or during the periods characterized by low interest rates. Contrary to previous, dynamic methods respect the current level of interest rate, expressing in this way mismatch between the values of money in initial moment of investing or during the period of investment object usage. So, in order to compare all values more precisely, by discounting all future receipts and expenditures that relate to investment they are brought to same moment, usually to beginning of the investment period and their present value (Ivanović, 2013; Gogić, 2014; Puška et al. 2018).

At current moment money is more valuable than in a year's time or later, as the time reduces its value. As cash flow (receipts and expenditures) of investment is turned to future (from couple to several years), money obtained or spent in upcoming period is worth less today. How much it is worth less depends on used interest rate and length of the investments' life cycle. So, discounting refers to the process of diminution of future cash inflows (receipts) and/or cash outflows (expenditures) for the value of interest generated during the future period. It assumes the use of a discount factor, i.e. minimum rate of return on investment, calculating under the following formula (Carter et al., 1997):

$$r = \frac{1}{(1+i)^n}$$

[1] Use of assessment indicators requires previous creation of overview of economic receipts and expenditures (except depreciation and paid interests on investment) that are done during the period of investment procurement and exploitation, i.e. economic flow. Final result derived from the economic flow is the net cash flow, and by its discounting we come to the net present value (NPV) of investment, and further to other evaluation indicators (Jeločnik, Nastić, 2019).

Where,

r - discount factor;

i - interest rate;

n - period of life cycle of investment.

Static methods for the evaluation of economic effectiveness of investment

Static assessment of investment projects does not consider the entire life cycle of investment. It relates just to one, representative year, assuming that in this year it had reached the full utilization of implemented investment (usually fifth year), as well as financial relaxation of investor. Besides general simplicity, main method disadvantage is economic analysis of just one production year, what could lead to incomplete perception of investment effects. Static assessment involves many indicators. Although there is no strict definition of indicators that should be used in investment analysis, in practice the most common are (Subić, 2010; Bartosova et al., 2015):

1) Total Output-Total Input Ratio

Indicator represents the ratio between the total incomes (market value of production) and total expenditures (costs of production) that come from the investment exploitation in previously determined representative year. It is expressed by the Economical-efficiency coefficient (i.e. profitability coefficient):

$$Ee = \frac{Ot}{It}$$

Where,

Ee - economical-efficiency coefficient;

Ot - total output (market value of production);

It - total input (costs of production).

Production could be considered economical (economically efficient) if the value of coefficient is greater than one or equals to one. In this case, investment is considered as justified.

2) Net Profit Margin

Indicator represents the profitability of production, as the ratio between the profit and total income that comes from the investment exploitation in observed year. It is presented by the Net Profit Margin Ratio:

$$NPMR = \frac{P}{Ot} * 100$$

Where,

NPMR - net profit margin ratio;

P - profit;

Ot - total output (income).

Investment could be considered justified if the gained ratio value is greater than the current interest rate on the capital market.

3) Accounting Rate of Return

Profitability of investment could be considered as the ratio between the profit gained from investment exploitation in representative year and total value of investment. It is presented by Accounting Rate of Return:

$$ARR = \frac{P}{Vi} * 100$$

Where,

ARR - accounting rate of return;

P - profit;

Vi - total value of investment (initial outlay).

Investment could be considered justified if the value of ARR is greater than the current interest rate on the capital market.

4) Simple Payback Period (SPP)

Indicator represents the ratio between the total value of the invested financial resources and net cash flow generated in representative year of investment exploitation (it is assumed that all cash flows gained during project exploitation have approximately equal values). It is described by the period of investment usage needed for returning of previously invested financial resources, i.e. number of years required to compensate the initial outlay with the financial assets generated (accumulated) in net cash flow (i.e. difference between cash inflows (incomes) and cash outflows (expenses)). Method is commonly used in practice, while it could be mathematically expressed as:

$$SPP = \left(\frac{V_i}{CF_n}\right) * 100$$

Where,

SPP - simple payback period;

V_i - total value of investment (initial outlay);

CF_n - net cash flow in representative year (year n).

Dynamic methods for the evaluation of economic effectiveness of investment

Opposite to static methods, dynamic methods observe the cash inflows (receipts) and cash outflows (expenditures) during the entire life cycle of investment. Regarding greater complexity and respecting the component of time, they offer more complete and realistic analysis of investments' effectiveness. They involve a number of methods, where the Net present value (NPV), Internal rate of return (IRR) and Dynamic payback period (DPP) are the most used in practice (Jones, Smith, 1982; Carter et al., 1997; Tauer, 2000; Tassey, 2003; Andrić et al., 2005; Cicea et al., 2008; Götze et al., 2008; Sedliacikova, 2013; Arnaboldi et al., 2015; Bartnik et al., 2016).

1) Net Present Value (NPV)

Method estimates the absolute profitability of planned investment (it is profit oriented analytical tool). It expresses the total sum of increases in the investors' financial result caused by the procurement (building/construction) and use of certain investment object until the time of its liquidation that are brought down (according to previously defined discount factor) to the initial moment of investment implementation. Method is highly consistent with the objective of maximizing the farm's wealth.

Method discounts all expected cash inflows (receipts) and cash outflows (expenditures) that appeared, both during the period of the investment object procurement and during its exploitation, at the initial moment of investment usage (n = 0). Then the sum of discounted cash inflows is reduced by the sum of discounted cash outflows determining on that way the value of the expected net cash flow (sum of net annual financial benefits) derived from the investment use. So by method is calculated the present value of the sum of financial results gained within the investment life cycle. Indicator usually assumes that all cash inflows/outflows appear in same time intervals (e.g. at the end of year), or that over the years cash inflows/outflows could be presented in their average mutually equal values. Method could be mathematically presented by next simplified formula:

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} - I$$

Where,

CF_t - net cash flow gained in year t, while t could take value from 1 to n (n represents entire period of investment exploitation);

i - interest rate;

I - initial value of investment (initial outlay);

1+i - discount rate.

If the gained value for NPV is greater than zero (NPV > 0), meaning that all expenditures incurred during the investment object procurement and use are reimbursed, or investment earns more than the discount rate, so investment will be considered as economically justified. Method is usually applied during the pre-investment period (while investment idea is planning and elaborating), in which the obtained value signalizes the investor either to enter or not into the investment process.

Group of factors that primarily affect the value of the NPV include: the value of initial investment outlay, level of interest rate (higher rates result in the decrease in NPV), value of net annual financial benefits gained from the investment exploitation, etc.

Certain NPV disadvantages are: difficulties to determine proper discount rate (in reality risk is dynamic category that requires constant recalculation of the used discount rate); it is useful just for the projects whose costs and benefits could be expressed in monetary value; method could not be used for risky investments as it does not accounts to managerial flexibility in situation of frequent inflow/outflow fluctuations; etc.

2) Internal Rate of Return (IRR)

This is a method which could present absolute and relative effectiveness of investment. Nowadays it is widely used for the evaluation of investments at the level of legal entity (e.g. for assessment whether it is worth to invest in certain project at the farm). It's a powerful tool for ranking of investment alternatives towards the level of their economic effectiveness.

Indicator could be observed like the interest rate under which the sums of cash inflows and cash outflows that have appeared during the investment procurement and exploitation are mutually equating after they have been discounted to the previously defined moment (usually the initial moment of investment object implementation).

Indicator shows the average ability of invested financial assets to earn the money during life cycle of investment. It represents the interest rate at which the NPV equals to zero, while ratio between the cash inflows and cash outflows equals to one. The method indicates for how much the discount (i.e. interest) rate may increase while the investment still remains economically justified. Internal rate of return (IRR) could be presented by following mathematical formula:

$$0 = NPV = \sum_{t=1}^{n} CF_t \ /(1+IRR)^t$$

Where,

CF_t - net cash flow gained in year t, while t could take value from 1 to n (n represents entire period of investment exploitation);

IRR - internal rate of return;

NPV - net present value.

Internal rate of return could be also calculated by next formula:

$$IRR = i_{min} + (i_{max} - i_{min}) * \frac{NPV(+)}{NPV(+) + |\ NPV(-)\ |}$$

Where,

IRR - internal rate of return;

NPV (+) - net present value of the investment under discount rate (i_{min});

NPV (-) - net present value of the investment under discount rate (i_{max});

i_{min} - discount rate under which the value of NPV is positive for the last time;

i_{max} - discount rate under which the value of NPV is negative for the first time.

Evaluation of investment considers the comparison of IRR with assumed interest rate (i - usually the interest rate at which the financial assets could be borrowed). Investment is economically justified when the value of IRR is above or equals to assumed interest rate (IRR ≥ i). Contrary, if the value of IRR is less than assumed interest rate (i), it could be considered that project's rate of return will not overrun its costs (costs of debt and equity), so project has to be rejected. The higher the IRR, the project is characterized with higher growth potential. Sometimes investors are facing the situation that very small (by value) investment could gain towering IRR, while in some cases they could pick the investment with lower IRR but higher absolute value opportunity.

The value of used interest rate is the most often conditioned by: expected investment life cycle, expected risk level within the period of investment exploitation, used structure of assets for financing of investment, etc. Structure of initially used financial assets (relation between the amounts of internal - farm assets and external - borrowed assets) for the investment procurement, usually affects the use of mixed (weighted) interest rate during the IRR or NPV calculation. Used "calculative" interest rate implies exact proportion of financial assets structure and height of interests' rates linked to them.

Method has certain disadvantages: above all its uselessness in situations in which there is negative cash flow, or there are frequent cash flow oscillations from-to positive-negative values (except in initial moment of investment implementation); as a decision making tool method is generally unreliable in assessment of mutually exclusive investments or investments that largely differ in length of life cycle; method is impractical if the interest rate at capital market is unstable; etc.

Determination of IRR could be affected by certain factors such are the amount and distribution of economic benefits within the period of investment exploitation, the value of initial outlay, duration of investment life cycle, etc.

3) Discounted (Dynamic) Payback Period (DPP)

Any investor is eager to know the time of the expected return of initially invested financial assets. Method represents a sort of determination of the amortization period of implemented investment, i.e. it determines the period in which it is possible to make a return of initial outlay and settled interest from the sum of discounted net annual benefits derived from the investment exploitation. It could be also defined as a part of planned investment life cycle in which it is feasible to return the previously invested assets together with appropriate level of interest, i.e. until the moment when NPV equals to zero. Indicator could be expressed by following formula:

$$\sum_{t=0}^{[n_d]} (Ci_t - Co_t) * (1+i)^{-t} = NPV([n_d]) < 0$$

$$\sum_{t=0}^{[n_d]+1} (Ci_t - Co_t) * (1+i)^{-t} = NPV([n_d]+1) \geq 0$$

Where,

t - expected life cycle of investment, while t could take value from 0 to n;

$[n_d]$ and $[n_d]+1$ - marginal points of depreciation period;

i - interest rate;

Ci_t - annual cash inflow;

Co_t - annual cash outflow;

NPV - net present value.

Indicator's value is expressed in years. If the payback period of the investment is shorter than its life cycle or shorter than period of loan expiration, investment could be considered as acceptable. A conservative view is that justification of investment requires DPP shorter than the half of investment life cycle.

DPP is mostly used for risk assessment in investment realization, considering the growth of uncertainty in determination of investments' economic effectiveness as times goes by.

Although it's easy to use, method is partially unreliable in evaluation of high value projects, since it carries a certain dose of subjectivity. It is usually used as additional check to the NPV and IRR methods. Main disadvantages of DPP are considered to be: incomplete comprehension of time value of money, as it does not give any indices whether the investment contributes to the growth of the investor's capital, along with the fact that all net cash flows beyond the payback period are ignored. Calculation of DPP could become complex if during the life cycle of investment, a multiple negative cash flows appear.

Break-even analysis

Among the influence of many factors active within the production environment, the biological character of agricultural production primarily affects the certain level of its uncertainty. In these circumstances, the evaluation of economic effectiveness of investment at the farm level can be easily and reliably made by the use of Break-even point (BEP) analysis. BEP analysis is appropriate method for reconsideration of the relation between fixed and variable costs, and returns related to the use of certain investment object. It determines the moment in which the investment will make a positive return. Analysis calculates the volume of production that will initiate the covering of all costs. So BEP could be understood as the critical or minimal value of the production volume or sales incomes under which the investment is not economically justified. Additional indicator related to BEP analysis is the Margin of safety, which presents the level of possible fall (in percentage) of volume of production or sale without loss expression. It can be presented by following formulas (Gutierrez, Dalsted, 1990; Dubas et al., 2011; Hancock et al., 2015):

$$BEP_r = \frac{FC}{GM} * 100$$

$$BEP_v = \frac{I * BEP_r}{100}$$

$$MS = \left(1 - \frac{BEP_v}{I}\right) * 100$$

While,

$$GM = I - VC$$

Where,

BEP_r - Break-even point (relative);

BEP_v - Break-even point (value);

MS - Margin of safety;

GM - Gross margin;

I - incomes;

FC - Fixed costs (immaterial costs without depreciation and paid interest reduced for labour costs);

VC - Variable costs (material costs increased by labour costs).

3. Case study: Evaluation of economic effectiveness of investment in conventional or organic vegetable production in protected area (plastic greenhouse)

Logic and mechanism of application of previously defined methodology will be practically presented within the following case study. The model for choosing the best investment alternative at farm level will be considered in detail.

Description of farm capacities and investment idea

Observed farm is traditionally oriented to vegetable production in protected area (plastic greenhouse). It's located in semi-urban area "green-belt" of the Belgrade, Serbia. Currently, farm has on disposal 5 technically unified plastic greenhouses, with productive capacity of each greenhouse of 500 m^2. According to market requirements and available resources, farm is in position to enlarge its production capacities by building and equipping of new plastic greenhouse at the remote part of property. As at that location exists all technical pre-conditions (access to water – well and public electric grid) for establishment of both, conventional or organic production of veggies, farmer is comparing whether to invest in new greenhouse and enrol in organic production in which he has certain experience (i.e. creation of farm value-added by skipping to new system of production), or to continue with current conventional practice. Being aware of all (dis)advantages of each production system, he will select the best investment alternative according the results and suggestions derived from investments' economic assessment.

It will be procured tunnel type plastic greenhouse, with size of 500 m^2 (dimensions 50 m x 10 m x 4.75 m). It will have galvanized double-pipe construction covered with double foil (proper automatic inflating foil enables creation of air chambers that could increase the inward temperature for several degrees in cold days). The sides of greenhouse could be lifted up for better ventilation during the period with high temperature and humidity. Greenhouse will be purchased together with adequate equipment from local dealer of agro-equipment. Additional equipment involves electric water pump of 2.2. KW and proper irrigation system (its combined system that includes covering of production area with 10 rows of drip system and greenhouse drizzling system framed by installation of 8 fine tuning sprinklers in 2 rows, as well as primary and lateral hoses, connectors, etc.). Costs of greenhouse procurement will also cover transportation to defined location and its installation.

Farm is mostly involved in production of tomatoes, cucumber, peppers, onions and garlic, spinach, green salad, leek, radishes, mangold, carrot, etc. In order to simplify development of investment analysis crop rotation will consider just tomatoes, spinach and green salad. All commonly used inputs (pesticides, fertilizers, seed, tape drip lines, raffia, clips, etc.) are purchased in local agro-pharmacy. Produced vegetables are primarily realized through the green market, and some smaller quantities within the long-term contract with one of city bakeries. In case of potential approaching to organic production, products will be mainly realized at farm gate, while some quantities will be sold at the green market (within department for organically produced agro-food products). In production activities are continuously involved 5 farm members (two generation), while in season and certain production peaks 2-3 external workers are additionally involved (as full employees or on part time basis). Farm disposes with required agro-machinery (tractor, moto-cultivator, equipment, etc.), production and infrastructure facilities (space for manipulation and packaging of vegetables, access to electro transformers, storage for vegetables and inputs, garage, several universal sheds, etc.), land, several wells, transportation van, etc. that can be used for production in newly established facility.

Potential investment, whether it will be used in conventional or organic production, considers identical technical characteristics of procured elements, unique initial outlay, almost identical organization of production activities, etc. So, derived results from applied methods for investment's evaluation could be mutually highly comparable and strongly turned to the selection of the best possible investment alternative (procurement of plastic greenhouse in order to farm approach to organic or conventional production of veggies).

Investment analysis

Procurement of required fixed assets involves several components (Table 1.), whose technical characteristics are previously described.

Table 1. Planned investment in new fixed assets (in EUR)

No.	Description	Value
I	**Production facilities**	**11,250.00**
1.	Plastic green-house (500 m^2)	11,250.00
II	**Equipment**	**1,250.00**
1.	Electric vacuum pump (2.2 kW)	537.64
2.	Irrigation system	712.36

Source: IAE, 2019/2020.

Total value and structure of planned investment is defined in next table (Table 2.). It involves investment in fixed assets and appropriate volume of permanent working capital.

Table 2. Total investment (in EUR)

No.	Description	New investment	Total investment	Share in total investment (in %)
I	**Fixed assets**	**12,500.00**	**12,500.00**	**90.91**
1.	Production facility	11,250.00	11,250.00	81.82
2.	Equipment	1,250.00	1,250.00	9.09
II	**Permanent working capital**	**1,250.00**	**1,250.00**	**9.09**
Total		**13,750.00**	**13,750.00**	**100.00**

Source: IAE, 2019/2020.

In line with general agro-accounting practice, investment in permanent working capital as a part of investment in plastic green-house and required equipment for veggies production is determined as 10% of the value of fixed assets. Within the structure of total investment more than 90% will be linked to the procurement of fixed assets, while more than 80% relies to the purchase of needed production facility (plastic green-house).

Financing of investment assumes partly use of farm financial resources (accumulation), where part of used sum will be additionally refunded with the public grant for farm investments in greenhouses establishment (it could be refunded up to the 60% of the total value of investment (in fixed assets) excluding the VAT). Rest will be financed from bank credit. With farm's financial assets, entire value of permanent working capital and larger part of fixed assets will be financed. Within the structure of financing sources share of accumulation is for almost 50% higher than the share of borrowed capital (Table 3.).

Table 3. Sources of investment's financing (in EUR)

No.	Description	New investment	Total investment	Share in total investment (in %)
I	**Internal financial resources**	**8,125.00**	**8,125.00**	**59.09**
1.	Fixed assets	6,875.00	6,875.00	50.00
2.	Permanent working capital	1,250.00	1,250.00	9.09
II	**External financial resources**	**5,625.00**	**5,625.00**	**40.91**
1.	Fixed assets	5,625.00	5,625.00	40.91
Total			**13,750.00**	**100.00**

Source: IAE, 2019/2020.

Analysis is based on "calculative" interest rate of 3.05%. It represents weighted interest rate, gained after the crossing of share of used internal and external financial assets with the value of their interests' rates. It is assumed that internal financial assets could be saved in the bank under the interest rate of 1%, while farm would take the commercial credit under the interest rate of 6%. Repayment of credit will last for 5 years.

According to the above formation of total farm income will consider crop rotation of three crops (tomatoes, spinach and green salad) and assigned value of subsidies for establishment of organic production. Related to discrepancy in gained yields and market prices, total value of annually generated farm income differs toward the applied production system (Tables 4.1. and 4.2.).

Differences in sale prices are mostly the result of gained price premium for organic products at local market. Lower yields in organic production of vegetables derive from reduced input application and farm tendency to compensate the products' quantity with higher quality. Differences in fruit classes are not in relation to their quality, but to the unstandardized fruit size and shape. Write-offs mostly consider spoiled vegetable, or mechanically damaged fruits that are not for human consumption. As farmer is fully experienced in applied production technology, it's assumed that it will not come to the expressed oscillations in gained yields. Besides, stability of local market is resulting in identical prices of vegetable during the entire life cycle of investment. In other words, analysis considers the immutable amount of total annual incomes.

Farmer could generate for almost 18% higher incomes while practicing the organic production. It is primarily caused by unsaturated local market of organic products that boosts products' prices, and relatively high income of consumers willing to buy organic products (farm products are mainly realized in Belgrade, large regional consumer centre). State incentives related to veggies production are slightly over the 1% of the sum of total incomes.

As direct material (main inputs) are considered seedlings, and used fertilizers and pesticides (Table 5.). It should be mentioned that costs of seedlings involve the costs of their production at the farm and price of previously purchased seed of veggies. Types of inputs that are commonly used at farm are most often advised by local extension officer, representative of national association of organic producers or local dealers of agro-inputs. Applied volumes of certain input are in line with general recommendations and applied practice.

Table 4.1. Forming of total farm incomes (cash inflow), (in EUR) - conventional production

Source: IAE, 2019/2020.

No.	Products, subsidies and services	UM	Year of investment life cycle														
			I			II			III			IV			V		
			Price per UM	Quantity	Value	Price per UM	Quantity	Value	Price per UM	Quantity	Value	Price per UM	Quantity	Value	Price per UM	Quantity	Value
0	1	2	3	4	5=3x4	6	7	8=6x7	9	10	11=9x10	12	13	14=12x13	15	16	17=15x16
1.	Sales incomes				13,458.06			13,458.06			13,458.06			13,458.06			13,458.06
1.1.	Spinach I class (90%)	kg	0.85	1,125.00	956.72	0.85	1,125.00	956.72	0.85	1,125.00	956.72	0.85	1,125.00	956.72	0.85	1,125.00	956.72
1.2.	Spinach II class (9%)	kg	0.60	112.50	66.97	0.60	112.50	66.97	0.60	112.50	66.97	0.60	112.50	66.97	0.60	112.50	66.97
1.3.	Spinach rejected (1%)	kg	0.00	12.5	0.00	0.00	12.5	0.00	0.00	12.5	0.00	0.00	12.5	0.00	0.00	12.5	0.00
1.4.	Tomatoes I class (88%)	kg	0.94	8,250.00	7,717.53	0.94	8,250.00	7,717.53	0.94	8,250.00	7,717.53	0.94	8,250.00	7,717.53	0.94	8,250.00	7,717.53
1.5.	Tomatoes II class (10%)	kg	0.65	937.50	613.89	0.65	937.50	613.89	0.65	937.50	613.89	0.65	937.50	613.89	0.65	937.50	613.89
1.6.	Tomatoes rejected (2%)	kg	0.00	187.50	0.00	0.00	187.50	0.00	0.00	187.50	0.00	0.00	187.50	0.00	0.00	187.50	0.00
1.7.	Green salad I class (90%)	pcs	0.43	9,018.00	3,834.53	0.43	9,018.00	3,834.53	0.43	9,018.00	3,834.53	0.43	9,018.00	3,834.53	0.43	9,018.00	3,834.53
1.8.	Green salad II class (9%)	pcs	0.30	901.80	268.42	0.30	901.80	268.42	0.30	901.80	268.42	0.30	901.80	268.42	0.30	901.80	268.42
1.9.	Green salad rejected (1%)	pcs	0.00	100.20	0.00	0.00	100.20	0.00	0.00	100.20	0.00	0.00	100.20	0.00	0.00	100.20	0.00
2.	Subsidies	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.	Services	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total incomes					**13,458.06**			**13,458.06**			**13,458.06**			**13,458.06**			**13,458.06**

Table 4.2. Forming of total farm incomes (cash inflow), (in EUR) - organic production

No.	Products, subsidies and services	UM	Year of investment life cycle														
			I			II			III			IV			V		
			Price per UM	Quantity	Value	Price per UM	Quantity	Value	Price per UM	Quantity	Value	Price per UM	Quantity	Value	Price per UM	Quantity	Value
0	1	2	3	4	5=3x4	6	7	8=6x7	9	10	11=9x10	12	13	14=12x13	15	16	17=15x16
1.	Sales incomes				15,636.64			15,636.64			15,636.64			15,636.64			15,636.64
1.1.	Spinach I class (95%)	kg	1.17	989.58	1,157.43	1.17	989.58	1,157.43	1.17	989.58	1,157.43	1.17	989.58	1,157.43	1.17	989.58	1,157.43
1.2.	Spinach II class (4%)	kg	0.82	41.67	34.11	0.82	41.67	34.11	0.82	41.67	34.11	0.82	41.67	34.11	0.82	41.67	34.11
1.3.	Spinach rejected (1%)	kg	0.00	10.42	0.00	0.00	10.42	0.00	0.00	10.42	0.00	0.00	10.42	0.00	0.00	10.42	0.00
1.4.	Tomatoes I class (92%)	kg	1.29	7,187.50	9,247.24	1.29	7,187.50	9,247.24	1.29	7,187.50	9,247.24	1.29	7,187.50	9,247.24	1.29	7,187.50	9,247.24
1.5.	Tomatoes II class (6%)	kg	0.90	468.75	422.16	0.90	468.75	422.16	0.90	468.75	422.16	0.90	468.75	422.16	0.90	468.75	422.16
1.6.	Tomatoes rejected (2%)	kg	0.00	156.25	0.00	0.00	156.25	0.00	0.00	156.25	0.00	0.00	156.25	0.00	0.00	156.25	0.00
1.7.	Green salad I class (95%)	pcs	0.58	7,932.50	4,638.97	0.58	7,932.50	4,638.97	0.58	7,932.50	4,638.97	0.58	7,932.50	4,638.97	0.58	7,932.50	4,638.97
1.8.	Green salad II class (4%)	pcs	0.41	334.00	136.73	0.41	334.00	136.73	0.41	334.00	136.73	0.41	334.00	136.73	0.41	334.00	136.73
1.9.	Green salad rejected (1%)	pcs	0.00	83.50	0.00	0.00	83.50	0.00	0.00	83.50	0.00	0.00	83.50	0.00	0.00	83.50	0.00
2.	Incentives*	ha	221.11	0.05	11.06	221.11	0.05	11.06	221.11	0.05	11.06	221.11	0.05	11.06	221.11	0.05	11.06
3.	Subsidies**	500 m^2	350.00	0.60	210.00	350.00	0.60	210.00	350.00	0.60	210.00	350.00	0.60	210.00	350.00	0.60	210.00
4.	Services	ha	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total incomes					**15,857.70**			**15,857.70**			**15,857.70**			**15,857.70**			**15,857.70**

Source: IAE, 2019/2020.

*State incentives for establishment of organic production (on annual basis) are approximately 221 EUR/ha (www.agropress.org.rs/cir/details/itemlist/tag/organska%20proizvodnja).

**State subsidies for covering of control and certification costs (up to 50% without VAT), (www.srbijadanas.com/biz/novcanik/zasto-je-organska-hrana-u-srbiji-toliko-skupa-2019-01-18

Table 5. Planned costs of direct material (main inputs), (in EUR)

No.	Description	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
1.	Seedlings	1,574.53	1,574.53	1,574.53	1,574.53	1,574.53
2.	Mineral fertilizers	133.64	133.64	133.64	133.64	133.64
3.	Pesticides	229.39	229.39	229.39	229.39	229.39
Total		**1,937.55**	**1,937.55**	**1,937.55**	**1,937.55**	**1,937.55**
Organic production of vegetables						
1.	Seedlings	1,731.12	1,731.12	1,731.12	1,731.12	1,731.12
2.	Mineral fertilizers	146.93	146.93	146.93	146.93	146.93
3.	Pesticides	252.20	252.20	252.20	252.20	252.20
Total		**2,130.24**	**2,130.24**	**2,130.24**	**2,130.24**	**2,130.24**

Source: IAE, 2019/2020.

In order to fully simplify conducted analysis, in line with farmer's previous experience and assumed price stability, all presented categories of costs represent the value of optimal quantity of used inputs towards the selected crops and system of production (inter-annually all costs within the certain cost category have unique value). Used inputs in organic production generate for almost 10% higher annual costs.

Table 6. Planned costs of electricity and fuel (in EUR)

No.	Description	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
1.	Electricity	233.44	233.44	233.44	233.44	233.44
2.	Fuel	340.06	340.06	340.06	340.06	340.06
Total		**573.50**	**573.50**	**573.50**	**573.50**	**573.50**
Organic production of vegetables						
1.	Electricity	228.77	228.77	228.77	228.77	228.77
2.	Fuel	329.65	329.65	329.65	329.65	329.65
Total		**558.42**	**558.42**	**558.42**	**558.42**	**558.42**

Source: IAE, 2019/2020.

Electricity is mainly used for running of irrigation system, while fuel is spent in some activities that imply use of mechanization (e.g. soil cultivation prior to planting of new crop, transportation, etc.). Considering fairly balanced water needs of used crops, almost unified level of transportation and utilized mechanization, observed systems of production could assume approximately identical costs of energy (Table 6.).

Table 7. Planned other material costs (in EUR)

No.	Descriptions	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
1.	Change of external foil at the facility	0.00	0.00	0.00	0.00	661.44
2.	Packaging	252.45	227.66	240.06	252.45	227.66
3.	Binder and raffia	11.48	11.48	11.48	11.48	11.48
4.	Mulch foil	29.75	29.75	29.75	29.75	29.75
5.	Drip tapes	38.67	38.67	38.67	38.67	38.67
6.	Water purification filter	9.92	9.92	9.92	9.92	9.92
Total		**342.26**	**317.47**	**329.87**	**342.26**	**978.91**
Organic production of vegetables						
1.	Change of external foil at the facility	0.00	0.00	0.00	0.00	661.44
2.	Packaging	238.23	211.46	222.97	238.23	211.46
3.	Binder and raffia	10.52	10.52	10.52	10.52	10.52
4.	Mulch foil	27.27	27.27	27.27	27.27	27.27
5.	Drip tapes	35.45	35.45	35.45	35.45	35.45
6.	Water purification filter	11.34	11.34	11.34	11234	11.34
Total		**322.81**	**296.04**	**307.55**	**322.81**	**957.47**

Source: IAE, 2019/2020.

According to technical specification, change of foil at the plastic green-house (Table 7.) is planned to be carried out every five years. Depending on specific type of vegetable, for packaging plastic bags, wooden or plastic crates or cardboard boxes are mostly used. Primarily in order to prevent deadlocks in work of irrigation system, filters for mechanical purification of water are changed on annual basis. As water is drawing from farm well, there are no costs of used water. There is slight difference between the sums of observed cost category in used production systems.

Annual amount of depreciation of procured facility (plastic green-house) and equipment is calculated under the generally used depreciation rates in agro-accounting practice (Table 8.).

Table 8. Depreciation (in EUR)

Type of investment	Purchase price (without VAT)	Useful life (year)	Depreciation rate (in %)	Annual value of depreciation	Repayment period of credit (years)	Salvage value
Production facility	9,375.00	15	6.67	625.00	5	6,250.00
Equipment	1,041.67	10	10.00	104.17	5	520.83
Fixed assets	**10,416.67**	**-**	**-**	**729.17**	-	**6,770.83**
Permanent working capital	1,250.00	-	-	-	-	**1,125.00**
Salvage value of investment		**-**	**-**	**-**	-	**8,020.83**

Source: IAE, 2019/2020.

Calculation of annual value of depreciation considers the price of purchased fixed assets decreased for the VAT value. Under salvage value of investment in our case is considered the undepreciated book value of fixed assets left after the repayment of entire credit increased for the value of permanent working capital. In order to facilitate investment analysis, it is assumed that repayment period of used credit and life cycle of investment will last the same time period (5 years).

Costs of labour (Table 9.) involve just costs of external labour that will be engaged in newly established green-house. Paid gross salary is in line with average gross salary at local level, characteristic for this sector of agriculture. Both, full and seasonal employees are skilful and experienced in vegetable production, and they are mostly engaged in farm activities for many years. For almost 15% higher salaries in organic production are caused by more expressed requirement for manual labour during the usual daily shifts.

Table 9. Required labour and costs of labour (in EUR)

No.	Description	Number of workers	Share in total number of employees (in %)	Average number of working months	Average monthly gross salary	Average annual gross salary
0	1	2	3	4	5	6 = 2 x 4 x 5
Conventional production of vegetables						
I	**Full employees**	2	50.00	9	415.87	7,485.70
II	**Seasonal employees**	2	50.00	1	415.87	831.74
Total		**4**	**100.00**	**10**	**831.74**	**8,317.44**
Organic production of vegetables						
I	**Full employees**	2	50.00	9	476.73	8,581.16
II	**Seasonal employees**	2	50.00	1	476.73	953.46
Total		**4**	**100.00**	**10**	**953.46**	**9,534.63**

Source: IAE, 2019/2020.

As was previously said, farm will take a 5 year credit from the commercial bank. The credit values 5,000 EUR. Grace period is one year, and credit is burdened with 6 % interest rate. Annuities will be paid quarterly (calculated by the method of equal annuities), (Table 10.).

Table 10. Credit repayment (in EUR)

Year of investment life cycle	Unpaid part of credit	Interest	Principal	Annuity
I	5,962.50	0.00	0.00	0.00
II	4,602.43	327.53	1,360.07	1,687.60
III	3,158.90	244.07	1,443.53	1,687.60
IV	1,626.79	155.49	1,532.11	1,687.60
V	0.00	61.47	1,626.13	1,687.60

Source: IAE, 2019/2020.

There are large differences between the generated non-material costs in observed systems of production (depending on the year, they are three to four times higher in organic production). In conventional production, non-material costs are primarily directed to paying fitting local or national taxes (e.g. tax for melioration, property tax, etc.) greenmarket fees, maintenance of mechanisation, etc. (Table 11.). On the other side, total sum of non-material costs in organic production is additionally burdened with the costs of control and certification of production activities, as well as with the costs of required laboratory analyses (farm traditionally practices the crop-rotation of three crops. Soil and water analysis are made every second year, usually before the start of vegetation. Fruits of each crop are analysed after harvesting. Fruit analysis is 127.56 EUR/crop, while soil and water analysis involved in calculation amounts 85.04 EUR each).

Table 11. Other non-material costs (in EUR)

No.	Description	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
1.	Taxes and greenmarket fee	225.00	225.00	225.00	225.00	225.00
2.	Other non-material costs	57.50	57.50	57.50	57.50	57.50
Total		**282.50**	**282.50**	**282.50**	**282.50**	**282.50**
Organic production of vegetables						
1.	Laboratory analysis (soil, water and fruit)	552.77	382.69	552.77	382.69	552.77
2.	Control and certification	405.00	405.00	405.00	405.00	405.00
3.	Taxes and other costs	87.50	87.50	87.50	87.50	87.50
Total		**1,045.27**	**875.19**	**1,045.27**	**875.19**	**1,045.27**

Source: IAE, 2019/2020.

In both system of veggies production, within the sum of total costs the group of non-material costs are dominating (Table 12.). This is primarily caused by the fact that vegetable growing in green-house is labour intensive production. Quite a high share in the structure of total costs has the costs of direct material. It could be noticed that cash outflow is pretty much unvaried throughout the entire life cycle of investment. Besides, in average sum of total costs is for more than 16.5% higher in organic than in conventional production.

Table 12. Forming of total costs of production (cash outflow), (in EUR)

No.	Cost category	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
I	**Material costs**	**2,853.32**	**2,828.53**	**2,840.92**	**2,853.32**	**3,489.96**
1.	Direct material	1,937.55	1,937.55	1,937.55	1,937.55	1,937.55
2.	Energy	573.50	573.50	573.50	573.50	573.50
3.	Other material costs	342.26	317.47	329.87	342.26	978.91
II	**Non-material costs**	**9,329.11**	**9,656.64**	**9,573.18**	**9,484.60**	**9,390.58**
1.	Depreciation	729.17	729.17	729.17	729.17	729.17
2.	Labour	8,317.44	8,317.44	8,317.44	8,317.44	8,317.44
3.	Interest	0.00	327.53	244.07	155.49	61.47
4.	Other non-material costs	282.50	282.50	282.50	282.50	282.50
Total (I+II)		**12,182.42**	**12,485.16**	**12,414.10**	**12,337.91**	**12,880.54**

Organic production of vegetables						
I	**Material costs**	**3,011.47**	**2,984.70**	**2,996.21**	**3,011.47**	**3,646.14**
1.	Direct material	2,130.24	2,130.24	2,130.24	2,130.24	2,130.24
2.	Energy	558.42	558.42	558.42	558.42	558.42
3.	Other material costs	322.81	296.04	307.55	322.81	957.47
II	**Non-material costs**	**11,309.06**	**11,466.51**	**11,553.13**	**11,294.47**	**11,370.54**
1.	Depreciation	729.17	729.17	729.17	729.17	729.17
2.	Labour	9,534.63	9,534.63	9,534.63	9,534.63	9,534.63
3.	Interest	0.00	327.53	244.07	155.49	61.47
4.	Other non-material costs	1,045.27	875.19	1,045.27	875.19	1,045.27
Total (I+II)		**14,320.53**	**14,451.21**	**14,549.35**	**14,305.94**	**15,016.68**

Source: IAE, 2019/2020.

Value of net profit is well-balanced during the observed period. Significant cut in last year is caused by the costs that will be paid for foil changing (Table 13.). It should be noted that income tax could differs from country to country (its value in Serbia for family farms is 10%), in line with tax legislation. As previously mentioned, somewhat higher values of net profit gained in organic production (in average over the 30%) are generally caused by attraction of price premium at local market.

Table 13. Profit and loss statement (in EUR)

No.	Description	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
I	**Total incomes (1+2+3)**	**13,458.06**	**13,458.06**	**13,458.06**	**13,458.06**	**13,458.06**
1.	Sales incomes	13,458.06	13,458.06	13,458.06	13,458.06	13,458.06
2.	Subsidies	0.00	0.00	0.00	0.00	0.00
3.	Other incomes (services)	0.00	0.00	0.00	0.00	0.00
II	**Total expenditures (1+2)**	**12,182.42**	**12,485.16**	**12,414.10**	**12,337.91**	**12,880.54**
1.	Business expenditures	12,182.42	12,157.64	12,170.03	12,182.42	12,819.07
1.1.	Material costs	2,853.32	2,828.53	2,840.92	2,853.32	3,489.96
1.2.	Non-material costs without depreciation and interest	8,599.94	8,599.94	8,599.94	8,599.94	8,599.94
1.3.	Depreciation	729.17	729.17	729.17	729.17	729.17
2.	Financial expenditures	0.00	327.53	244.07	155.49	61.47
2.1.	Interest	0.00	327.53	244.07	155.49	61.47
III	**Gross profit (I-II)**	**1,275.64**	**972.90**	**1,043.96**	**1,120.15**	**577.52**
IV	**Income tax**	127.56	97.29	104.40	112.01	57.75
V	**Net profit (III-IV)**	**1,148.07**	**875.61**	**939.57**	**1,008.13**	**519.77**
Organic production of vegetables						
I	**Total incomes (1+2+3)**	**15,857.70**	**15,857.70**	**15,857.70**	**15,857.70**	**15,857.70**
1.	Sales incomes	15,636.64	15,636.64	15,636.64	15,636.64	15,636.64
2.	Subsidies	221.06	221.06	221.06	221.06	221.06
3.	Other incomes (services)	0.00	0.00	0.00	0.00	0.00
II	**Total expenditures (1+2)**	**14,320.53**	**14,451.21**	**14,549.35**	**14,305.94**	**15,016.68**
1.	Business expenditures	14,320.53	14,123.68	14,305.28	14,150.45	14,955.20
1.1.	Material costs	3,011.47	2,984.70	2,996.21	3,011.47	3,646.14
1.2.	Non-material costs without depreciation and interest	10,579.90	10,409.81	10,579.90	10,409.81	10,579.90
1.3.	Depreciation	729.17	729.17	729.17	729.17	729.17
2.	Financial expenditures	0.00	327.53	244.07	155.49	61.47
2.1.	Interest	0.00	327.53	244.07	155.49	61.47
III	**Gross profit (I-II)**	**1,537.16**	**1,406.49**	**1,308.35**	**1,551.76**	**841.02**
IV	**Income tax**	153.72	140.65	130.84	155.18	84.10
V	**Net profit (III-IV)**	**1,383.45**	**1,265.84**	**1,177.52**	**1,396.58**	**756.92**

Source: IAE, 2019/2020.

Like in case with net profit, during the formation of both flows (net cash or economic flow), the value of final result gained in organic production is in some extent more expressed (primarily initiated at income side), (Tables 14. and 15.). Of course, comparing the both flows, final results gained in economic flow are generally higher as they not involve obligation towards the financial resources (paid annuities). In further analysis of investment (development of static and dynamic assessment indicators) the economic flow will be used.

Table 14. Forming of net cash flow (in EUR)

No.	Description	Zero moment	Year of investment life cycle				
			I	II	III	IV	V
	Conventional production of vegetables						
I	**Total cash inflow (1+2+3)**	**13,750.00**	**19,708.06**	**13,458.06**	**13,458.06**	**13,458.06**	**21,478.90**
1.	Total income	0,00	13,458.06	13,458.06	13,458.06	13,458.06	13,458.06
2.	Financial resources	13,750.00					
	2.1. Internal resources	8,125.00					
	2.2. External resources	5,625.00					
3.	Salvage value	0,00	6,250.00	0.00	0.00	0.00	8,020.83
	3.1. Fixed assets	0,00	6,250.00				6,770.83
	3.2. Permanent working capital	0,00					1,250.00
II	**Total cash outflow (4+5+6+7)**	**13,750.00**	**11,580.82**	**13,213.36**	**13,232.86**	**13,252.87**	**13,835.26**
4.	Investment value	13,750.00					
	4.1. In fixed assets	12,500.00					
	4.2. In permanent working capital	1,125.00					
5.	Costs without depreciation and interest	0.00	11,453.26	11,428.47	11,440.86	11,453.26	12,089.90
6.	Income tax	0.00	127.56	97.29	104.40	112.01	57.75
7.	Obligation towards financial resources (annuities)	0.00	0.00	1,687.60	1,687.60	1,687.60	1,687.60
III	**Net cash flow (I-II)**	**0.00**	**8,127.24**	**244.70**	**225.20**	**205.19**	**7,643.64**
	Organic production of vegetables						
I	**Total cash inflow (1+2+3)**	**13,750.00**	**22,107.70**	**15,857.70**	**15,857.70**	**15,857.70**	**23,878.53**
1.	Total income	0,00	15,857.70	15,857.70	15,857.70	15,857.70	15,857.70
2.	Financial resources	13,750.00					
	2.1. Internal resources	8,125.00					
	2.2. External resources	5,625.00					
3.	Salvage value	0,00	6,250.00	0.00	0.00	0.00	8,020.83
	3.1. Fixed assets	0,00	6,250.00				6,770.83
	3.2. Permanent working capital	0,00					1,250.00
II	**Total cash outflow (4+5+6+7)**	**13,750.00**	**13,745.08**	**15,222.77**	**15,394.55**	**15,264.06**	**15,997.74**
4.	Investment value	13,750.00					
	4.1. In fixed assets	12,500.00					
	4.2. In permanent working capital	1,250.00					
5.	Costs without depreciation and interest	0.00	13,591.37	13,394.52	13,576.11	13,421.28	14,226.04
6.	Income tax	0.00	153.72	140.65	130.84	155.18	84.10
7.	Obligation towards financial resources (annuities)	0.00	0.00	1,687.60	1,687.60	1,687.60	1,687.60
III	**Net cash flow (I-II)**	**0.00**	**8,362.61**	**634.93**	**463.15**	**593.64**	**7,880.79**

Source: IAE, 2019/2020.

Table 15. Forming of economic flow (in EUR)

No.	Description	Zero moment	Year of investment life cycle				
			1	2	3	4	5
	Conventional production of vegetables						
I	**Total cash inflow (1+2)**	**0,00**	**19,708.06**	**13,458.06**	**13,458.06**	**13,458.06**	**21,478.90**
1.	Total income	0,00	13,458.06	13,458.06	13,458.06	13,458.06	13,458.06
2.	Salvage value	0,00	6,250.00	0.00	0.00	0.00	8,020.83
	2.1. Fixed assets	0,00	6,250.00				6,770.83
	2.2. Permanent working capital	0,00					1,125.00
II	**Total cash outflow (3+4+5)**	**13,750.00**	**11,580.82**	**11,525.76**	**11,545.26**	**11,565.27**	**12,147.66**
3.	Investment value	13,750.00					
	3.1. In fixed assets	12,500.00					
	3.2. In permanent working capital	1,250.00					
4.	Costs without depreciation and interest	0,00	11,453.26	11,428.47	11,440.86	11,453.26	12,089.90
5.	Income tax	0.00	127.56	97.29	104.40	112.01	57.75

III	**Net cash flow (I-II)**	**-13,750.00**	**8,127.24**	**1,932.30**	**1,912.80**	**1,892.79**	**9,331.24**
	Organic production of vegetables						
I	**Total cash inflow (1+2)**	**0,00**	**22,107.70**	**15,857.70**	**15,857.70**	**15,857.70**	**23,878.53**
1.	Total income	0,00	15,857.70	15,857.70	15,857.70	15,857.70	15,857.70
2.	Salvage value	0,00	6,250.00	0.00	0.00	0.00	8,020.83
	2.1. Fixed assets	0,00	6,250.00				6,770.83
	2.2. Permanent working capital	0,00					1,250.00
II	**Total cash outflow (3+4+5)**	**13,750.00**	**13,745.08**	**13,535.17**	**13,706.95**	**13,576.46**	**14,310.14**
3.	Investment value	13,750.00					
	3.1. In fixed assets	12,500.00					
	3.2. In permanent working capital	1,250.00					
4.	Costs without depreciation and interest	0,00	13,591.37	13,394.52	13,576.11	13,421.28	14,226.04
5.	Income tax	0.00	153.72	140.65	130.84	155.18	84.10
III	**Net cash flow (I-II)**	**-13,750.00**	**8,362.61**	**2,322.53**	**2,150.75**	**2,281.24**	**9,568.39**

Source: IAE, 2019/2020.

The economic result (i.e. economic effect of the farm business) depends both of the market value of realized production and incurred costs. In case that market value of farm output overcomes the incurred costs, it will gain certain level of gross profit and accumulation. Otherwise farm will realize loss and possible insolvency (Sredojević, Simić, 2016). Investment is economically justified in both systems, as the value of Economical-efficiency coefficient is higher than one in representative year (fifth year) of investment exploitation (Table 16.). According to this indicator it could be not be determined to which system investment fits the best, as in both cases indicator has shown almost identical values during the entire life cycle of investment.

Table 16. Economical-efficiency coefficient (in EUR), (Ee > 1)

Year of investment life cycle	Total output (market value of production)	Total input (costs of production)	Ee
0	**1**	**2**	**3 = 1/2**
Conventional production of vegetables			
I	13,458.06	12,182.42	1.10
II	13,458.06	12,485.16	1.08
III	13,458.06	12,414.10	1.08
IV	13,458.06	12,337.91	1.09
V*	13,458.06	12,880.54	1.04
Organic production of vegetables			
I	15,636.64	14,320.53	1.09
II	15,636.64	14,451.21	1.08
III	15,636.64	14,549.35	1.07
IV	15,636.64	14,305.94	1.09
V*	15,636.64	15,016.68	1.04

Source: IAE, 2019/2020.

Like with previous indicator, similar situation occurs with Net profit margin ratio (Table 17.). Investment is economically justified in both systems, as the indicator value is higher than assumed “calculative” interest rate (weighted interest rate, i.e. 3.05%), as in representative, as well as in all other observed years. Sharp drop in indicators’ value in fifth year is affected by the costs of foil change. Assessment of investment based on this indicator slightly favours the system of organic production.

Table 17. Net profit margin ratio (in EUR), (NPMR > i)

Year of investment life cycle	Profit	Total output (income)	NPMR
0	**1**	**2**	**3 = 1/2*100**
Conventional production of vegetables			
I	1,148.07	13,458.06	8.53
II	875.61	13,458.06	6.51
III	939.57	13,458.06	6.98
IV	1,008.13	13,458.06	7.49
V*	519.77	13,458.06	3.86
Organic production of vegetables			
I	1,383.45	15,636.64	8.85
II	1,265.84	15,636.64	8.10
III	1,177.52	15,636.64	7.53
IV	1,396.58	15,636.64	8.93
V*	756.92	15,636.64	4.84

Source: IAE, 2019/2020.

Considering ARR (Table 18.), investment could economically fit both systems, as the value of indicator in representative year oversteps the value of supposed "calculative" interest rate, i.e. 3.05%. Again, sharp drop in indicators' value in representative year is affected by the costs of foil change. According to this indicator, investment is better matching for the organic production.

Table 18. Accounting rate of return (in EUR), (ARR > i)

Year of investment life cycle	Profit	Initial outlay	ARR
0	**1**	**2**	**3 = 1/2*100**
Conventional production of vegetables			
I	1,148.07	13,750.00	8.35
II	875.61	13,750.00	6.37
III	939.57	13,750.00	6.83
IV	1,008.13	13,750.00	7.33
V*	519.77	13,750.00	3.78
Organic production of vegetables			
I	1,383.45	13,750.00	10.06
II	1,265.84	13,750.00	9.21
III	1,177.52	13,750.00	8.56
IV	1,396.58	13,750.00	10.16
V*	756.92	13,750.00	5.50

Source: IAE, 2019/2020.

Table 19. Simple payback period (in EUR), (SPP < n)

Year of investment life cycle	Net cash flow from economic flow	Cumulative net cash flow
Conventional production of vegetables		
0	-13,750.00	-13,750.00
I	8,127.24	-5,622.76
II	1,932.30	-3,690.46
III	1,912.80	-1,777.65
IV	1,892.79	115.14
V	9,331.24	9,446.38
Organic production of vegetables		
0	-13,750.00	-13,750.00
I	8,362.61	-5,387.39
II	2,322.53	-3,064.85
III	2,150.75	-914.10
IV	2,281.24	1,367.14
V	9,568.39	10,935.53

Source: IAE, 2019/2020.

According to value for SPP (Table 19.), investment will be returned in 3 years and 11.27 months in case of conventional production, or 3 years and 4.81 months in case of organic production. In both systems of production investment will be economically effective, as its exploitation will successfully compensate initial outlay before the date of credit expiration. SPP also slightly favours the organic production.

In relation to the NPV (Table 20.), in both cases, during the use of investment in observed five years period, investment will make the increase in investors' profit possible (discounted by the i = 3.05 to the zero moment) for almost 7.5 thousands EUR, or almost 8.8 thousands EUR. According to this indicator, preference will be given to investments' implementation within the organic system of production.

Table 20. Net present value (NPV) and internal rate of return (IRR), (in EUR)

No.	Description	Zero moment	Year of investment life cycle					Cumulative
			I	II	III	IV	V	
0	1	2	3	4	5	6	7	8
Conventional production of vegetables								
1.	Net cash flow from economic flow (columns 3 to 7)	-13,750.00	8,127.24	1,932.30	1,912.80	1,892.79	9,331.24	***23,196.38***
2.	Discount rate (%)	3.05	3.05	3.05	3.05	3.05	3.05	-
3.	Discount factor $(1+i)^{-n}$ where i = discount rate; n = year of investment life cycle	1.0000	0.9704	0.9418	0.9139	0.8869	0.8607	-
4.	Present value of net cash flow from economic flow (columns 3 to 7)	-13,750.00	7,887.04	1,819.78	1,748.17	1,678.75	8,031.47	***21,165.22***
5.	**Net present value of investment (columns 2 to 7)**	**7,415.22**						
6.	**Relative net present value of investment [(columns 2 to 7) / | column 2|]*100 > i**	**54.00%**						
7.	**Internal rate of return (IRR > i)**	**20.46%**						
Organic production of vegetables								
1.	Net cash flow from economic flow (columns 3 to 7)	-13,750.00	8,362.61	2,322.53	2,150.75	2,281.24	9,568.39	***24,685.53***
2.	Discount rate (%)	3.05	3.05	3.05	3.05	3.05	3.05	
3.	Discount factor $(1+i)^{-n}$ where i = discount rate; n = year of investment life cycle	1.0000	0.9704	0.9418	0.9139	0.8869	0.8607	
4.	Present value of net cash flow from economic flow (columns 3 to 7)	-13,750.00	8,115.46	2,187.28	1,965.64	2,023.28	8,235.59	***22,527.25***
5.	**Net present value of investment (columns 2 to 7)**	**8,777.25**						
6.	**Relative net present value of investment [(columns 2 to 7) / | column 2|]*100 > i**	**64.00%**						
7.	**Internal rate of return (IRR > i)**	**23.49%**						

Source: IAE, 2019/2020.

According to IRR, investment is profitable in both systems of production, as indicators' value significantly overcomes the "calculative" interest rate (3.05%), and even interest rate related to borrowed capital (6.00%). Considering higher IRR value, it could be concluded that investment utilization better fits the system of organic production.

Considering DPP (Table 21.), investment will be returned in 4 years and 0.92 months in case of conventional production, or 3 years and 8.79 months in case of organic production. So, investment is economically justified in both production systems, as it will result in credit repayment before its expiration. Like in case of SPP, this indicator also favours the organic production.

Table 21. Dynamic payback period (in EUR), (DPP < n)

Year of investment life cycle	Present value of net cash flow from economic flow	Cumulative net cash flow
Conventional production of vegetables		
0	-13,750.00	-13,750.00
I	7,887.04	-5,862.96
II	1,819.78	-4,043.18
III	1,748.17	-2,295.01
IV	1,678.75	-616.26
V	8,031.47	7,415.22
Organic production of vegetables		
0	-13,750.00	-13,750.00
I	8,115.46	-5,634.54
II	2,187.28	-3,447.26
III	1,965.64	-1,481.62
IV	2,023.28	541.66
V	8,235.59	8,777.25

Source: IAE, 2019/2020.

Table 22. Variable costs (in EUR)

No.	Description	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
1.	Variable costs (VC = MC + L)	11,170.76	11,145.97	11,158.36	11,170.76	11,807.40
2.	Material costs (MC)	2,853.32	2,828.53	2,840.92	2,853.32	3,489.96
3.	Labour (L)	8,317.44	8,317.44	8,317.44	8,317.44	8,317.44
Organic production of vegetables						
1.	Variable costs (VC = MC + L)	12,546.10	12,519.33	12,530.84	12,546.10	13,180.76
2.	Material costs (MC)	3,011.47	2,984.70	2,996.21	3,011.47	3,646.14
3.	Labour (L)	9,534.63	9,534.63	9,534.63	9,534.63	9,534.63

Source: IAE, 2019/2020.

Table 23. Fixed costs (in EUR)

No.	Description	Year of investment life cycle				
		I	II	III	IV	V
Conventional production of vegetables						
1.	Fixed costs (FC = NMC - L)	282.50	282.50	282.50	282.50	282.50
2.	Non-material costs (NMT), without depreciation and interest	8,599.94	8,599.94	8,599.94	8,599.94	8,599.94
3.	Labour (L)	8,317.44	8,317.44	8,317.44	8,317.44	8,317.44
Organic production of vegetables						
1.	Fixed costs (FC = NMC - L)	1,045.27	875.19	1,045.27	875.19	1,045.27
2.	Non-material costs (NMT), without depreciation and interest	10,579.90	10,409.81	10,579.90	10,409.81	10,579.90
3.	Labour (L)	9,534.63	9,534.63	9,534.63	9,534.63	9,534.63

Source: IAE, 2019/2020.

According to evaluation of investment under uncertainty (Table 24.), use of investment passed the test in both systems of production. In both production systems investment the biggest risk for the investment is in the fifth year of investment exploitation when production volume mustn't fall below 17.11%, or 42.56%, i.e. gained incomes have not fallen below 2,303.26 EUR, or 6,655.27 EUR.

On the other hand, investment in both production systems is least risky in second year of investment use, when it could allow fall in production volume for 87.78%, or 71.92%, i.e. the gained sales income could be decreased for 11,813.71 EUR, or 11,246.65 EUR without fear of financial loss.

Table 24. Break-even point of investment exploitation (in EUR)

No.	Description	Year of investment life cycle				
		I	II	III	IV	V
	Conventional production of vegetables					
1.	Incomes (I)	13,458.06	13,458.06	13,458.06	13,458.06	13,458.06
2.	Variable costs (VC)	11,170.76	11,145.97	11,158.36	11,170.76	11,807.40
3.	Fixed costs (FC)	282.50	282.50	282.50	282.50	282.50
4.	Gross margin (GM = I - VC)	2,287.30	2,312.09	2,299.70	2,287.30	1,650.66
5.	Break-even point (relative) (BEPr = (FC / GM) * 100), in %	12.35	12.22	12.28	12.35	17.11
6.	Break-even point (value) (BEPv = (I * BEPr) / 100), in EUR	1,662.18	1,644.35	1,653.22	1,662.18	2,303.26
7.	Margin of safety (MS = ((1 - (BEPv / I)) * 100), in %	87.65	87.78	87.72	87.65	82.89
	Organic production of vegetables					
1.	Incomes (I)	15,636.64	15,636.64	15,636.64	15,636.64	15,636.64
2.	Variable costs (VC)	12,546.10	12,519.33	12,530.84	12,546.10	13,180.76
3.	Fixed costs (FC)	1,045.27	875.19	1,045.27	875.19	1,045.27
4.	Gross margin (GM = I - VC)	3,090.55	3,117.31	3,105.80	3,090.55	2,455.88
5.	Break-even point (relative) (BEPr = (FC / GM) * 100), in %	33.82	28.08	33.66	28.32	42.56
6.	Break-even point (value) (BEPv = (I * BEPr) / 100), in EUR	5,288.56	4,389.99	5,262.58	4,428.02	6,655.27
7.	Margin of safety (MS = ((1 - (BEPv / I)) * 100), in %	66.18	71.92	66.34	71.68	57.44

Source: IAE, 2019/2020.

Finally, as the step of verification of project assessment, one table that will summarize all used indicators during the economic analysis of investment will be presented (Table 25.).

Table 25. Values of used indicators – summarized

No.	Description	Conventional production	Organic production
1.	Total yields – annually		
1.1.	Spinach (kg/500 m^2)	1,250	1,042
1.2.	Tomatoes (kg/500 m^2)	9,375	7,812
1.3.	Green salad (pcs/500 m^2)	10,020	8,350
2.	Total sales income – annually		
2.1.	Spinach (EUR/500 m^2)	1,024	1,192
2.2.	Tomatoes (EUR/500 m^2)	8,331	9,669
2.3.	Green salad (EUR/500 m^2)	4,103	4,776
3.	Variable costs (EUR/500 m^2) – average	11,290. 65	12,664.63
4.	Total costs (EUR/500 m^2) – average	12,460.03	14,528.74
5.	Discount rate	3.05	3.05
6.	Net profit (EUR/500 m^2) – average	898.23	1,196.06
7.	Static project assessment		
7.1.	Economical-efficiency coefficient – average	1.08	1.07
7.2.	Net profit margin (%) – average	6.67	7.65
7.3.	Accounting rate of return (%) – average	6.53	8.70
7.4.	Simple payback period	3 years and 11.27 months	3 years and 4.81 months
8.	Dynamic project assessment		
8.1.	Net present value (EUR/500 m^2)	7,415.22	8,777.25
8.2.	Internal rate of return (%)	20.46	23.49
8.3.	Dynamic payback period	4 years and 0.92 months	3 years and 8.79 months
9.	Break-even point analysis		
9.1.	Break-even point (%) – average	13.26	33.29
9.2.	Break-even point (EUR/500 m^2) – average	1,785.07	5,204.88
9.3.	Margin of safety (%) – average	86.74	66.71

4. Conclusion

Awareness, understanding, accepting and at the end full implementation of principles of sustainability is fundamental for the further development of agriculture, rural communities and, above all, farms. Creation of the value-added at the farm and in that relation transferring to organic farming could be a road well taken in adjusting to the sustainability requirements (i.e. organic production perfectly matches the farm sustainability concept, as it does not endanger the environment, economically and managerially is viable and socially suitable).

At the other side, farm sustainability is generally difficult to achieve without additional labour engagement, procurement of proper machinery, equipment and supplies, availability of adequate production facilities, tech-tech proactivity, etc., i.e. without sufficient level of investments. Therefore, claim that investments are the prerequisite for survival of agriculture and rural areas has been proven to be very true. Farmers are constantly facing certain issues toward the investment process. There are always some levels of struggle between the lack of available financial assets and value of farm sustainability maintaining. Besides, farmers are usually not fully aware the investment's irreversibility, as well as the level of its own risk aversion, or willingness to get into the investment at all. So, avoiding the selection of wrong investment alternative, which could endanger farm profitability, even drive up to farm bankruptcy, should be in relation to expert investment analysis, i.e. analysis that will eliminate farmer's subjectivity. In order to evaluate economic efficiency of planned investment at the farm usually adequate static (Total Output-Total Input Ratio, Net Profit Margin, Accounting Rate of Return, or Simple Payback Period) and dynamic (Net Present Value, Internal Rate of Return, discounted Payback Period or Brake-even analysis) assessment methods are used.

To interpret the analytical strength of mentioned methods and their influence on selection of the best possible investment alternative, appropriate case study was developed. It considers farmers' justification of economic advantages to invest in plastic greenhouse and necessary equipment for vegetable production. According to the fact that procured assets could be used both in conventional or organic production of veggies, throughout the conducted economical assessment was also considered which system of production would be a better alternative for increasing of farm sustainability. As expected, establishment of organic production proved to be a more rational solution for farm profitability.

There is no firm belief in where is more profitable to invest, as it's not possible to generalize the gained results from the case study, since a small change in production and market presumptions can completely change the presented data. But in line with the fact that investing in both production systems is economically justified, our personal opinion is that from the aspect of current and future generations (whether they are on the side of production or consumption) is generally fairer to turn to nature and its laws, i.e. organic production.

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Appendix – Definitions of key terms

farm sustainability – it represents the ability of certain farm to operate, survive and grow within the particular socio-economic and natural surroundings, while keeping up for a longer period its administrative, economic, ecological and social functions at satisfactory level. Farm sustainability corresponds to four mutually equal aspects of sustainability: managerial sustainability; economic sustainability; social sustainability; and ecological sustainability.

value-added at farm level – under the given circumstances it represents the best possible portfolio of farm activities and agricultural practices created by farmer in order to fit the farm output (primarily agro-food products and services) with the consumers' preferences. It is usually related to changes in shape, form and structure, or appearance of specific characteristics of certain product, as well as its permanent availability, or emerging the new identity and quality level that was not available in previously offered farm products and services.

vertical integration at farm level - it represents the mechanism in which the farm introduces the previously produced primary product into the higher degree of processing (production of semi-finished products or food products) by engaging its own processing capacities.

investments in agriculture – they usually considers the transfer of financial assets into the purchase or up-building of capital goods (facilities, land, livestock, machinery, tools, equipment, etc.), which are not subject of current consumption but they are in function of production of consumer goods and services in long-term period.

time value of money – currently, money is more valuable than in upcoming years, as the time reduces its value. So, as a cash flow of investment is turned to future, money obtained or spent in upcoming period is worth less today. Amount for its worth lessens depends on used interest rate and length of the investments' life cycle.

static methods for evaluation of economic effectiveness of investment – static assessment does not consider the entire life cycle of investment. It relates just to one, representative year (usually fifth year), assuming that in this year previously procured investment object has reached its full rate of utilization. They do not consider the time value of money. Generally, the commonly used methods are Economical-efficiency coefficient, Net profit margin, Accounting rate of return, and Simple payback period.

dynamic methods for evaluation of economic effectiveness of investment - dynamic assessment observes the cash inflows and cash outflows during the entire life cycle of investment. It respects the component of time, offering more complete and reliable analysis of investments' effectiveness. The usually used dynamic methods in practice involve Net present value, Internal rate of return, and Dynamic payback period.

Ch. 4.2. EVALUATION OF ECONOMIC EFFICIENCY OF INVESTMENTS IN ORGANIC PRODUCTION AT THE FAMILY FARMS

OBJECTIVES:

The main purpose of previously presented chapter is to provide the students a practical knowledge how to use selected methods for assessment of economics efficiency of investment in sector of agriculture.

SKILLS:

Students have acquired advanced knowledge in tools for analytical analysis in decision making process towards the investment at farm level.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

What are the main aspects of the micro (farm) sustainability concept?

- ☐ Managerial sustainability, economic sustainability and ecological sustainability
- ☐ Economic sustainability and social sustainability
- ☐ Ecological sustainability and economic sustainability
- ☐ Economic sustainability, ecological sustainability, managerial sustainability and social sustainability

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

What is the brief definition of value added formation at farm level?

- ☐ Strict adherence to the principles of organic agriculture or good agricultural practices
- ☐ Implementation of procedures for protection of local cultural and historical heritage
- ☐ Creation of the best possible portfolio of farm activities and agricultural practices in order to match the farm output with consumers' preferences
- ☐ Use of autochthonous animal and plant varieties adapted to the local ecosystem

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

To which time frame are usually focused the static methods for evaluation of economic effectiveness of investment?

- ☐ To moment when initial investment outlay is done
- ☐ To entire life cycle of investment
- ☐ To representative year of investment exploitation

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

What are the commonly used dynamic methods for evaluation of economic effectiveness of investment?

- ☐ Simple payback period, net profit margin and accounting rate of return
- ☐ Internal rate of return and accounting rate of return
- ☐ Net present value, internal rate of return and dynamic payback period
- ☐ None of previously mentioned

QUESTION 5 (PLEASE CHECK THE CORRECT ANSWER)

What determines the Margin of safety?

- ☐ It determines the level of farm incomes that will enable farmer to reach the decent living standard
- ☐ It determines the maximal use of pesticides per hectare of farms' utilized agricultural area
- ☐ It determines the level of possible fall in farms' volume of production or sale without loss expression
- ☐ It determines the required level of vitamins that have to be consumed in daily human nutrition

PRACTICAL APPLICATION OF THE PREVIOUSLY ACQUIRED KNOWLEDGE:

TASK: try to define/assume all production elements related to certain farm that are required for development of economic analysis (main production orientation and established production line at the farm, available production resources, level and market prices of used inputs and realized outputs, used supply and market chain, etc.). devise possible investment idea that will be in function of advancement of observed production line and current level of farm sustainability (procurement of certain fixed assets). define/assume all elements that will follow the realization of planned investment (value of initial outlay, possible financial structure and current external financing conditions, availability of subsidies, grants or incentives, etc.). make an evaluation of previously defined investment under preassumed circumstances by the use of static methods and devise the correct investment decision.

FIFTH SECTION: Innovation

- Agro-ecological potential assessment based on smart sensing and IoT
- Objective methods for evaluation of plants behavior for farming optimization based on data science

5.1. Agro-ecological potential assessment based on smart sensing and Iot

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Abstract: In the context of current realities when the global population is growing by more than 80 million a year some of the studies are predicting an increasing pressure on the planet natural resources also including the food resources. One of the solutions is the adoption of precision agriculture that contributes to the development of efficient and sustainable agricultural production. The implementation of precision agriculture with high performance is based on accurate measurement of parameters associated with the physical and biological potential of natural resources. Using the new technologies including geographic information system and artificial intelligence accurate estimations of resources can be carried out. For better results on ecological agriculture, several reports are underlining the importance of agro-ecological zonation that provides preliminary evaluation for a regional sustainable development planning including the usage of remote sensing and distributed sensing. Thus, the productivity of terrestrial vegetation can be assessed based on remote sensing of the field and the weather through the data obtained by satellite. Additionally, IoT ecosystem including wireless sensor network nodes distributed on the land or associated with UAV can provide information about temperature, relative humidity, rainfall, solar radiation conditions that are suitable for vegetation growth the characterization and production prediction can be obtained using appropriate machine learning elements. The main goal of the chapter is to present the hardware and software technologies that are used to perform the agro-ecological assessment, technologies that are also part of the 21st century agriculture, the precision agriculture.

Keywords: agro-ecological, smart sensors, IoT, remote sensing, machine learning.

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1. Introduction

The global population is growing together with the high requirements for farming production in the context of reduced agriculture land size. The global warming phenomena increase the environmental unbalance making necessary the optimization on the utilization of existent resources such as water. To protect the environmental conditions for a greater agriculture production the reduction of fertilizers quantities is also an important issue that can be reached by using new techniques and methods. Precision Agriculture (PA) combines technologies and practices to optimize the production. The PA includes specific farm management that assures the effective usage of the resources used to reduce environmental degradation. The precision agriculture focusses on the accuracy of operations considering the place, time to act and method to be applied. The agricultural operations are carried out to reach the production goals using the information provided by the wireless sensor networks (WSN) with fixed nodes distributed on the land or mobile those are associated with Unnamed Aerial Vehicle (UAV). The WSN and other devices are part of Internet of Things (IoT) for PA (Al Fuqaha et al., 2015) is used to turn the farming operations into data (Tzounis et al., 2017). These new technologies will contribute to slightly replacement of the human decisions based on their accumulated experience to machine-based decision where the data science will play an important role, extending the capabilities of the experts to make the right decisions. This new way to act in agriculture is related to the fact that classical decisions are cannot be applied nowadays when the cultivated areas are much extended that conduct to miss-management with yield losses. Through sensors, actuators the control of applied quantity of fertilizer is calculated from the data obtained by distributed sensing system designed for soil parameters measurement. Additional information such as ambient temperature or relative humidity can be also considered. Incorporating feedback into the system using sensors, actuators, and decision-making algorithms the sustainability can be assured adjusting the flow rate and duration of applied fertilizer or water according to with measured local conditions.

Using the data from multiple sensing systems distributed on the crop field the optimal management of operation can be performed based on the extraction of the knowledge associated with the sensor data and data coming from alternate sources. Techniques that are known as knowledge discovery or data mining are successfully applied in PA. Data mining is process of knowledge extraction from data obtained from different PA data source, thus data mining is expected to change the way of acting in precision agriculture performing real-time data analysis with massive data (Issada et at., 2019).

As part of data mining tools, machine learning can discover unknown regularities and patterns from data sets (Treboux, Genoud, 2018). The process of knowledge extraction (data mining) can be done in close collaboration with agriculture expert considering the measured parameters and variable to be controlled during operations. The usage of a distributed sensing system that can include nodes characterized by anomalous functioning regarding sensing or communication specific evaluation process might be applied to the acquired data for optimal features selection. Based on this procedure the accuracy of the results can be improved. Machine learning algorithms, such as Artificial Neural Network, Support Vector Machine, Convolutional Neural Network and Deep Learning (Raschka, Mirjalili, 2019) are usually used for the automatic extraction of knowledge from the data. The output of ML algorithms is decision rules that are strongly related to the optimization of agricultural operations.

The chapter describes IoT technologies implemented in agriculture to extract the agro-ecological information and presents artificial intelligence techniques as part of precision agriculture. Referring to the sensing as part of the IoT ecosystem the land distributed sensing and remote sensing are considered while regarding the data mining machine learning techniques but also the new requirements for distributed machine learning are discussed. The work is part of precision agriculture research focussing on objective evaluation of the agro-ecological potential and optimization of the farm operations' management in agriculture. The applied methodology was based on literature review different articles that reports novel technologies for precision agriculture being considered. Regarding remote sensing for precision agriculture data set provided satellite imaging corporation was used as example to highlight the advantages of this kind of method.

2. Land IoT Ecosystem for agro-ecological evaluation

Agriculture experienced a technology evolution in the last decades due to major companies' investment in this area and due to research and development of precision agriculture (Marios, Georgiou, 2017). For example, Deere and Company, one of the leaders in Agriculture Machinery had invested between 1.7 to 1.8 billion U.S. dollars in research just in 2019 with an estimated eight percent increase year-on-year.

Precision agriculture is an emerging trend that is keeping these giants' manufacturers investing with competitive technological products to encourage clients to buy new equipment that will increase yields by controlling irrigation, crops growth and pests (Statista, 2019). These advantages can assure the high demand for agricultural products in the context of an increased population that quadrupled in the last century. The population is expected to continue growing together with a demand for food which required finding new solutions that can assure faster production and losses minimization (Elferink, Schierhorn, 2016).

To extend the production areas vertical farming appears as a new type of cultivation. Generally, the plant production is carried out in this case without soil by giving plants nutrition via the irrigation system. Water and nutrients optimized quantities are satisfying the plants need to grow. This type of farming can be included in metropolitan areas because it can be built inside a warehouse (Kalantari et al., 2017)

The modern food production implies the usage of smart sensors, IoT, cloud computing to optimize the agricultural processes based on data science (Cho et al., 2012). Smart agriculture, considered as part of modern food production, is an emerging trend that intends to reduce labor impact, pollution, and overall costs providing bigger yields for farmers (Shirish, Bhalerao 2013). The emerging of IoT (Internet of Things) gathered new possibilities in several areas, the main idea of the IoT is that every object could become connected to the internet. In the area of agriculture every machine, soil, and irrigation system started to will be connected and will collaboratively perform the agricultural operation to provide faster production and bigger yields. Referring to sustainability, smart agriculture acts to avoid excessive water consumption, fuel consumption by machinery. The reduction of applied pesticide quantities through local identification of pests' attacks and localized treatment will also contribute to costs reduction (Zhao et al., 2010; Tan, Wang 2010).

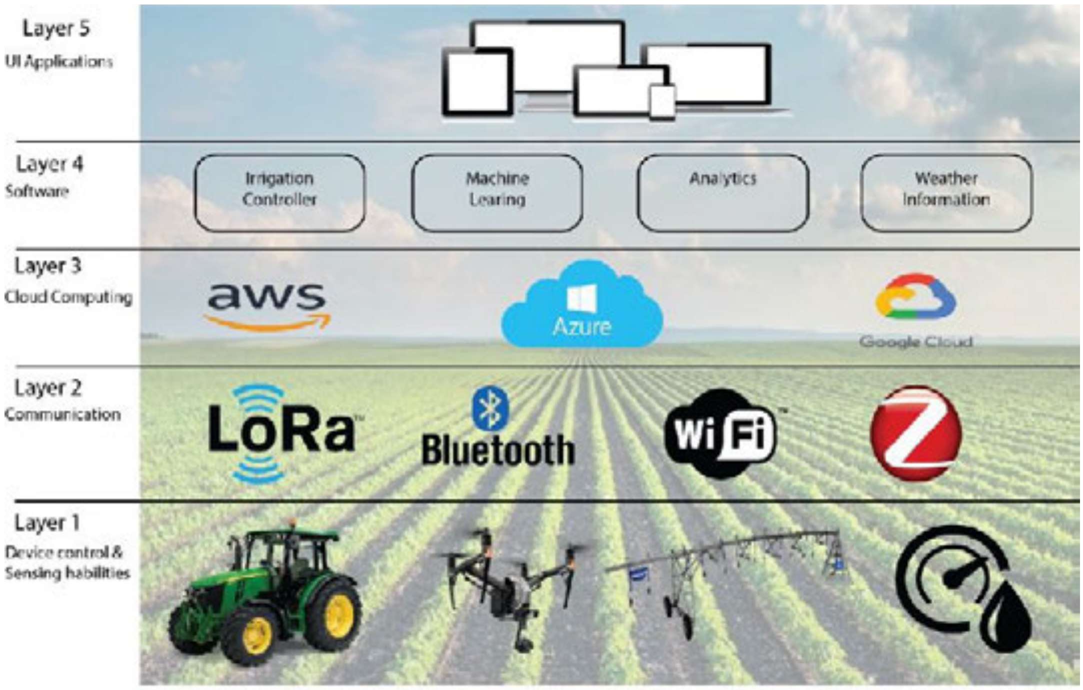
There IoT for agriculture includes smart irrigation, smart soil fertilization, smart pest control, and plant disease detection and short time and long-term forecasting of the pests' attacks but also the production forecasting (Sekulic et al., 2016).

2.1. Smart Irrigation Systems

Agricultural water is water that is used to grow fresh produce and sustain livestock. The use of agricultural water makes it possible to grow fruits and vegetables and raise livestock, which is the main part of our diet. Agricultural water is not potable one, however is plenty used for irrigations and for crops fertilizer application. According with the weather conditions the agriculture water is also applied for crops cooling or frost control (Centers for Disease Control and Prevention 2016).

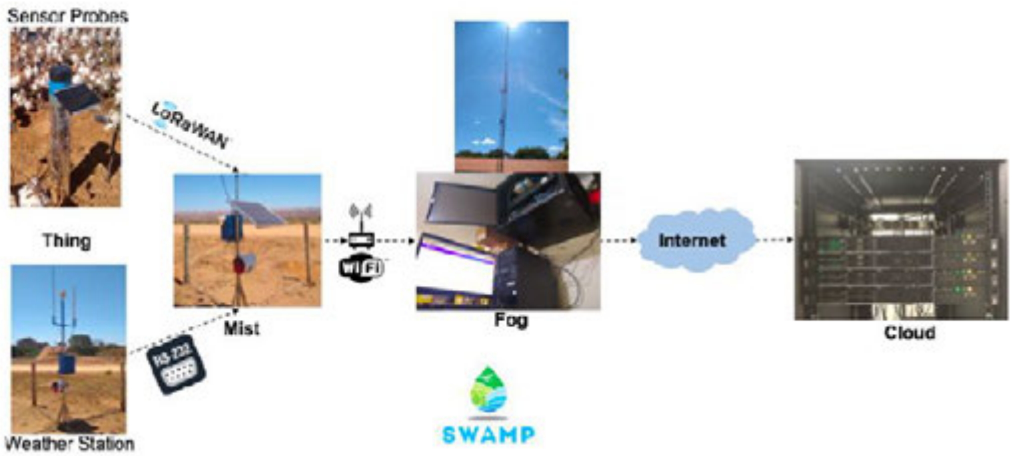
Crops are major water consumers and water consumption optimization represents a big challenge. In this context, the IoT irrigation systems are emerging and are appropriate to detect the plant water needs and according with implemented algorithms, the system will provide automatically the necessary quantity of water. Kumar et al., 2017 are mentioned a regression algorithm to forecast the amount of water required for daily irrigation for specific crop based on data provided by a distributed sensing system. The information coming from the sensors is delivered to the agricultural expert through a mobile application and the user can decide to validate the irrigation program for economical usage of water resources. Rajalakshmi and Mahalakshmi, 2016 reported an IoT system that can monitor crop-field using sensors (soil moisture, temperature, humidity, and light) that helps to reduce wastage and effective usage of fertilizer increasing yield. These smart sensors are related to automatization of the irrigation system. Wireless communications were also used to transmit the data to a web server. By controlling moisture and temperature levels the system triggers the irrigation when needed. The farmers are periodically notified about the irrigation status and water consumption during the agricultural operations. Based on IoT implementation this system is 92% more efficient than manual control. A general architecture for a smart irrigation system is presented in Figure 1.

Figure 1. Smart Irrigation System Architecture



The Smart Water Management Platform (SWAMP) reported an IoT-based smart water management platform for precision irrigation in agriculture. SWAMP architecture including sensor probes, expressed by sensor probes (things) that are part of LoRaWAN network that includes hybrid communication nodes (MIST) that receive the data from the weather station. The data is transmitted through Wi-Fi to a SWAMP FOG computation platform that assures the primary processing of the data received from MIST and based on Internet Connectivity transmits the data to the cloud platform Figure 2.

Figure 2. SWAMP IoT Architecture (Kamienski et al., 2019)



India is one of the most populated countries (1.2 billion) therefore some researchers from India know it will in 25-30 years be a serious problem of food. Thus, Indian scientists are working to improve the effectiveness of the irrigation systems. Kansara et al., 2015 reported the development of an automated irrigation system that includes sensors to acquire the temperature and humidity values.

Low-cost solutions in the field are using a computational platform such as Raspberry Pi or Beagle board black. Rao and Sridhar , 2018 reported the usage of Raspberry Pi as part of an automatic irrigation system that contributes to increasing the productivity of the crop. The major advantage of the system is to implement the PA with cloud computing.

2.2. Soil and Water Quality

Water plays an important role in agriculture and in humans' health and for this reason, the quality of water represents an important issue considering the relationship between contaminated water and the risk for humans to contract diseases. Controlling and contain analysing the water is important also in the agriculture context. As contaminants, the heavy metals are considered one of the major contaminants present in water supplies that threaten the health of millions of people worldwide normally associated with cancerous and non-cancerous health risks. Thus, it is very important to quantify the contaminant levels in water however taking into account the reduced concentration (e.g. 10 ppb) the quantitative on-site measurement is difficult and involves complex setup.

2.2.1. Heavy Metal Concentration in water

The evaluation of heavy metal concentration is performed off-site and involves the transportation of the water probes followed by primary chemical processing and analysis using atomic absorption spectroscopy (Maurya et al., 2018). Farmers normally are using water wells, rivers, streams, irrigation ditches, impounded water such as ponds, reservoirs, and lakes to irrigate crops. The quality of this water is not controlled, and the water analysis implies laboratory procedures that are improper for current activities. On-site measurement as part of IoT architecture represents an appropriate solution combining electrochemical devices with nano-sensors to assure and Internet connectivity. Advantages such as portability, integration, and affordability are mentioned for these types of architectures (Monge et al., 2019).

Ahmed et al., 2018, studied the heavy metal (e.g. Cu, As, Cd, Pb) in higher concentration that affects mainly agriculture water and soil. The study consider also the heavy metal concentration in farms affected by near industry in Bangladesh (Ahmed et al., 2019). The industry affect the environment (mainly the water quality) through the discharge of wastewater on canals that are used for irrigation. The crops that will receive contaminated water going to the food chain can affect human and animals making the contaminated land to lose the agro-ecological potential. Other research groups were researched specific heavy metal concentration.

The arsenic has been associated with persuading a variety of complications in body organ systems: integumentary, nervous, respiratory, cardiovascular, hematopoietic, immune, endocrine, hepatic, renal, reproductive system and development, so it is important to prevent arsenic from contaminating soil and water as it is also affecting crop growing mechanism (Saldaña Robles et al., 2018).

Thus, Wu and associates purposed an affordable point-of-use platform capable of detecting arsenic in water using low-cost custom-developed potentiostat characterized by low cost and good accuracy (Wu et al., 2017). The system can sample at a rate up to 1ksamples/s and the output data rate is adjustable from 1ksamples/s down to 1 sample per second. The board uses 12-bit data converters to provide a voltage resolution of 806 microvolts. The results showed the possibility of developing a cheap device that is capable to detect arsenic. Although this device works under PC remote control the specific software being developed to control the potentiostat. The miniaturization is a tendency followed regarding the potentiostat implementation.

A CMOS potentiostat has been reported to detect heavy metal ions and other solvents based on electrochemical sensing (Hwand, Sonkusale, 2010). The potentiostat provides mobility and can be used for on-site water quality measurement.

Another system capable to measure the Pb concentration that uses anodic stripping voltammetry and electrochemical sensor expressed by three-electrode cell (Glassy Carbon -working electrode (WE), silver/silver chloride reference electrode (RE), Carbon as the counter electrode (CE)) has been reported. This potentiostat includes an RF communication interface that assures the remote control and data communication (Lama, Tarrillo, 2018).

To assure the measurement of Cu concentration presented in water under test a potentiostat that use a gold disk as WE, platinum as disk as CE and a commercial Ag/AgCl as RE (Li et al., 2019).

The system present high sensitivity (0.0075 μA/μgL $^{-1}$) to Cu^{2+} and a measurement range [0; 400] μg/L. The used voltammetry technique used to detect the Cu concentration is expressed by square wave voltammetry (SWV). The standard substance tests also exhibit a good accuracy of the system for simultaneous determination of Cu^{2+} and Pd^{2+} concentration. The usage of this system multi pollutants detection in water can be also considered. Multiple heavy metal concentration measurement is reported by (Zou et al., 2007). Thus, a monitoring system that performs zinc, cadmium, lead, copper, iron, and arsenic concentration measurement in water. The applied voltammetry technique is electrochemical stripping voltammetry to measure very low concentrations expressed in parts-per-billion. The system can be used for on-site measurements of farms water sources providing information about water contamination. This measurement can be very important to avoid plant-growing problems and hazards for animals and humans.

A multi-parameter water quality analysis is proposed by (Pereira et al., 2007) that consider the heavy metal detection together parameters such as temperature, conductivity, salinity, pH, dissolved oxygen and turbidity that plenty characterizes the water quality.

2.2.2. Soil pH measurement

Soil pH represents an indicator of chemical processes in the soil in direct relation with the nutrients and their chemical reactions. Thus, pH monitoring is an important task associated with an objective evaluation of agro ecological potential. Punctual pH measurement can be performed with commercial pH sensor probes however to map the soil pH is still an important challenge. Kheiralla et al., 2016 propose a system capable to perform the mapping of the pH in the soil. The developed pH probe is coupled to an active arm of a tractor that assures the displacement of the probe. A cleaning system is used to washes the probes between successive measurements and the localization of the performed measurements are carried out using a differential GPS that assures the position measurement accuracy.

A proper pH level can ensure the sustainable growth of a crop and its balance can lead to higher yields. Abhyankar and associates purposed a system that does both measurements and correction of the pH level and also measures the moisture of the soil. A solenoid valve is used to control Sulphur distribution to control the pH level. By doing this control and correction the system is making the crop more profitable (Abhyankar et al., 2019).

The potentiostat based systems can provide information regarding several parameters associated with agro-ecological potential including nitrogen, phosphorus, temperature, pH. With a multi-sensor IoT compatible system, the farmers could accurately measure and ensure the soil nutrients according with feedback to the farmer assured by IoT system (Warudkar, Dorle, 2016).

2.2.3 Water stress and soil temperature

Water stress is present in every crop, but the early and late control of stress will affect crop development and growth. The techniques available to control water stress are based on soil temperature measurement that can be performed using temperature contact sensors (e.g. RTD, thermocouple, and thermistor), thermal cameras (e.g. Flir E50) or satellite imagery (Veysi et al., 2017).

The automatic water stress management is based on a temperature measurement associated with stress level followed by activation of irrigation system on the specific zone reducing the temperature. The contact temperature sensor is difficult to be used for increased crop dimensions and in this case remote sensing solutions are considered. One of the solutions with practical use is expressed by the usage of drones with thermal cameras that fly from time to time to check for temperature and trigger the irrigation system (Alomar, Alazzam, 2018; Puengsungwan, Jiraserccamomkul, 2018).

2.3. Pest Control

Pests are defined as unwanted animals that interfere with domesticated plants and animals (Kurma, 1999). Pest bugs can have harmful effects on crops, pesticides are the most common way of dealing with them. Although they are expensive and reducing the use of them has several advantages such as more yield (only if there is implemented other way of dealing with pests) the food becomes more biological and less industrialized (Priyadarsini et al., 2019). Methods that avoid the usage of pesticide will become dominant in the context of new standards of agricultural production-oriented on consumer protection. One of the solutions to avoid the pest is expressed by ultrasounds generators that prove to be very effective (Tiwari, Ansari, 2016).

To reduce the use of fertilizer Lee et al purposed a system that uses weather stations near crops and data with pests allowing early detection and control (Lee et al., 2017).

3. Remote Sensing for Precision Agriculture

Food demands are increasingly taking into account the growth of the world population. Important limitations in food production come from climate changes. Thus, climatic conditions as drought and high temperature require implies the usage of new technologies to optimize the production of the crop sustainably, saving water and energy. According with the world regions different phenomena are expected. Thus, in the Mediterranean region, climatic changes mean important decrease of precipitation and increase evapotranspiration that will imply the necessity to apply new technologies to maintain or increase the actual production (Montaldo, Oren, 2018). Increasing productivity is based on precision agriculture that assures the appropriate tools associated with efficient crop management. Using precision, the available resources are plenty used in the way to increase the profitability and sustainability of agricultural operations and at the same time, it permits to reduce negative environmental impact. Seelan et al., 2003 highlight the advantages of precision agriculture that includes optimal administering of specific agricultural inputs such as crops fertilizers, crops herbicides and pesticides. The improvement of decision-making is based on collection and analysis of data provided by distributed sensing system with fixed and mobile nodes that operates with and without contact with monitored agricultural areas (Glenn et al., 2008). Remote sensing techniques involves data collection based on ground remotes sensing, airborne or satellite systems followed by advanced data processing and analysis that assure an optimal agricultural decision in relation with crop condition assessment and stress detection (Geipel et al., 2016). Three types of remote sensing are used in the agricultural field and include: ground remote sensing, aerial remote sensing and satellite image. All of these techniques are being characterized by specific data processing and interpretation.

3.1. Ground Remote Sensing

Ground remote sensing, are based on optical systems mounted on the level of agricultural machinery, that extract data that is following processed for optimal planning of operations (e.g. irrigation, fertilization). Using data the prediction algorithms can be applied to accurate estimate the yield for a sustainable agriculture (Yousfi et al., 2019). Ground remote sensing devices are employed with very good results for crops stress monitoring cultivated on land reduced areas, considering biotic and abiotic factors. The remote sensing technology is characterized by higher temporal, spectral, and spatial resolutions than satellite remote sensing technology.

Commercial solutions such as GreenSeeker from Timble (Figure 3) that can be mounted on a vehicle and overhead irrigation allowing high-resolution field imagery with minimal operational cost. This system is an active ground remote sensing system supply own light source (red and IR) that made the measurements independent by the sun angle.

Figure 3. GreenSeeker, Variable Rate Application and Mapping Systems (Greenseeker, 2020)

The system verifies in real-time the amount of nitrogen in soil based on complex agronomic calculations that are based on normalized difference vegetation index (NDVI) that is defined by:

$$NVDI = \frac{NIR_{800} - Red_{670}}{NIR_{800} + Red_{670}}$$

Where:
Red - reflectance in the red band, λ_{Red}=670nm;
NIR - reflectance in the near-infrared band, λ_{NIR}=800nm;

GreenSeeker is able to process the data from the embedded optical sensors and to control through the fertilizer machine the applied fertilizer quantity, avoiding nutrients stress on the crop level. The NVDI is a simple indicator of photosynthetically active biomass being used for the calculation of vegetation health. NDVI value varies with the absorption of red light by plant chlorophyll and the reflection of NIR radiation by water-filled leaf cells (Fang , Liang, 2014). NDVI is one of the most well-known vegetation indices being used to evaluate in objective way nitrogen uptake and plant health. This parameter is also used as part of yield predictors that are currently used in precision agriculture being correlated with measured photo-synthetically active radiation and also with nitrogen content.

This kind of system presents some limitations regarding the number of radiation bands per instruments (no more than three visible/NIR bands) and the distance between this instrument and the target that cannot exceed 2 meters. Using ground remote sensing the water stress can be measured and the crop production can be increased based on appropriate management of the operations.

3.2. Aerial Remote Sensing

Remote sensing implies the usage of cameras characterized by different radiation bands. In the case of aerial remote sensing, the camera is mounted on the level of Unmanned Aerial Vehicle (UAVs). Considering the limitations regarding the limited number of spectral bands the UAV are commonly characterized by multiple cameras that can extract information about crops. According to (Araus, Cairns, 2014) different categories of imaging systems are used for remote sensing tasks as demonstrated in Figure 4.

Figure 4. Aerial Remote Sensing with IR camera

Thus, RGB/CIR cameras, which combine infrared (CIR), red, green, and blue light imagery (visible or RGB) are used to estimate the green biomass using normalized difference vegetation index as the main information.

Crops monitoring in remote way involve the usage of multispectral cameras (MCs) characterized by limited number of spectral bands (e.g. four bands) considering the visible and near infrared regions. In precision agriculture applications the MCs are collecting information about the green biomass and process of deterioration with age of monitored plant. At the same time can be estimated the necessity of nutrients and water for a specific field.

Thermography measures the distribution of temperatures in remote way, the thermographic camera can be attached to the UAV to perform the monitoring of specific agricultural area. Information about water distribution on the crops' level, full development of the crops pests and diseases detection can be extracted based on thermographic images analysis. These remote systems are usually used for relative measurements including crop growth and management decisions.

Referring practical application (Geipel et al., 2016) reported the usage of a multispectral camera system to estimate above-ground biomass and N content, as well as to predict grain yield and grain protein content in winter wheat where grain protein content was predicted best with Red Edge Inflection Point (REIP). Herrmann et al., 2011 and Behmann et al., 2018 prove the usability of a portable hyperspectral camera to extract information about crops through NDVI, REIP and PRI calculation underlining the big potential of aerial remote sensing for agriculture applications.

3.3 Satellite Imagery

Specific satellite provides multispectral and hyperspectral images associated with the evolution of crop growth and farm management considering large spatial and temporal scale. Different application programming interfaces (APIs), provided by satellite imagery services, are used to develop software for data of satellites that are used in PA for accurate prediction of yields. Image analysis is also used to detect the crop changes for specific soil conditions and crops classification (Figure 5).

Figure 5. Google Earth™ / Sentinel-2 NDVI** Vegetation Index

Source: Satellite imaging corporation, Precision Agriculture Mapping. (https://www.satimagingcorp.com/gallery/rapideye/agriculture-mapping-pivot/

Remote sensing of vegetation infested by insect pests is part of satellite imagery application.

Satellite Monitoring assures rational fertilizing is enhanced by satellite images for increased accuracy. The remote sensing assures lower carbon signature considering the decreasing of consumed fuel considering the optimal management of operations. Obtained data can be used to implement the prediction of different parameters based on artificial intelligence algorithms (FarmaManagement, 2018).

The weather and the satellite camera resolution affect the generalized usage of satellite imagery with application in agriculture, however the data fusion from remote sensing systems (e.g. satellite and airborne) can conduct to accurate information of monitored crops for accurate estimation of yields.

Concluding a comparison between different technologies of remote sensing applied in architecture underline strength and drawback for each one (Table 1). A comparison between different remote sensing systems for precision agriculture is presented in Table 1. Elements such as distance from the sensor to the target area, covered area, the obtained image resolution delays and processing requirement as so as the prices of this remote sensing system were compared (Salima et al., 2019).

Table 1. Strength and Drawbacks for Remote Sensing Systems (Salima et al., 2019)

RS Type	Strengths	Drawbacks
Ground remote sensing	• Easy to measure • Available • High resolution • Low cost	• Small monitored area to diagnostics
Aerial Remote Sensing	• High spatial resolution • Different types of imageries • Accessible • Moderately low cost	• Weather conditions can influenced • Necessitate certification to fly • Limited fly height
Satellite Imagery	• Free images with some Satellites; • Free API for some image satellite providers • Information of large area	• Clouds may influenced collected data • High cost for some images with high resolution • Data sometimes is not accessible at critical times

4. Artificial Intelligence for Precision Agriculture

As it was presented the deployment of IoT systems for Precision Agriculture include fixed and mobile sensing node with contact or remote measurement capabilities wireless sensor network, remote sensing is increasing day by day. Data are produced in extended amount and the usage of this data by new tools that are developed to process the data for food security, profitability and sustainability represent a big challenge. Artificial Intelligence including Machine Learning techniques is associated with the new tools that process the information delivered by sensors to extract information about crop disease, water and nitrogen stress, pests and satisfying the increased needs related the optimal agriculture management. Considering the distributed nature of IoT for PA techniques such as data fusion, edge data mining (Gaura et al., 2013) or distributed machine learning (Verbraeken et al., 2020).

Combining this data science technology accurate, timely analyses of vast amounts of data delivered by IoT sensors for PA will become paramount in increasing efficiency and sustainability of agriculture.

4.1. Data Fusion and Edge Mining

Taking into account the distributed measurement systems associated with PA can be underlined the fact that data generated can be characterized by redundancy owing to overlapping in the monitoring of individual sensors according to the density of the sensors in the field. Combining the data from different sensors can assure the optimization related message exchange between distributed measurement system nodes. The autonomy of the system can be improved in this way caused by communication efficiency that originates lower energy consumption. At the same time, the reliability of the system is improved. The data fusion objective is mainly related to decreasing of the traffic between measurement nodes but also in collaborative actions associated with detection of some specific patterns (Aygün et al., 2019) such as the detection of water stress region in a crop field. According with IoT for PA different architectures of sensors data fusion can be applied: high-level fusion (HLF) that promote the processing on the sensor level (edge level) and low-level fusion (LLF) is expressed by main processing of raw sensor data to take place in a central level (cloud level).

Data fusion can be related to analytics tasks as noise suppression and outlier identification. HLF requires distributed intelligence on the smart sensor level when complex algorithm such machine learning algorithms are implemented as part PA operations strategy. Thus, (Gaura et al., 2013) proposed an approach called edge mining that can reduce network traffic in distributed sensing systems as part of the IoT Ecosystem. For this kind of implementation, the sensing units transmit events' occurrences (e.g. pest attack, water stress) to the IoT cloud reducing the necessity to deliver raw data. The historical data are used to define an internal representation model (e.g. linear, decision tree, or histogram), (Ivanov et al., 2015) that assures the representation acquired data. New acquired data is used to update the model according to occurred events (e.g. temperature changes, heavy rain) within the environment that can affect the predicted crops production.

4.2. Machine Learning and Distributed Machine Learning

Machine learning (ML) has emerged together with big data technologies and high-performance computing to create new opportunities to discover, quantify, and understand relations between data acquired by distributed sensing nodes of IoT Ecosystem to be used for the optimization of agricultural operation management. Machine learning (ML) algorithms are applied in the PA to compute tasks such as species recognition, water management, crop quality and disease and pest detection (Ding, Taylor, 2016).

The application of artificial intelligence in agriculture nowadays become a reality, taking into account the developments in related research fields regarding computation platforms and the successful of new machine learning algorithms. Nowadays the edge mining platform such as Movidius – Neural Compute Stick from Intel (Intel, 2020) is becoming part of IoT for PA. This kind of platforms can be used for small machine learning models (Verbraeken et al., 2020) that can be trained using reduced size of data, complex models require the management of increased amount of data. Considering convolutional neural networks (CNN) that are used to model multi-parameters systems the size required training data increase exponentially versus the number of parameters considered for the model. In the context of large amount of data associated higher computation load algorithms (e.g. deep learning algorithms) the distribution of ML workload become the common used solution and involve computation machine of IoT Ecosystem (e.g. edge, fog and cloud computing machine).

Using distributed ML (DML) accurate yield estimation become a reality. Based on ML the information regarding the match between crop supplies with demand is obtained for a higher productivity. Ramos et al., 2017 reported an efficient, low-cost, and non-destructive method that automatically counted coffee fruits on a branch example of ML application being also reported the usage of Support Vector Machine for classification of parasites and automatic detection of thrips associated with strawberry culture (Ebrahimi et al., 2017). Regarding wheat culture (Moshou et al., 2006) reported high performance on stress identification using Self-Organising Maps (SOMs). In the last years, high computational load ML were considered to perform the detection and diagnosis of plant diseases for an extended number of crops using deep learning (Ferentinos, 2018). Deep neural network is also reported to an estimation of pest incidence (Brunelli et al., 2019).

5. Conclusion

In this study, the objective methods applied for evaluation of agroecological potential and the optimization of agricultural operations management and decisions.

IoT Ecosystems that include distributed smart sensing characterized by local and remote sensing as so as the data communication, edge, fog and cloud data processing and analysis can handle farm data making the precision agriculture an extended reality. Based on smart farm analytics there is customized solutions for each farm to improve the yield in the context of climate change. The farmers nowadays are leading with digital solutions including autonomous vehicles, UAV and artificial intelligence that implies new challenges regarding interoperability, and usability of this kind of systems. Mobile technologies represent a good solution to provide an easy interaction between the users and IoT ecosystem data new kind of interfaces coming from augmented reality side that will work under 5G communication protocols will require deep training needs to be delivered to users. Is the new technology tailored only for people motivated to learn and apply new technologies to agriculture? How we can act to transform the precision agriculture to be applied by an increased number of users. The solutions are coming from the artificial intelligence materialized in algorithms that can be implemented to solve problems and to provide data that can be easily used to make appropriate decisions known as part of data-driven management. Integration in IoT ecosystem for agriculture of different technologies that can extract information from the worked land will play a key role to design the next generation of farm machines but also to protect the resources based on optimization of applied nutrients, quick detection of an anomalous situation for preserving of agro-ecological potential.

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Appendix – Definitions of key terms

precision agriculture (PA) - gathers a range of application techniques aiming optimizing crop production and crop protection to obtain the best results with targeted practices, and within these targeted product applications.

farm management - is defined by making and implementing of the decisions involved in organizing and operating a farm for maximum production and profit.

smart sensors (SS) - are devices, characterized by sensing module, conditioning circuits, analog to digital converters, built in microprocessor and communication interface, that convert measured real-world variables into a digital data stream.

remote sensing - is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from satellite or aircraft).

machine learning (ML) - is the science of getting computers to learn and act like humans do, and improve their learning over time in autonomous fashion, by feeding those data and information in the form of observations and real-world interactions.

Ch. 5.1

AGRO-ECOLOGICAL POTENTIAL ASSESSMENT BASED ON SMART SENSING AND IOT

Sensing for an increased crops yield

OBJECTIVES: The chapter objective is to transmit knowledges to the students regarding hardware and software technologies associated with agro-ecological potential assessment and precision agriculture.

SKILLS: The test verify if the students have been acquired knowledge about the sensors, smart sensors, remote sensing and artificial intelligence technologies that are used to extract and process the data for optimal farm management. Two open questions are also considered at the end of the test to have students' opinions versus technologies for precision agriculture and how these technologies can be adapted organic farming needs and increased crops yield necessities.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

The implementation of precision agriculture implies.

- ☐ crop production optimization and optimal water management;
- ☐ higher energy consumption;
- ☐ incompatibility with organic farming;
- ☐ pest optimal management expressed by an increased quantity of applied; pesticide;

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

Smart sensors for precision agriculture

- ☐ materialize the actuation part of the irrigation system;
- ☐ are exclusively characterized by analog processing of the signals coming from the sensing units;
- ☐ transmit in digital form the values such humidity, temperature and light intensity associated with objective evaluation of field conditions;
- ☐ are similar to already used analog sensors for soil characteristics measurement;

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

Heavy metals are:.

- ☐ contaminants of the irrigation water;
- ☐ crops Nutrients;
- ☐ COMMONLY measured using the remote sensing technology;
- ☐ presenting hight concentration in soil assuring and organic farming;

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

Ground remote sensing

- ☐ includes Optical sensing system attached to the UAV;
- ☐ includes optical sensing system that provides high resolution field images by comparison with satellite imagery;
- ☐ transmit satellite images to mobile devices distributed on the ground;
- ☐ includes contact sensors such as pH soil sensor;

QUESTION 5 (PLEASE CHECK THE CORRECT ANSWER)

Machine learning (ML):

- ☐ creates new opportunities to discover, quantify, and understand relations between acquired data provided by WSN in the PA context
- ☐ includes all the Artificial Intelligence Technologies;
- ☐ is expressed by wireless communication protocols;
- ☐ is part of analog sensor for abiotic factors assessment:

PRACTICAL APPLICATION OF THE PREVIOUS CHAPTER (E.G., SOLVE THE PROPER TASK OR WRITE THE SIMULATION OF CERTAIN SITUATION/DESCRIBE THE NOTICED PROBLEM, ETC.)

Two practical applications are considered regarding the **Precision Agriculture Data Analysis Task 1.1.** Using specific sensors, Soil Hygrometer Humidity Detection Moisture Sensor and relative humidity and temperature sensors connected to a low cost computation platform (e.g. Arduino uno) the evolution of the humidity in time for different quantities of water applied to the office plant. The data from the computation platform that together the sensing units materialize a smart sensor (SS) for humidity and temperature assessment is transmitted to the laptop computer.

Will be considered the wireless communication between the SS and the computer where a specific software will provide the data visualization in real time and the data storage in a text file.
The users will analyse the data in excel including the statistics calculations regarding the temperature and humidity evolution on air and on the soil of the office plant during the experience where different quantities of water are applied.

Note: if the hardware associated for the task will not be available the data set will be provided by the workshop organizers.

Task 1.2. Thermography Data Analysis – Thermographic images of the office plants obtained for different level of humidity will be analysed using the Flir Tools Software. The correlations the soil temperature and soil humidity, the air humidity and soil humidity and the plant leaves thermographic images will be studied..

Note: The thermographic images will be provided during the workshop including the air and soil measured parameters
A short report about the performed data analysis will be provided by the workshop participants.

5.2. Objective methods for farming optimization based on data science

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Abstract Farming comprises production, manufacturing transformation and distribution of the farming product. To optimize results farming supply chain needs to be managed in an integrated, systematic and rigorous way. This requires appropriate performance metrics and accurate data. Aiming to optimize farming results through data science, this chapter proposes a business process management approach using information based visual modelling standard language (BPMN 2.0). Data science techniques (AI, machine learning, Big Data, data analysis and visualization) may be considered within the scope of the farming business processes. The approach is applied to two key farming products: rice and wine making. Some opportunities and constraints for data science in farming are identified. Considering the educational purpose of this book the reader is challenged to apply the approach to fresh farming products like leafy green, herbs, vegetables, fruits or flowers that may be produced in more controlled environments like green houses or indoor vertical farms.

Keywords: farming optimization; data science; business process management in agriculture; food products supply optimization.

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1. Introduction

Performance optimisation in modern farming has to consider production, transformation and distribution in an integrated way. It needs to apply innovative methods and technologies in managing specific business processes, the farming operations and the overall supply chain (Wolfert et al., 2017). Digital technologies, including data science techniques become key elements in precision agriculture and digital agriculture 4.0 (Farooq et al., 2019).

To blend traditional wisdom and scientific knowledge in farming new business processes and practises is paramount to improve products and to succeed in the highly competitive world markets for farming value added goods.

Data science techniques (AI, machine learning, Big, Data data analysis and visualization), associated with smart sensors and actuators (IoT), are key to redesign processes and to optimise farming performance. These innovations are particularly important when seeking to reduce the usage of resources - water, energy, seed, fertilizers, herbicides, pesticides, materials, workload – and to improve product yields – final, intermediate, variants and sub products (Matthews, 2019). Although being generic, these technologies must be adapted, adjusted and integrated in systems and applications, which tend to be specific for distinct categories of product and types of production process.

In this chapter the farming production, manufacturing transformation and distribution processes are described and the role of data science technologies is set. The chapter comprises four additional sections. The next section presents the methodology and describes the scope and motivation that is behind the research. It is followed by a section that provides an overview of the farming environment. This is followed by section four which sets the role of data science techniques in agriculture. The next section presents case studies in the rice and wine making sectors that may optimise performance by adopting data science applications. The final section summarizes the chapter contribution.

2. Research methodology and scope

The methodology that was adopted included a literature review on farming innovation and best practices, as well as interviews with academic experts and with farmers from the sectors that have been addressed in the research.

This report is a result of a wider project that is being developed aiming to foster sustainability and increase innovation in the key farming sectors in Portugal, through the adoption of an circular economy certificate (ADENE, 2019). The project enabled a deep understanding of the internal organization of the farming business processes across the supply chain. Considering the sustainability requirements the study analyses, highlights and promotes the adoption of circular economy practices in the farming sectors, namely: eliminate waste; reduce the usage of natural resources (water, energy); provide healthier products by minimizing the use of pesticides and fertilizers; promote a better use of residues as, for instance, to generate energy in biomass plants or to be transformed in fertilizers; minimize the use of transports by bringing production closer to the consumer; develop added value by-products; enhance the overall service that is delivered to customers and consumers; or regenerate the natural systems (EC, 2020).

Reduce, reuse and recycling are key principles that may be adopted by the whole range of farming sectors, from the more traditional intensive cultures up to the new organic cultures. The use of data science techniques enables the distinct players to increase the intelligence levels that are required to manage the modern farming. Vertical farming may be pointed as an example where data science, sustainability and organic farming come together to address to satisfy the food demand of a growing world population living in urban areas (Plantagon, 2017).

3. The farming domain

Farming optimization requires to address the overall supply chain in an integrated way, comprising production, manufacturing transformation and distribution (Figure A.1.).

The chapter focus mainly on the production and manufacturing transformation processes which are specific for each family of farming products. The more generic logistics and transportation processes are not considered in this study despite their importance for farming optimization.

The full processes of two products - rice and wine - are analysed as case examples (Table A.1.) and the role of data science techniques for performance optimization is described. This generic supply chain modelling approach is suitable for most farming products.

4. Data Science in farming

Farming optimization requires a deep knowledge of the business and also sound information to sustain decision-making for problem solving. Data is the essence of information. Modern technology enables to collect, store and analyse huge amounts of data from distinct sources. Data science is a scientific knowledge domain integrates contributions from a significant group of other scientific areas like statistics, computer science, information science, information science, mathematics. It provides a set of techniques able to handle and to provide meaning to data: big data, data mining, deep learning, data architecture and data analysis (Wikipedia Data Science, 2020). The theoretical background, the methodological approaches and the techniques provided by data science enables to foster the decision makers' capabilities to identify, understand and solve complex problems in a broad set of application domains in healthcare, finance, business, education, physics and also farming.

Data science may be used by farmers, scientists, managers and technicians to optimize yields, improve the quality and the crops quantity by making better decisions concerning the time when seeds may be planted, when pesticides, insecticides and fertilizers have to be used, and in what quantities, as well as when crops may be harvested.

Farming technologies enable to assess soil condition or provide detailed information on wind, fertilizer requirements, water availability and pest infestations through the use of sensors that provide granular data points on fields and crops (Nidhi, 2020; Shastry, Sanjay, 2019). Extending the farming concept to the manufacturing transformation of plants and other farming products, data science may be used in predictive analysis to anticipate problematic issues (overproduction, idle time, logistics, inventory, etc.), time-based and usage-based fault prediction and preventive maintenance of farming manufacturing equipment, demand forecasting and inventory management using online data collected all over the supply chain, price optimization, product development based on customer feedback data processing, computer vision AI powered applications to improved high-quality control or high speed processing capability to help managing supply chain risk (Kdnuggets, 2018; Sindel, 2019).

Data science applications work in a continuous process loop that collects raw data from the business system, places data in a temporary store, cleans up the data and puts it in a well-structured data warehouse. The data set is then used by the smart ML algorithms to provide reports that help farmers to make decisions (Figure B.1.).

Artificial neural networks, support vector machines, decision trees, and random forests are common machine learning techniques, frequently applied for agricultural management purposes like targeting crops, soil, weeds and diseases, and weather/climate change (Tantalaki et al., 2019).

Big Data are information assets characterized by high volume, velocity, variety, veracity and also value (IBM, 2020). It is the result of high-resolution remote sensing techniques, smart information from satellites or weather stations and even data from neighbouring farms received through advanced communication technologies. Machine Learning may help unlock the power of Big Data if properly integrated with data analytics. Both techniques have shown great potential for data-driven decision making, scientific discovery, and process optimization (Sun, Scanlon, 2019). Data science becomes part of a broad set of integrated farming technological infrastructure (Figure B.2)

Optimizing the farming supply chain processes requires a systematic approach to business process management (Dumas et al., 2018). The following life cycle diagram identifies the key steps that may be considered when adopting data science application to farming business processes comprising both the technological solutions and the management requirements (Figure B.3).

Having identified which business processes are we dealing with and which performance measures should be used, the next phase is to understand the business process in detail. This is called process discovery. The identification of weaknesses and their impact give clues to redesign an optimized process which integrates data science and technology elements. After the project is implemented it becomes possible to better monitor and control the process performance. The figure also highlights the intermediate and final results of the process: the as-is, the to-be and the executable process models.

5. Cases in farming process optimization through using data science

Two important farming products - rice and wine making – are presented and some opportunities and constraints for data science in farming are identified.

5.1. Rice Farming

The plant and the product

Cultivated rice is a herbaceous plant included in the class Liliopsida (Monocotiledônea), order Poales, family Poaceae, genus Oryza. It is an annual grass, classified in the group of plants C-3, adapted to the aquatic environment.

There are currently two cultivated species of rice: Oryza sativa L., of Asian origin, and Oryza glaberrima Steur, of African origin. Regarding Asian rice, genetic studies state that it originates from wild rice (Oryza rufipogon) and it is believed the three most common subspecies - indica, japonica and javanica – have originated in the Himalayas due to climatic differences.

The dynamics of plant growth, as well as its development, can be enhanced by climatic factors, such as the duration of the daily light period, solar radiation and air temperature, when they favor photosynthesis.

To realize its productive potential, the culture requires a temperature around 24 to 30° C and high solar radiation. Water availability is not a limiting factor when grown in flooded soil.

The vegetative cycle of rice can be divided into the following main phases: seedling, vegetative and reproductive (which includes grain filling and maturation).

The development of the rice plant is generally expressed by the chronological age, that is, in the number of days after emergence, and not by the physiological age. The specific time intervals between the stages and the total number of developed leaves can vary between cultures, growing seasons, sowing times and growing regions (Freitas et al., 2006). The cycle duration varies between 100 and 140 days for most crops in the flooded system, with most of the variation between cultures occurring in the vegetative phase. The upland rice cultures last between 110 and 155 days. (Figure C.1.)

The importance of rice production to the worldwide human population is crucial as one out of every three people on earth dependent on rice as a staple food in their diet and 80-100 million new people need to be fed annually. Scientists and farmers face the daunting task of increasing yield while minimizing rice farming's negative environmental effects (Rice, 2020; Yao, 2017).

Rice production

The stages in the vegetative cycle are as follows (Figure. C.2)

1. Soil preparation and flooding - after being irrigated for several days, the rice field is then plowed by tractor or animal force. This operation kills weeds and mixes the soil. The field is flooded for 10 to 14 days and then soaked, meaning the soil is mixed with water and turns in mud. The surface is then smoothed by grading for several times. Two days before planting, the field is levelled by dragging a wooden plank behind an animal or tractor.

2. Planting / nursery - the seeds are grown in beds, also called nurseries before being transplanted. The nurseries occupy 5-10% of the rice fields. The transplant requires about 30 to 50 kg of seeds per hectare. Direct sowing, without using nursery planting, may require 90 to 120 kg of seeds per hectare.

3. Transplanting rice and seeds - after about 20 days, the seedlings are transplanted to the flooded rice fields. The seedlings are harvested in clusters, then some seedlings are planted in a square pattern approximately every 10-20 cm. Manual transplantation requires about 30 days for a person to plant a one hectare rice field, while a single person with mechanical equipment can transplant a hectare field in one day.

4. Phytosanitary treatments - procedures practiced to combat living organisms that may be in any way harmful to the environment and the plant.

5. Weed - remove weeds from a plantation.

6. Harvesting - the water supply is suspended about 2 to 3 weeks before harvesting, in order to allow this operation to be carried out with the soil already dry. When the plant is ripe and fields are drained, rice is harvested, either manually in developing countries or mechanically in larger fields and industrialized countries. In automated processes, a combine harvester is used to harvest and separate grain and straw.

7. Threshing - the rice is dried and then passed through a mill to remove the outer layers of the grain and obtain brown rice.
8. Storage - the brown rice is temporarily stored to be later processed industrially.
9. Transportation - it ensures rice transportation to the industrial processing unit.

Water is a fundamental resource for the germination of rice. Water management is then essential to ensure that the water level remains constant (5 to 10 cm) during the plant's growth period. On average, 1,432 liters of water are needed to produce 1 kg of rice in an irrigated lowland production system. Irrigated rice receives about 34 to 43% of the total irrigation water in the world or about 24 to 30% of the freshwater resources developed worldwide (IRRI, 2020)

The overall farming production process is described in (Figure C.2.).

Technological innovation in rice production includes (Figure C.3.):

- Satellite aircraft guidance technology to spread the seed evenly across the beds
- Sowing by automatic or robotic machine
- Laser technology to ensure a uniform level of the planting surface
- Use of drones for phytosanitary treatment
- Automated harvesting and threshing

The contribution of data science to rice farming becomes important concerning sustainability, seeking to optimize the use of resources, and to increase farming yields.

Big data is becoming promising in many water related applications such as planning optimum water systems, detecting ecosystem changes through big remote sensing and geographical information system, scheduling irrigations, mitigating environmental pollution, studying climate change impacts etc. (Sirisha, 2017; Kamilaris et al., 2019). It has been reported that the adoption of a climate-based site-specific agriculture decision-making smart tool, using data-mining techniques to analyze information from annual rice surveys, harvest monitoring data and experiments on rice sowing dates has prevent loses by warning farmers in advance not to do their rice sowings (The Guardian, 2014).

The most important manufacturers are investing in innovation to incorporate technology in their agricultural equipment for collecting and processing agronomic data (crop management) and machine operating data (for example, fuel level, location, machine hours, engine RPM)). These devices use GPS location sensors, embedded in the machines and in the field (soil), and measure the number of seeds planted, the volume of fertilizer sprayed, the quantities of ears and grains harvested, as well as data collected from external sources (for example, weather forecast data).

Through telematics, data is automatically loaded into the cloud via a mobile phone network, Wifi or Bluetooth connection. Farmers access and manage data through a portal on a cloud platform. Through a web application, they can monitor activities in real time, analyze performance, determine the best way to use the equipment, collaborate with other farmers to obtain information. Farmers also receive "recommendations" from AI algorithms that help them to decide what to plant, where and when, with optimized conditions (Williams, 2019)

System automation facilitates maintenance operations and to monitor the growth conditions inside the greenhouse nursery (Shah, Bhatt, 2017; Pallavi et al., 2017)

Data science methods have been used to study the effects of delaying transplanting on agronomic traits and grain yield of rice under mechanical transplantation (Liu et al., 2015; Kushwaha et al., 2016).

Data driven decision support help optimize pest management strategies is another data sciences application domain. (Meisner et al., 2016; Kalita et al., 2016; Tabuchi et al., 2017)

Data science enables weather prediction and data analysis, can show what seed to plant on which day, which days to add fertilizer and herbicide, and when to harvest (Talbot, 2015)

The analysis and redesign stages of the BPM life cycle provide room to identify alternative ways to improve farming process performance - time, quality, flexibility, cost, yield and sustainability indexes – by integrating technology with highly innovate practices in the farming process. For instance, to grow rice outside the water while controlling the weeds with biodegradable films (Choe, 2018).

Rice manufacturing transformation

To get to the white grains the paddy rice must go through a manufacturing transformation process to remove the bran, husk and germ. This process improves the taste, appearance (whitening) and extends the useful life of the rice grain (Rice, 2020).

The main stages of the manufacturing transformation process are as follows:

1. Clean - paddy rice always comes with a lot of external material, including weeds, soil, seeds, etc. These residues must be removed in order not to affect the efficiency of the equipment used in the subsequent phases of the transformation process.
2. Remove the peel (dehusking or dehulling) - removing the husk from the paddy rice makes brown rice. The husk is removed by friction, causing the rice grains to pass through the husk separator, which is a mill with two abrasive surfaces that move at different speeds. The husk weight can represent up to 10% of the rice weight.
3. Bleach or Polish - white rice is produced by removing the bran layer and then the rice germ. The bran layer is removed from the core, using different means such as abrasive or friction polishers made of rubber. The amount of bran removed is normally between 8 and 10% of the total weight of paddy rice.
4. Grading - once the rice is polished, the white rice is separated into main rice, small, broken (cracked) and large rice. Main rice is generally classified as kernels with a 75 to 80o ration or more than one whole grain. To have a greater degree of precision in classification and separation, a length grader is used.
5. Sorting - through a machine that uses optical devices it is possible to separate the rice according to the grain tonality. Other classification criteria that include grain length or volume can be considered.
6. Pack / store - this activity includes the tasks of bag packing, weighing and subsequent storage of rice before being transported to the distribution circuit.
7. Shipping and Transport - rice is usually shipped on pallets or boxes and transported by truck to the warehouse of the logistics operator or wholesaler who ensures the distribution of the product.

The key activities of the rice manufacturing transformation process is depicted in (Figure C.4.).

Innovation in rice manufacturing transformation

Manufacturing at a rice mill is a continuous process, mechanical, highly automated, efficient and also quite noisy (Figure C.5.).

It is considered that the current analog milling equipment developed by the main manufacturers Satake and Buhler has reached a limit (Bühler, 2016).

There is an opportunity for creating the world's first digital fully connected smart rice mill with AI based control systems and IOT features (Howarth et al., 2019). Manufacturing process optimization includes new methods for conveying rice, able to minimize damage and simultaneously separating rice, bran and husk. New efficient vertical conveyors increase reliability and enable on demand feeding of machines avoiding the need for large storage. Concerning data science, machine and mill data will be captured and connect to a secure cloud based platform. Data analytics, AI, machine learning and auto-tuning provide real time management decision support tools to operators, to optimise mill management and production, and will be used to train operators and managers.

To make this new rice mill available to customers, the project aims to adopt an Advanced Manufacturing Services (AMS), "pay as you mill" business model. This approach aims to reduce two major barriers to adoption of the technology which are the perceived technology risk (the risk passes to technology supplier) and the perceived Capex Cost (moving the cost from capex to opex).

5.2. Wine-making farming

Wine-making comprises the technical operations that guarantee the transformation of the grape into wine. Viniculture is the set of activities for the production, conservation, packaging, promotion and sales of wines. The history of wine-making stretches over 8 millennia. It is a farming activity full of tradition and deeply enrooted in the local cultures of the farmers communities (Taylor, 2019; Fitzpatrick, 2016).

The plant and the product

Vitis vinifera, also called European or vinifera, is the main species used for wine production in most countries. According to the International Organization of Vine and Wine (OIV), it is estimated that there are 6,000 different varieties of grapes within the species Vitis vinifera. Castelão, Baga, Trincadeira, Cabernet Sauvignon, Chardonnay and Sauvignon Blanc are some examples of different varieties of this grape species, which determine the characteristics of the wine.

Wine grapes production

The vegetative cycle of the grapes has the following stages (Figure. C.6.):

1. Vegetative rest - After the harvest, with the advance of autumn and the consequent lowering of temperatures, the vine will no longer have conditions to support its activity, the leaves will turn yellow and fall. Between late autumn and early winter, the vine enters vegetative rest and will only come out of it when the average soil temperature exceeds 12 ° C. It is during this period of vegetative rest that pruning takes place.
2. Crying - occurs in the last days of winter or early spring and represents the end of vegetative rest and the beginning of a new vegetative cycle of the vine, manifesting itself through the loss of sap by the pruning cuts. This only happens when temperature conditions start to allow the plant's enzymatic activity.
3. Sprouting - initially the knot buds left by pruning begin to swell, looking as if covered in cotton. A green tip begins to appear and then the small leaves are perfectly visible and separated.
4. Period before flowering - after the small leaves are visible, a period of vegetative expansion follows, during which the most important facts, in chronological order, are: the appearance of the clusters, the separation of the clusters and the separation of the buds floral.
5. Flowering - it lasts for about a week and a half, usually in the late spring. It is a crucial period for the definition of a harvest. If flowering occurs in the rain, pollen is washed away from the stamens and flowers, pollination and consequent fertilization are not carried out; the flower does not "thrive" in fruit and the harvest will be greatly affected.
6. Grapes growth - this is a period of great vegetative expansion coinciding with a time of higher temperatures. Before the appearance of the grapes, the formation of the bunch takes place: as the vine is hermaphrodite, each vine goes through its own germination, without depending on another. After fertilization, the bunch actually develops and the fruits (grape berries) start to appear completely closed. Until this stage, the berries of the white and red varieties keep their opaque green color.
7. Maturation - we can define the beginning of maturation with the appearance of the "painter", which represents the stage of the vegetative cycle of the vine that coincides with the appearance of the color red in the bark of red berries and the translucent skin in white varieties. The "painter" may last from one to two weeks, but a berry changes color in 24 hours. From the "painter" begins a time period of 35 to 55 days when the grape accumulates sugars (glucose and fructose), amino acids, potassium and phenolic compounds while loses tartaric acid and malic acid (two acids that represent 90 % of acids present in grape berries). The hours of sunshine are important for the concentration and ripening of

chemical compounds, such as tannins, decreased acidity, concentration of sugars, etc. Then the bunches are ready to be harvested.

8. Harvest - it is time to harvest, the stage when the bunches of grapes are removed from the vineyards. The grape harvest marks the end of the vegetative cycle. Harvesting can be manual or mechanical and takes place in late summer or early autumn.
9. Transportation - It includes the activities of transporting the grapes to the winery.

From this point the cycle is repeated and the winegrower starts to prepare for the new campaign!

Innovation in wine grape farming

The economic importance of the wine industry is driving the development and application of innovative methods and technologies for monitoring vineyards. Data science in grape growing may be used to (Aboutalebi et al., 2020):

- Measure - automated sensors measuring intra-field variability: soil parameter, crop load, canopy size, irrigation requirements.
- Model – measures are used to construct geospatial maps of key relationships.
- Manage – information is used to spatially alter cultural practices to reduce variability in parcel yield, improve quality increase yield.

Italian grape farmers use aerial photography and satellite imagery to monitor crops and merge the images with GPS to improve vineyard management and ultimately the wine quality. Research and implementation projects include smart sensing, image processing and machine learning methodologies for precision viticulture (CSU, 2016; Fruition, 2020).

Other management aspects may also contribute to optimize grape farming like, for instance Biodynamic Viticulture, that looks at the farm and surrounding land as an ecosystem, which enable to determine the best ways to control pests and get the best yields.

Wine-making manufacturing process

Wine making is a long and complex manufacturing transformation process that comprises the following steps (Adirondack, 2017):

1. Receive the grapes - receive the grapes in the cellar and classify them according to the type of variety and degree of sugar.
2. Weigh - weigh the grape and record the data.
3. Stalking - crush the bunch of grapes separating the stems (woody part) from the grape berries
4. Crushing - Using presses, the berries are crushed, separating the wort (juice), the skins and the seeds.
5. Sulphite the must - add sulphur dioxide (SO2), in order to inhibit the growth of undesirable microorganisms, being that it works as an antioxidant.
6. Incubate - place the wort into the vats
7. Fermentation (alcoholic) - transformation of the wort into wine by modifying the sugar into CO2 and alcohol.
8. Reassemble - move the fermenting wort from the bottom of the vat to the top, promoting ventilation and homogenization.
9. Uncub and Press - separate the mass (skinks, seeds) and liquid (wine) through physical processes.
10. Fermenting (malolactic) - consists of transforming malic acid into lactic acid making the wine softer
11. Sulphite the wine - the addition of SO2 at this stage of the processing allows the wine to be stabilized and prevents the adulteration of its quality
12. Racking - pass the "clean" part of the wine to another vat, leaving the lees (residues of grape skins, seeds, yeast, etc.) in the old vat.
13. Maturing - this is the wine aging process in vats or barrels, mainly used for red wine.
14. Clarification - remove the unstable proteins in the wine that cause turbidity

15. Filter - this process allows removing the remaining impurities in the wine
16. Bottling - the wine that is already stabilized is placed in glass bottles or other containers (e.g. bag-in-box) which are then closed (e.g., corked).
17. Aging - certain wines are matured in bottles and are only put on the market a few years after being bottled.
18. Label and Pack - the bottles are labeled with a label and back label, or with a stamp depending on the wine's brand, and are placed in boxes.
19. Store - the boxes are arranged on pallets, wrapped in plastic wrap and placed in racks in the warehouse.
20. Shipping and Transport - wines are usually shipped on pallets or boxes and transported by truck.

The following diagram describes the wine making process (Figure. C.7.)

Innovation in wine manufacturing transformation

Palmaz Vineyards in the Napa Valley is a unique art winery that uses technology to enhance the winemaking process, by pursuing a modern digital strategy in an ancient analog industry (Cnet, 2017; Matt, 2020).

From top to bottom, the winery stretches to a depth of 75 meters, the equivalent of a 22-storey building, of which 18 stories are excavated underground. Instead of having the process of wine-making horizontally in only one floor at the surface, like most wineries do, they brought it in vertically inside a "dome" so each level is a different step in the wine-making process. On the top storey is grape sorting that tops down a hatch into a fermentation room lined with 24 fermentation tanks that can accommodate grapes from individual vineyards across the estate (Figure. C.8.). Downward storeys include the presses, tanks, barrels and filtration. From the tanks the wine is barrelled and aged, blended and bottled. Sensors in the tanks measure temperature, sugar and alcohol levels. Gravity-flow design minimizes the turbulence that damages wines' molecular structure when mechanical pumps are used in the winemaking process.

The fermentation room is equipped with several projection screens connected to a supercomputer named FILCS (pronounced Felix), short for Fermentation Intelligent Logic Control System, that supervises all the process stages.

Using a monitoring system for each tank and a sophisticated algorithmic for fermentation-control, FILCS projects a broad range of data (including real-time thermal imaging) onto the ceiling of the dome, giving instant insight into the fermentation process. This is a technological leap well beyond traditional fermentation, which relies less on data than on sheer guesswork — as such, it frees the winemaker to spend more time tasting.

The platform includes a system called Vigor that analyses aerial images of the vineyard checking the vines health. These images are taken twice a week using a small aircraft with a multispectral camera.

Wine makers use all that information to decide how to treat the wine as it passes through the critical fermentation process. It becomes possible to know from what parcel of land the grapes are grown on, how much water and sun they got and a minute-to-minute account of the FILCS assisted fermentation process (Palmaz, 2020).

Data science may also be helpful in many different aspects of wine-making (Hariharan, 2018; Tivon, 2018, 2019). Product innovation and new marketing strategies become fundamental to fulfill customers' expectations. Trends in the wine making process seek to reinvent a traditional product with a customer centered perspective (Striepe, 2012). This may be achieve in distinct ways: by improving the product characteristics like *sparkling wine* or *diet wine* (cutting the alcohol content is the most efficient way to reduce the calories); or by adopting micro-oxygentation (MicroOX), that adds oxygen to the wine as it ferments to help improve the taste.

Packaging is also a distinctive element in wine-making as it can also help reduce packaging waste, reduce transportation costs and differentiate the product. Alternative packaging includes: "canned wine" that are usually single serving, so the client don't expose a whole bottle's worth to oxygen just to have one "glass;

the "box wine" packaging as the use of lighter boxes, even for good quality wines, has a positive environmental benefits; "wine on tap", associated with a self-serve model enables customer to buy a card, then swipes it at whichever wine tap he/she wants; "quirky wine labels" as wine bottles with cute labels on grocery store shelves represents an interesting innovation in wine marketing in particular targeting millennials (those born after 1980).

Environmental sustainability is also a concern. An example is to turn wine-making waste into biofuel, by a process that produces hydrogen which is then used to create biofuel, and to reuse waste water which may go back to the fields to irrigate the vines. An alternative process is turn the cellulose from the skins and seeds into ethanol, which would significantly upgrade pomace's efficiency as a biofuel feedstock.

6. Conclusion

This chapter addresses the use of data science applications to optimise farming performance.

Traditional farming methods usually include walking in the fields, choosing soil samples for moisture analysis, and detecting plant diseases by observing the leaves manually. However it is important for all the agriculturists (and not just for the farmers) to have in mind the importance of technology in farming optimization (Shankar, 2020).

If unlocked intelligently, data science techniques have the potential to add value across each farming stage and can streamline food processing value chains starting from selection of right agri-inputs, controlling irrigations, assessing market prices, finding the best selling point and getting the right price (Nidhi, 2020).

Integrating AI, big data and machine learning with the agricultural domain - farming production, product transformation and distribution – enables to get meaningful knowledge from the large quantities of data that may be gathered along the supply chain.

Data Science in Smart Farming is still in an early development stage but it can bring about radical changes in how agriculture is being done currently (Vadagave, 2020).

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Appendix 1 – Definitions of key terms

big data - big data is a field that intends to analyze, systematically extract information from, or otherwise deal with data sets that are too large or complex to be dealt with by traditional data-processing application software. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source.

business process management – business process management (BPM) is the discipline of improving a business process from end to end by analyzing it, modelling how it works in different scenarios, executing improvements, monitoring the improved process and continually optimizing it, in support of enterprise goals, spanning systems, employees, customers and partners within and beyond the enterprise boundaries.

BPMN – business Process Model and Notation (BPMN) is a standard for business process modeling that provides a graphical notation for specifying business processes in a Business Process Diagram (BPD). The objective of BPMN is to support business process management, for both technical users and business users, by providing a notation that is intuitive to business users, yet able to represent complex process semantics.

data science – is an inter-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights, from many structured and unstructured data sets.

machine learning – it is a subset of artificial intelligence dedicated to the study of computer algorithms able to improve automatically through experience. Artificial neural networks, support vector machines, decision trees, and random forests are common machine learning techniques.

Appendix 2 – Tables and Figures

Figure A.1. Farming supply-chain

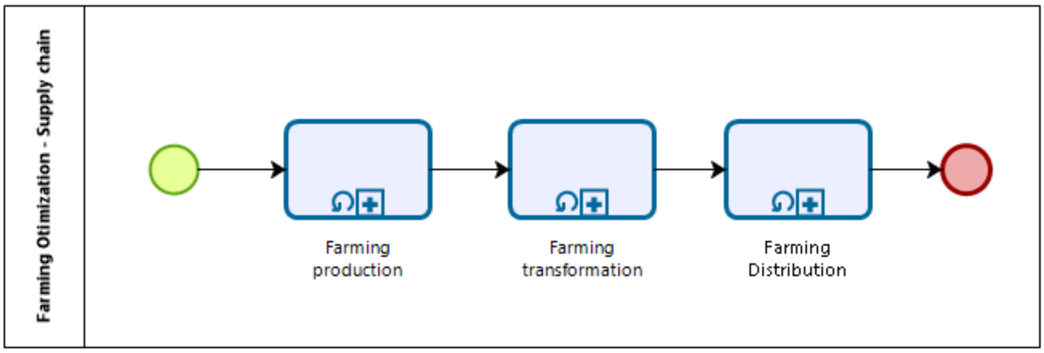


Table A.1. Rice and Wine farming processes

roduct	Farming Production	Manufacturing Transformation	**Distribution**
Rice	Oriziculture	Peeling, Bleaching, Glacier, Packing, Shipping and Transport	Logistics and Transportation
Wine	Viticulture	Crushing, Pressing, Fermenting, Maturing, Aging, Bottling, Packing, Shipping and Transport	

Figure B.1. The data science loop in farming (Bowery, 2020)

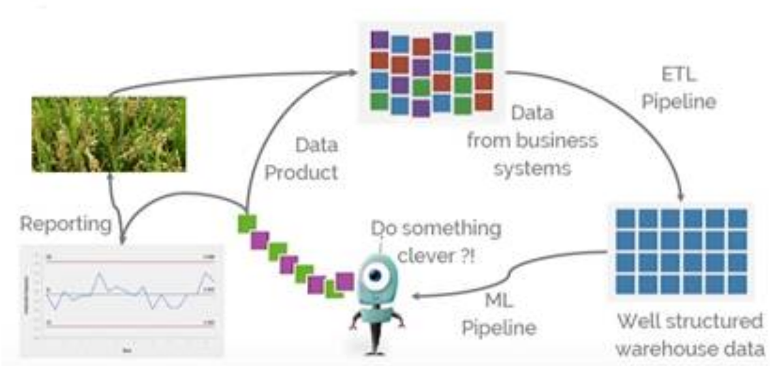


Figure B.2. Smart Farming technological trends. (Farooq et al., 2019)

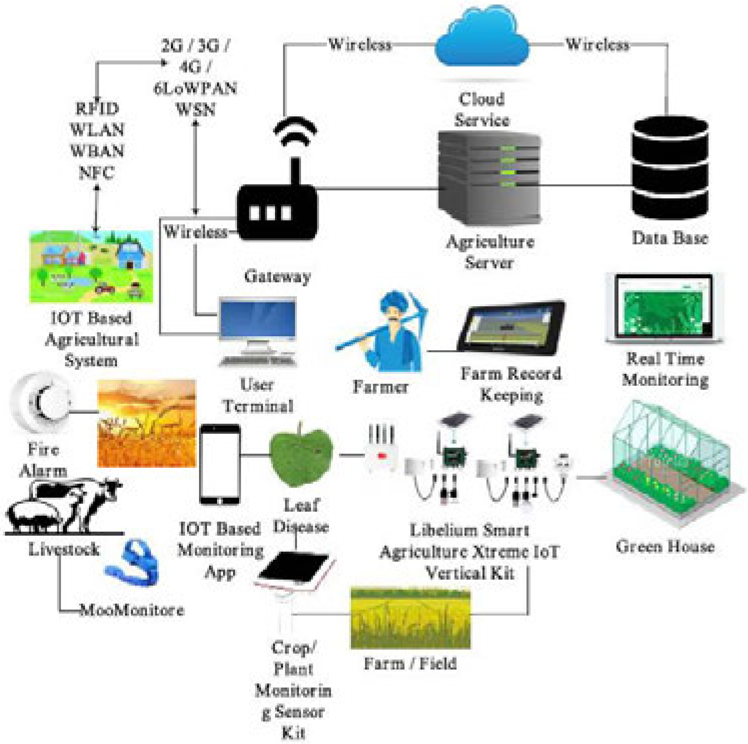


Figure B.3. BPM fife cycle (Dumas et al., 2018)

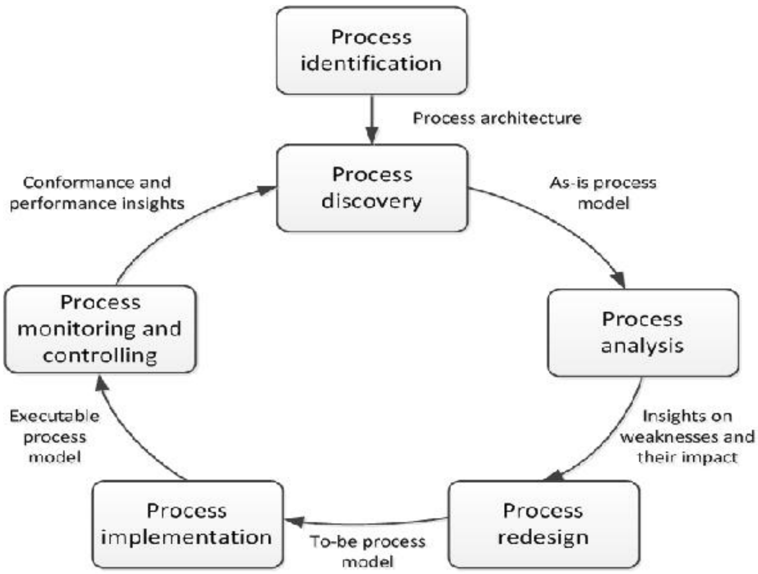


Figure C.1. Phenological phases in rice plants (Yang et al., 2016)

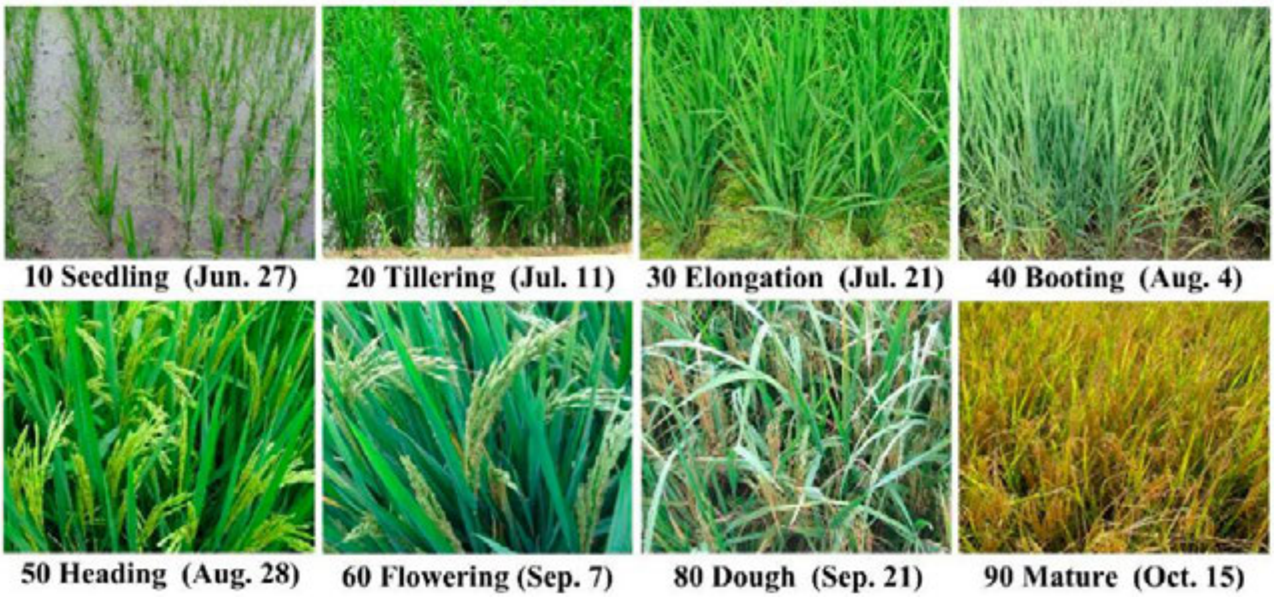
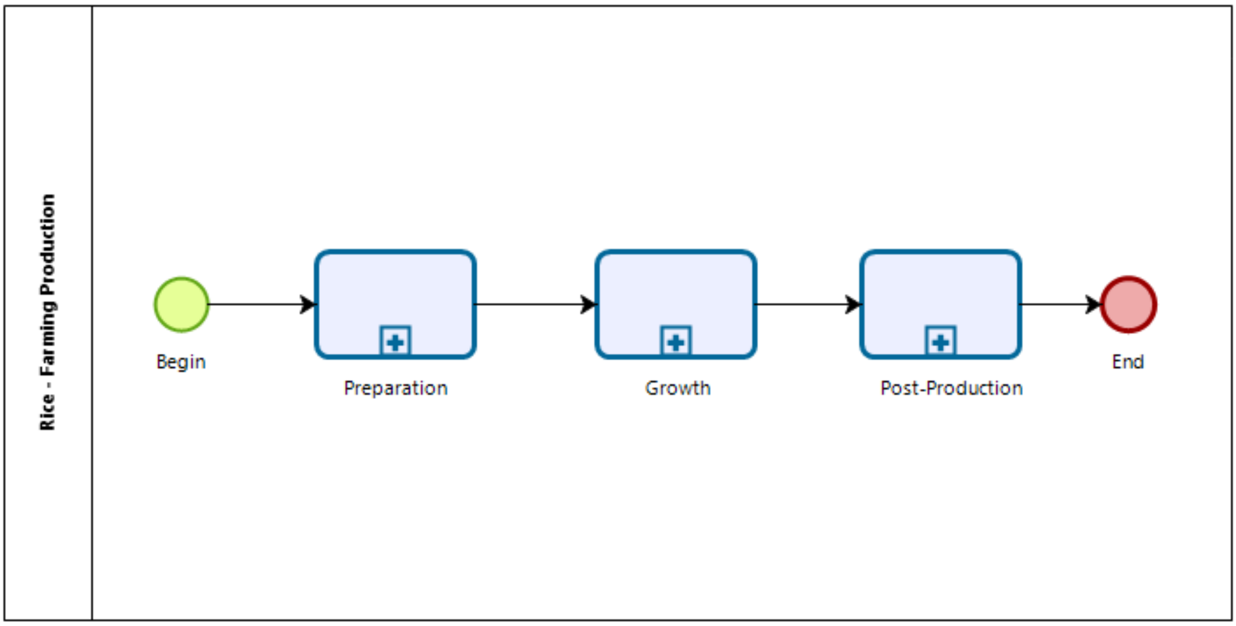
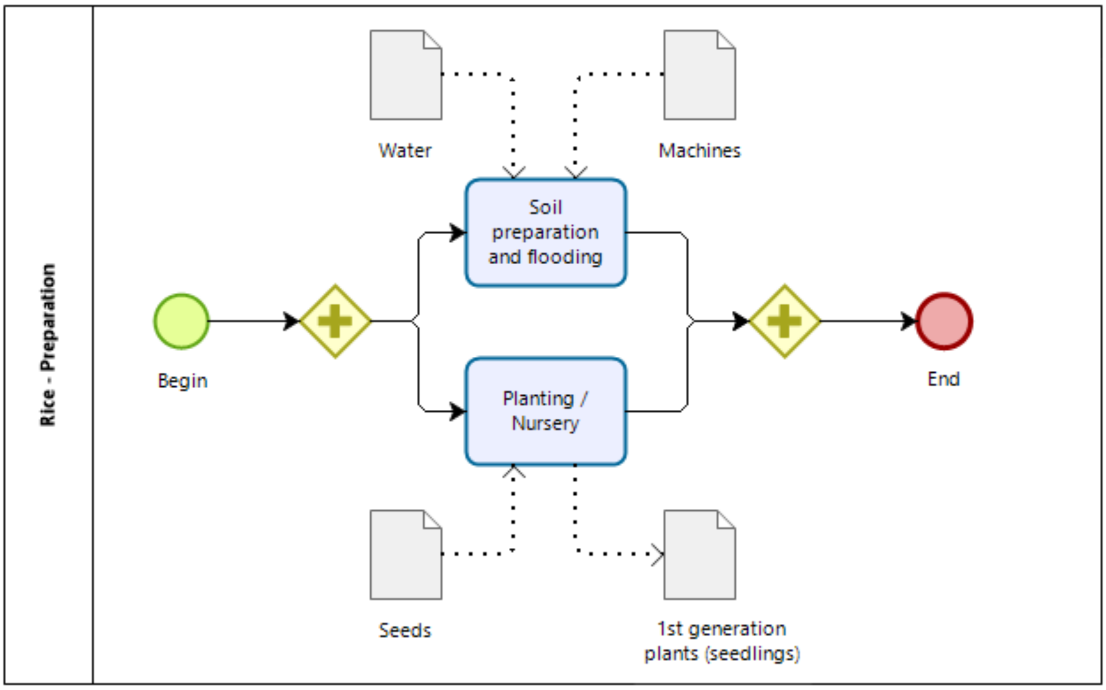
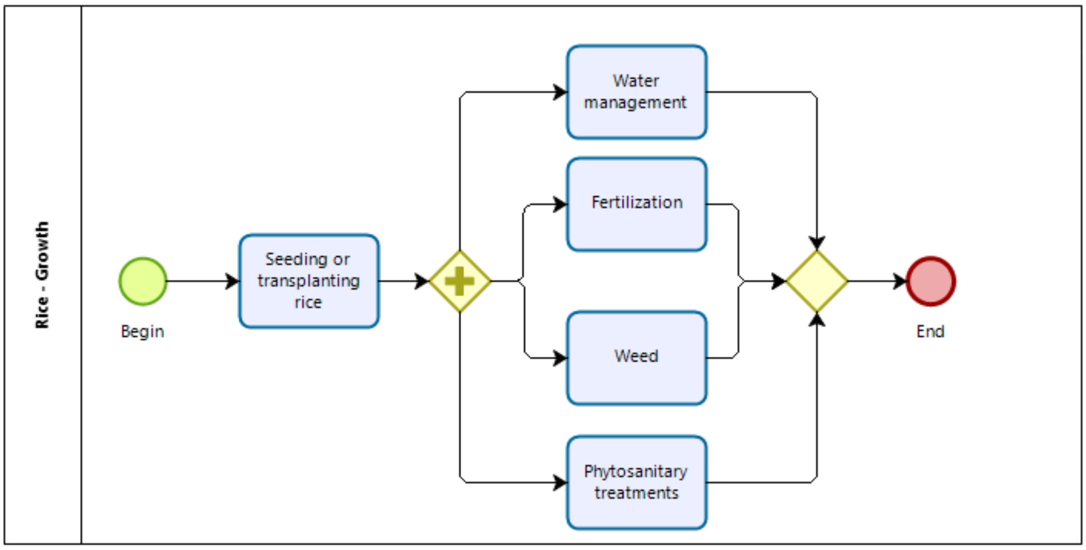


Figure C.2. Farming production processes




Rice - Preparation
Water
Machines
Soil preparation and flooding
Begin
End
Planting / Nursery
Seeds
1st generation plants (seedlings)


Rice - Growth
Water management
Fertilization
Begin
Seeding or transplanting rice
End
Weed
Phytosanitary treatments

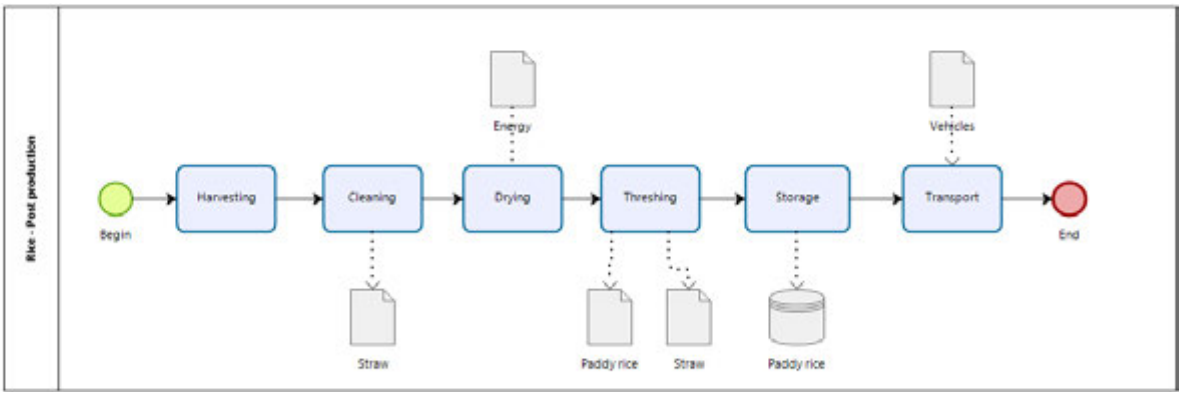

Rice - Post production
Energy
Vehicles
Begin
Harvesting
Cleaning
Drying
Threshing
Storage
Transport
End
Straw
Paddy rice
Straw
Paddy rice

Figure C.3. Wet Rice From Seed To Harvest Process – Modern technology (Noal, 2020)

Figure C.4. Rice manufacturing transformation processes

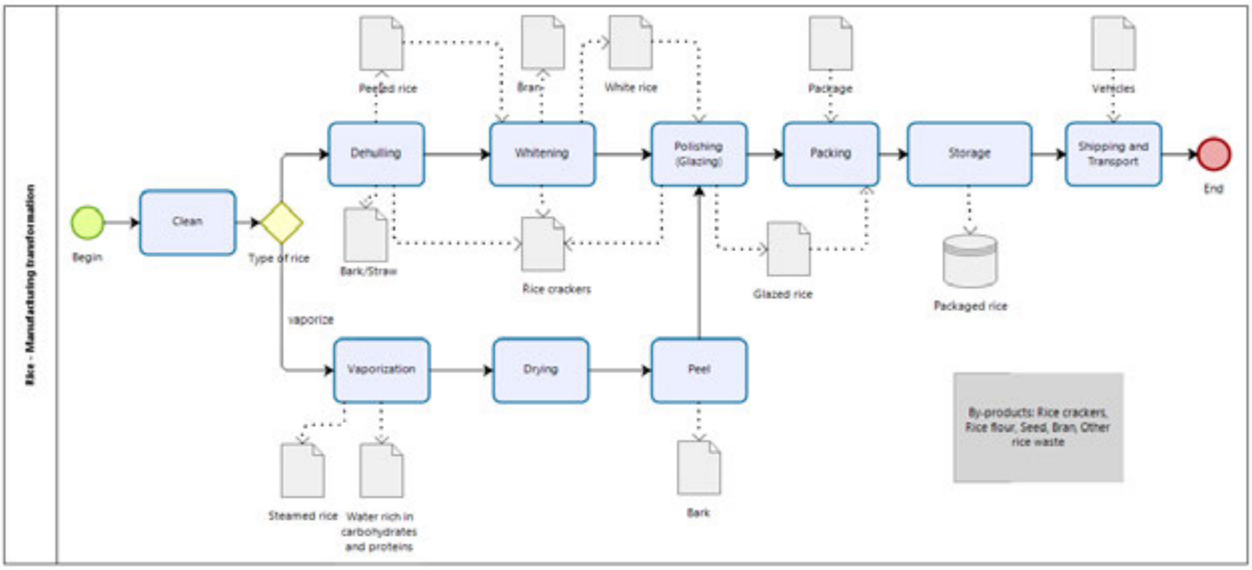


Figure C.5. Rice Processing (SATAKE 2017)

Figure C.6. Wine grapes production process

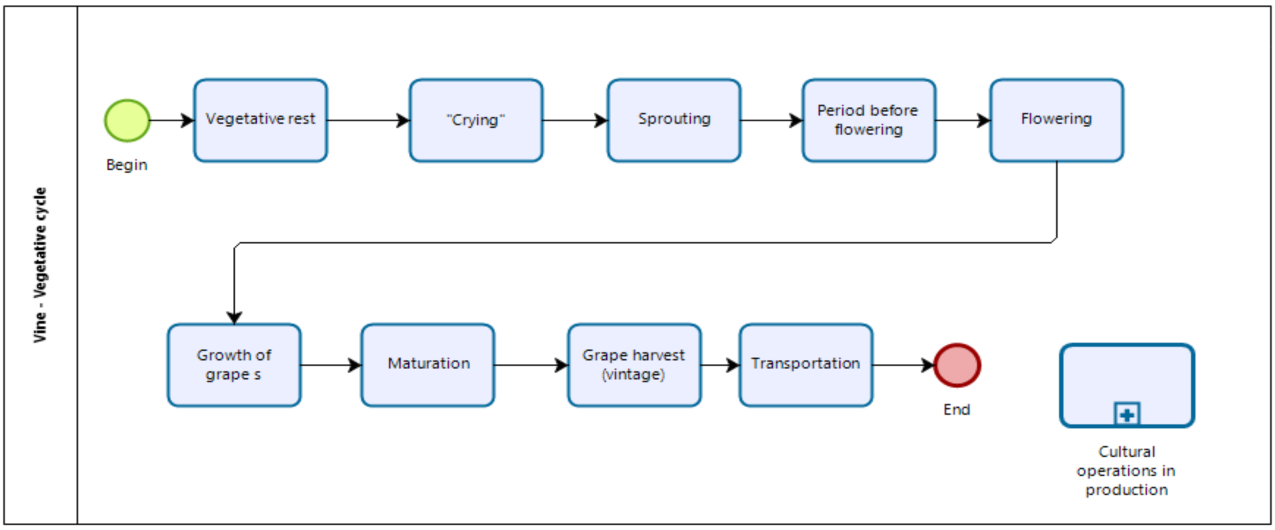


Figure C.7. Wine manufacturing transformation processes

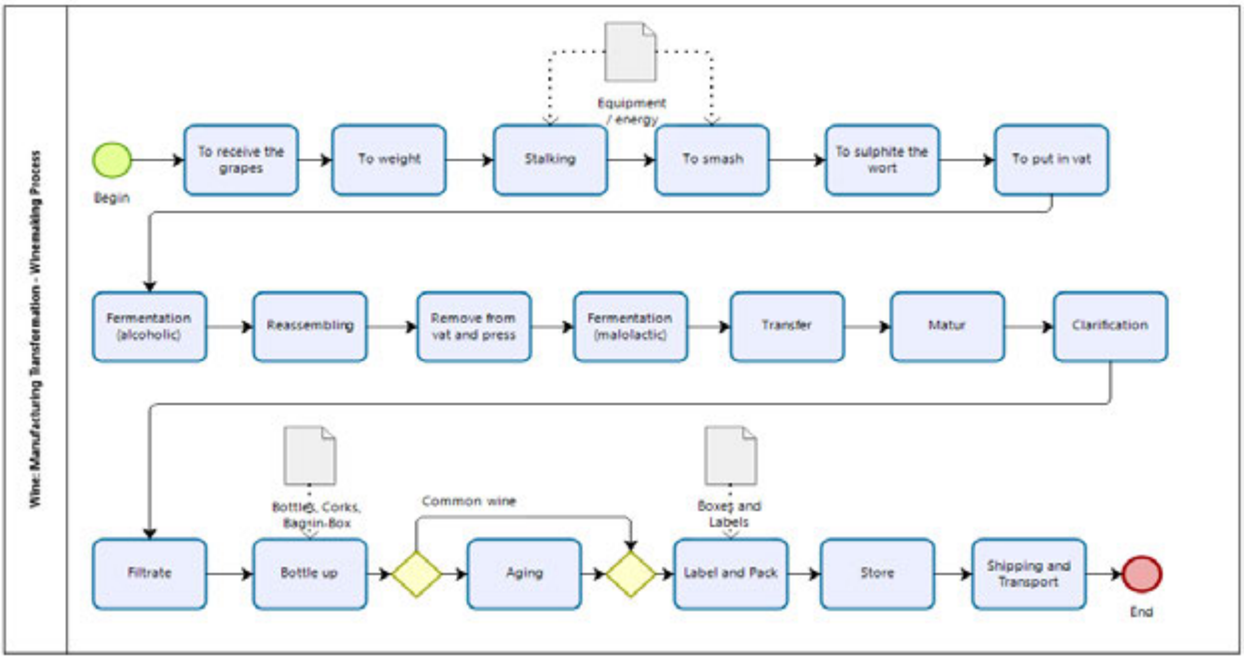
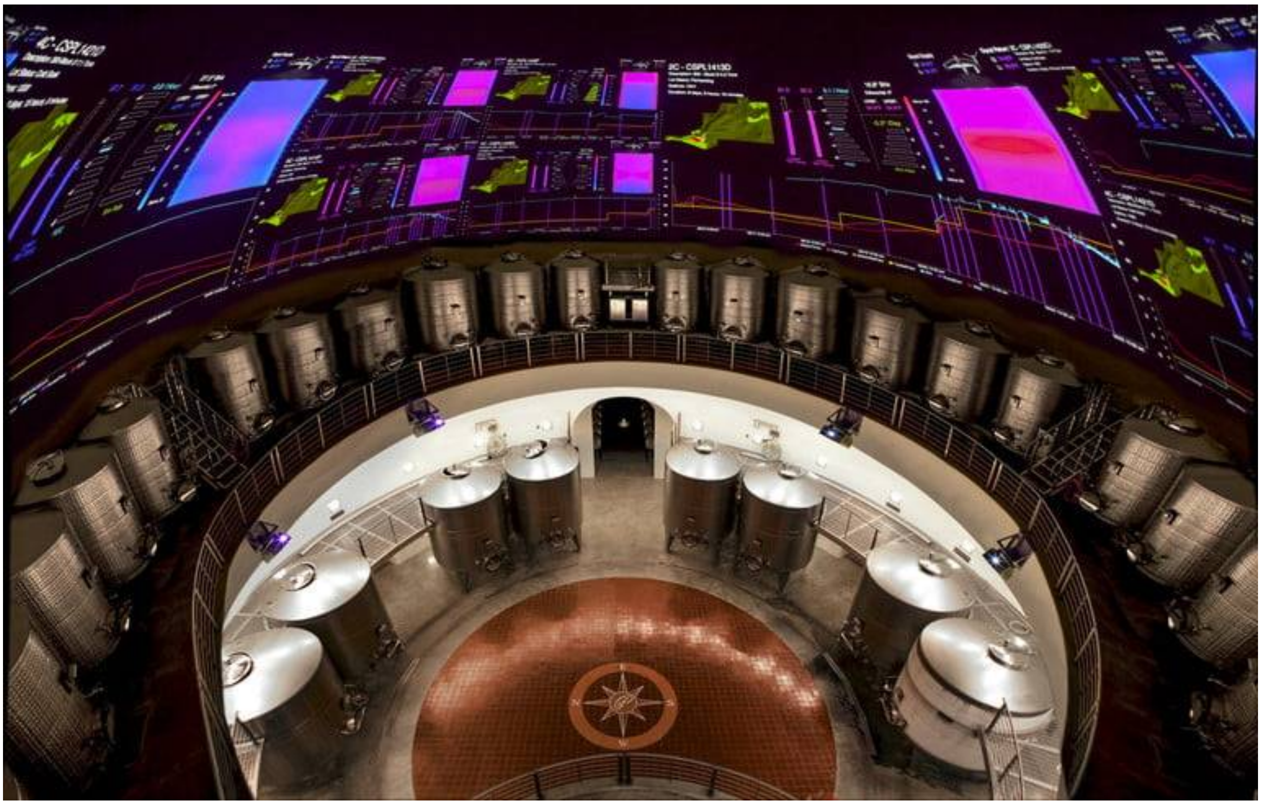


Figure C.8. Palmaz Vineyards fermentation room (Matt, 2020)



Ch. 5.2

OBJECTIVE METHODS FOR FARMING OPTIMIZATION BASED ON DATA SCIENCE

A Business Process Management (BPM) based approach

OBJECTIVES: This chapter aims to provide a broad perspective of the role of data science technologies to improve the production, transformation and distribution farming processes.

SKILLS: Students will be able to use visual modelling techniques to represent farming processes, to understand how business processes may be managed and what is the role, benefits and challenges of adopting data science to improve the farming performance.

QUESTION 1 (PLEASE CHECK THE CORRECT ANSWER)

All the following stages are part of the BPM life cycle except one. Which is it?

- ☐ Process redesign
- ☐ Process implementation
- ☐ Process analysis
- ☐ Process reengineering

QUESTION 2 (PLEASE CHECK THE CORRECT ANSWER)

Machine learning techniques that may be used in farming include:

- ☐ Artificial neural networks
- ☐ Decision forests
- ☐ Random trees
- ☐ All of the above.

QUESTION 3 (PLEASE CHECK THE CORRECT ANSWER)

<u>What are 4 characteristics of Big Data information assets:</u>

- ☐ Volume, velocity, visibility, veracity
- ☐ Volume, variation, variety, veracity
- ☐ Volume, velocity, variety, veracity
- ☐ Volume, visibility, variety, value

QUESTION 4 (PLEASE CHECK THE CORRECT ANSWER)

<u>What is the correct sequence of activities in wine making process?</u>

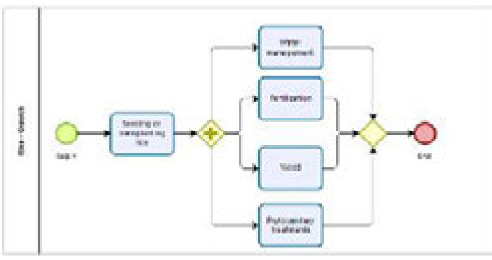
- ☐ Receive the grapes, Weigh, Stalking and Crushing
- ☐ Incubate, Fermentation, Reassemble and Uncub
- ☐ Maturing, Clarification, Filter and Bottling
- ☐ All of the above

QUESTION 5 DESCRIBE THE ROLE OF DATA SCIENCE IN THE PALMAZ VINEYARDS STRATEGY

<u>Please, enter the proper question related to specific content of the previous chapter.</u>

At PALMAZ VINEYARDS a supercomputer named FILCS (pronounced Felix), supervises all the process stages. Using a fermentation-control and -monitoring system for each tank, and a sophisticated algorithmic, FILCS gives instant insight of the fermentation process by providing a broad range of data (including real-time thermal imaging) that is projected onto the ceiling of the dome. The platform includes a system called Vigor that analyses aerial images of the vineyard checking the vines health. process This is a technological leap well beyond traditional fermentation, which relies less on data than on sheer guesswork.

DESCRIBE THE RICE GROWTH PROCESS USING THE BPMN 2.0 MODELLING LANGUAGE.



Correct answers to the questionnaires

First section: Descriptive data

- *Chapter 1*
  a. *first question: Health, ecology, fairness and trust.*
  b. *second question: It is characterised by the great growth of the organic sector in terms of cultivated areas and market value.*
  c. *third question: Spain.*
  d. *fourth question: Germany.*
- *Chapter 2*
  - *first question: Agricultural producers.*
  - *second question: More and more research show the benefits of organic food on health and on environment.*
  - *third question: The regulations are constantly changing.*
  - *fourth question: It should be kept to the minimal presence possible.*
  - *fifth question: 1) Quality 2) Aspect 3) Promotions 4) Expected health benefits 5) Price 6) Producer 7) Environmental benefits from the production process of the product 8) Producing country (the correct answer is any combination of three of these options).*
  - *Practical application: Discussions among peers about the results of the willingness to pay for the organic food survey with your peers through the debate technique. (Splitting the student group into two teams: pros and cons. These should answer to: Why to purchase/not purchase the organic food?).*

Second section: The quality of organic agriculture

- *Chapter 1*
  a. *first question: At least 95% of the ingredients of the product were obtained according to the organic production method and the product complies with the organic production rules.*
  b. *second question: Five to seven times per year.*
  c. *third question: OFIS - Organic Farming Information System.*
  d. *fourth question: Monitor the imports of food and animal feed, to improve the traceability of organic products and to provide more comprehensive statistical data on imports of organic products.*
- *Chapter 2*
  a. *first question: Organic food is grown without of additives; Organic meat and milk are richer in certain nutrients.*
  b. *second question: It is labelled; It is more expensive.*
  c. *third question: β-carotene (vitamin A precursor); Vitamin C.*
  d. *fourth question: The lack of pesticides residue on organic foods; The lower content in organic food than conventional ones.*
  e. *fifth question: Organic crops.*

- *Chapter 3*
    a. *first question: Voluntary.*
    b. *second question: All above.*
    c. *third question: The cost of adjustment with the requirements of standards and the certification costs.*
    d. *fourth question: All above.*
    e. *fifth question are: Reducing the amount of crop production because of the considerable reduction of mineral fertilizers applied; Reduction in the volume of meet production due to reduction in the volume of fodder produced; Increase in production costs refers to the significantly higher labor costs and use of machinery in crop and livestock production on the farm; (for checking correct answers please consult SWOT table in chapter).*
- *Chapter 4*
    a. *first question: Animal welfare.*
    b. *second question: Organic food consumption positively influences subjective wellbeing.*
    c. *third question: Consumers have a good subjective and objective knowledge about organic food.*
    d. *fourth question: There is evidence to indicate that organic food has lower levels of pesticide residue and lower levels of nitrate-nitrogen than non-organic food.*
    e. *fifth question: The MoBa study.*

Third section: Sustainability

- *Chapter 1*
    a. *first question: 40%.*
    b. *second question: No insecticides are used and there are wild plants in the spaces between the cultivated areas.*
    c. *third question: Organic farming.*
    d. *fourth question: Crop rotation is frequently induced depletion of soils into nutrients.*
    e. *fifth question: Production of a unit of product in organic agriculture.*
    f. *The main reasons why biodiversity is higher in areas where organic farming is practiced compared to those where traditional agriculture predominates are: Reduced use of synthetic chemicals, pesticides not allowed; Reduced pollution at all levels: soil, water, for the same reasons; The existence of uncultivated areas interspersed with cultivated areas; Lower density per unit area of cultivated plants; Greater variety of cultivated plants, the frequent rotation of crops, the lack of very large areas of monoculture.*
- *Chapter 2*
    a. *first question: The Corporate sustainability is the way a company constantly creates shared value through economic development, good governance, the responsiveness of stakeholders and environmental improvement.*
    b. *second question: Collaborative Consumption.*

    c. *third question: an individual's ability to know how to transform ideas into actions.*

- *Chapter 3*
    a. *first question: The certified area, along with the area under conversion.*
    b. *second question: 7.5 %.*
    c. *third question: Not only doubled in size, but even exceeded it.*
    d. *fourth question: €6.3 billion, which represents 6.4% of the total budget for EU RDPs (€99 billion).*
- *Chapter 4*
    a. *first question: By promoting the diversity of rural areas, diversifying activities, employing and developing of human capital in rural areas; By introducing traditional knowledge and modern agro-ecological research.*
    b. *second question: By using more species and old varieties adapted to the local ecosystem, as well as introducing agro-ecological measures in the production process.*
    c. *third question: Design of agricultural support, consumer demand and market prices and existence of an adequate marketing structure for organic products.*
    d. *fourth question: Because of the dominance of small farms, there is no ability to use advantage of the economy of scale effects; Lack of knowledge, agricultural inputs and organization; access to markets; certification; financial constraint.*
    e. *fifth question: Profitable (able to covers costs and gives the producer a favorable return that allows him a decent living standard); In a line with ecological principles of farming.*

Fourth section: Business and economic development

- *Chapter 1*
    a. *first question: To maintain the biodiversity of Europe, To build consumer trust in organic products, and To protect the environment.*
    b. *second question: Policy Framework for Climate and Energy, Waste Management Law, Water Framework Directive.*
    c. *third question: Austria.*
    d. *fourth question: Scheme for young farmers, Green payment.*
    e. *fifth question: 5% of their land for the purpose of protecting and improving biodiversity on farms.*
    f. *According to Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91, organic production is an overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards and a production method in line with the preference of certain consumers for products produced using natural substances and processes.*
    g. *Practical application: Consumers believe that organic foods are healthier and more environmentally friendly; Organic farming is recognized as a possible way forward to improve sustainability in agriculture; Contributing to the protection of the environment and animal welfare.*

- *Chapter 2*
    a. *first question: Economic sustainability, ecological sustainability, managerial sustainability and social sustainability.*
    b. *second question: Creation of the best possible portfolio of farm activities and agricultural practices in order to match the farm output with consumers' preferences.*
    c. *third question: To representative year of investment exploitation.*
    d. *fourth question: Net present value, internal rate of return and dynamic payback period.*
    e. *fifth question: It determines the level of possible fall in farms' volume of production or sale without loss expression.*

Fifth section: Innovation

- *Chapter 1*
    a. *first question: Crop production optimization and optimal water management.*
    b. *second question: Transmit in digital form the values such humidity, temperature and light intensity associated with objective evaluation of field conditions.*
    c. *third question: Contaminants of the irrigation water.*
    d. *fourth question: Includes optical sensing system that provides high resolution field images by comparison with satellite imagery.*
    e. *fifth question: Creates new opportunities to discover, quantify, and understand relations between acquired data provided by WSN in the PA context.*
- *Chapter 2*
    a. *first question: Process reengineering.*
    b. *second question: Artificial neural networks.*
    c. *third question: Volume, velocity, variety, veracity.*
    d. *fourth question: All of the above.*

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