

Foreword

The challenges to global food production.

The history of human life on our planet is continuously intertwined with the events determined by the evolution of agricultural and food production systems. Migration of human beings and urban settlements are social phenomena linked to the agricultural characteristics of territories, to the availability of water and food and to the evolution of knowledge for food production. The production of food on our planet encounters an increasing demand for quantity and quality, linked in part to population growth, but also to the increase in economic possibilities of large parts of the previously malnourished population, and not least by the continuous modification of lifestyles. The ability to expand and sustain a global agri-food system is limited by a number of risks and challenges, some global, but others exquisitely local. The ability to overcome these challenges and meet the food expectations of future populations is heavily dependent on science and technology as well as education in an environmentally sustainable food approach.

The greatest challenges, in our opinion, are listed below:

1. Population increase. In 2050, the world population is estimated to reach 9.7 billion people. This growth, which will inevitably require an increase in the demand for food production, will directly impact the productive capacity of soils, ecosystems and agricultural practices.
2. Climate change. The continuous increase in temperatures, the increase in the frequency of extreme weather events and changes in rainfall trends, are likely to affect crop yields with negative effects on global food production, with particular attention to the countries of the Mediterranean region. The phenomenon of climate change, along with that of desertification, is addressed at the international level with the assumption of obligations by the States that, if properly fulfilled, can help mitigate the negative effects.
3. Drinking water shortage. In combination with climate change, two-thirds of the world could face water scarcity, damaging food production and agricultural practices. This issue must be addressed taking into account, among other things, international obligations to protect the right to water access.
4. Greater demand for arable land. Population growth and the consequent increased demand for food will lead to a greater requirement of arable land. This demand will result in a loss of biodiversity, unless we can produce more using the same amount of land used today, or possibly less. As this is a global phenomenon, the loss of biodiversity is addressed internationally by numerous treaties; their implementation must be balanced with international obligations involving the right to food.
5. Food waste along the production chain, from field to table. Every year 1.3 billion tones of usable food are wasted or discarded along the production chain, becoming waste. This number corresponds to about one third of the food produced each year. And this occurs while some 800 million people in the world suffer from hunger or malnutrition.

6. Food safety. With increasing globalization, production chains have gone from local to global, with an exponential increase in the possible risks involved and less possibility of control. Moreover, the rules and procedures for ensuring food safety still differ greatly from country to country. In this context, the correct implementation of Community and EU law is a priority for Italy and the EU Member States.

7. Undernourishment. The amount of undernourished population, although reaching a considerable number of about 800 million, has decreased in percentage terms over the last 30 years from about 25% to about 15%, in the face of a growing population, indicating how a more correct distribution of food resources can succeed in resolving this problem..

8. Obesity. Over-consumption of nutrients leading to obesity affects some 600 million people, and is steadily increasing. The associated health problems place a huge burden on the global gross product (5% of global GDP is spent on the care of diseases related to overeating).

9. Poor micronutrient intake. Low intakes of some micronutrients, particularly vitamin A, iron and zinc, affect large proportions of some sections of the population, particularly the weakest. For example, it is estimated that around half a million children in the world suffer from vitamin A deficiency, and as many as 30% of the population (but as many as 50% of pregnant women and 40% of children) suffer from iron deficiency

10. Increased protein consumption. The increase in population is accompanied by a more than proportional increase in the consumption of protein, especially of animal origin, the production of which can generate pollution problems as a result of intensive livestock farming, and increases the consumption of land to support its growth. The implementation of international agreements for the protection of the environment and the sustainable use of resources, as well as compliance with FAO and WHO recommendations for a healthier, more balanced diet, is crucial in this area.

11. Food legislation in different states. Food legislation varies enormously from state to state. In order to ensure standard levels of quality and safety, a vast effort of harmonization between the different states would be needed, also in the light of the globalization of production and consumption chains. In Italy and in the other EU Member States, priority is given to implementing the obligations deriving from Community and EU law, both as regards quality and safety and as regards possible distorting effects on competition.

12. Consumer acceptability of novel foods. In some parts of the world, consumer perceptions of novel foods hinder their dissemination. Very often, these perceptions are not based on rational opinions, but are the result of emotional perceptions, often influenced by the media.

13. Consumer acceptance of new technologies. Despite the fact that development and globalization require innovative technologies in order to meet new challenges (i.e. feeding an increasingly populated world) as in the case of novel foods, innovation is often opposed and rejected by the majority of consumers who perceive it as artificial and dangerous. A typical example is the deep-rooted ostracism towards GMOs.

14. Compatibility of novel food production, new technologies and safety standards with obligations under international law. The production of novel foods, the use of new technologies, and food safety standards are in potential conflict with the preservation of those food traditions that are felt to be the identity of a certain culture. These traditions are protected by numerous international treaties dealing with cultural rights.

15. Consumer acceptability (or rather "non-acceptability"?) of intensive farming in the context of animal welfare. A recent survey conducted by the European Commission revealed that the vast majority of EU citizens care a great deal about animal welfare and would like to significantly improve the standards of animal husbandry for 'food' producing animals (hens not kept in cages, elimination of cages for suckling and gestation of sows, slower growing broilers, banning of 'chain' dairy cows, etc.). Ethical animal production is not only a cultural challenge, but also requires high-level training aimed at reconciling production ('market') requirements with those of modern animal husbandry that puts the (physical and mental) health of farmed animals first. Increasingly, EU law and conventional international law are placing limits on states in relation to the treatment of farm animals and their welfare.

16. Production of food of animal origin under sustainable livestock farming conditions. As the world population continues to grow, the issue of increased global needs for high biological value foods is becoming more pressing. The demand for animal protein is constantly increasing. Hence the need for animal breeding, which has evolved considerably over the last century with a constant trend towards intensification, leading to debates on the environmental impact and animal welfare and, consequently, on the sustainability of livestock farming.

17. Access to information, with particular reference to the right to 'adequate' food, and communication to the public about novel foods. The right of access to correct and complete information regarding, inter alia, new technologies and production processes and their impact on the environment is set out in numerous international treaties.

The 2015 Milan World Expo brought to the forefront of world interest the issue of how to provide food and feed properly, while respecting the Earth on which we live and from which we draw depletable resources. This is an issue that must take into account a network of interconnected themes such as the protection of the environment and soil, the availability of drinking water, nutrition and the need for food, the quality of food production, possible innovations in the agri-food sector, reducing waste in the food chain, and the sustainability of the production system as a whole. Themes to be defined in the light of the new global scenarios, diversified in the world's regions, at the center of which is the issue of the right to food. healthy, safe and sufficient food for everyone on the planet. A planet that will see its population increase by many units in the short term.

Expo 2015 has come to an end, leaving us more aware of the problems, but unanswered questions are left on the ground to 'feed the planet'. The challenge for the future remains that of indicating suitable development models for a system which, on a global scale, is growing rapidly, giving rise to a continuous series of new needs and new demands. A diversified system characterized by different geographical regions and populations. Poor populations, characterized by the need for healthy food and water (food security), and rich populations, characterized by the need for food

safety and security and the need to define better nutritional models. The environmental sustainability of agricultural and food production is becoming an increasingly urgent challenge. One third of the food produced globally, around 1.3 billion tones per year, is lost or wasted, highlighting a serious efficiency problem, with unnecessary consumption of resources during production and unnecessary CO2 emissions. In a global scenario characterized by falling production and rising food prices, reducing waste will also be a necessity. Waste, efficiency, sustainability, availability, environmental impact... all these represent parallel issues that call for integrated solutions.

The sustainability of processes can also be improved in the context of production intensification. This challenge can no longer be postponed. Sustainable intensification of the agri-food system (in line with the general aims of the Common Agricultural Policy) is in fact an essential objective in order to respond to the scarcity of arable land and the need to meet the increased demand for food, while limiting the use of natural resources for food processing. Production intensification must contribute to effectively enhancing the intrinsic quality of 'sustainability' that respects human health, the environment and the climate of our planet.

The evolution of the world population also highlights the emergence of new consumers. Consumers with very different needs and very different nutritional and health problems (malnutrition, undernourishment, increase in diseases linked to incorrect relations with food consumption).

In short, we need to consider the need to intensify food production, whether new or traditional, by defining production models that respect sustainability. We need to produce more and better, to provide safe and healthy food for all, but with production methods that do not exhaust natural sources of supply and do not damage our ecosystem.

It is clear that traditional models are often not compatible with sustainability. It is not possible to remain anchored in the past. This is a luxury no one can afford now or in the future. Particularly in the developing world, but with increasing urgency also in the industrialized world. Even some attractive new proposals, such as organic and "green", must be correctly declined if they are not to become "unsustainable" luxuries for the populations of the rich areas of the planet.

The intelligent use of knowledge and technology must enable us to find appropriate solutions. We therefore need scientific research, knowledge sharing and technological innovation.

Project plan:

THE FOOD OF THE FUTURE

It is right in this field that the University of Parma, which is the city of food *par excellence*, has to look for new solutions and make suggestions for the “food of the future” through “Food Project”.

Food project has to look forward to producing new and healthy food in the future, and it has to do it through life-cycle sustainable processes which can contribute to solve the problems and the challenges of the near and far future.

The first step of this project could be identified in the definition of in-depth parallel guidelines:

- Food sustainable productions in terms of soil fertility preservation, genetic and functional biodiversity

The challenge: the qualifying aspect of this project plan is the awareness of the fact that human wellness depends on the stock of our planet, whose ground is an integral part and constitutes the backbone from which the flow of goods and services - able to ensure human wellness - comes from. During the past century, some events, such as the growing agricultural exploitation, the massive raise in the number of human populations, the industrial and technological development dramatically modified the way soil is used, leading to an excessive exploitation of this resource. All over our planet, there are lots of soils which are no longer fertile or can't fulfil their function due to human impact. It must have been mostly caused by those processes that are fasten or directly triggered off by human activities often operating simultaneously and amplifying, by doing so, their effect. Among them, the most widespread processes are erosion, loss of fertility and decrease in organic matter, waste bundling, salinization, flooding and landslide phenomena, contamination, waterproofing, decrease in biodiversity. Agricultural practice itself - aiming at producing food for human or livestock use - takes on a key-role in this alarming scenario. All the damages following the soil deterioration inevitably lead to dramatic consequences for all the components of the biosphere, from water to living organisms. It results in severe issues either for the environment and the human health, and in a great economic loss in the agricultural sector, too. The main challenge of the current agronomic research is to achieve a sustainable balance between an agricultural ecosystem management, a genetic, functional and structural diversity preservation of the tilled soils and a quantitative production. Producing high-quality food, with all its component, is the end-point of a process whose roots lie in certain agronomic management choices, which have to be taken consciously and in compliance with human health and the environment itself. The management of the area affected by the agronomic productions should move towards sustainable and conservative agricultural practices, so to guarantee not only the quantitative cultivation yield but also the quality and the functionality of soils in terms of carbo stock, genetic and functional diversity supply, counteraction to climate changes etc.

In order to support this challenge, it is necessary to plan integrated projects focusing on the twofold sector of food production and agricultural ecosystem preservation.

Competences: The University of Parma has been holding a front line position for some years now in studying the effects of conservative and conventional agricultural managements on several sectors of the soil living community, on the preservation of the genetic and functional biodiversity, on the organic matter supply, on fighting erosion etc. Numerous national and international projects - including a H2O20 project involving several European countries and a Grand project in India - led the researchers from our University to discuss important matters relating to agricultural practice impacts on soils with different levels of exploitation. This is about global-interest subjects dealing with the necessity, either for the most developed countries and the poorest ones - even if with a completely different approach - to guarantee a kind of agriculture respectful of the environment and with the soil as its starting point. The competences of the research groups specialized in these fields are supported by numerous publications on international journals, contributions by invitation in high-scientific profile international congresses, and numerous regional, national and international research projects as well.

Solutions: relying on the University competences which have been developed even thanks to international cooperation, the project tries to identify, describe and spread - through a close cooperation with producers - agronomic and soil management techniques aimed at maximise: 1) agricultural production in terms of quality and quantity; 2) production and functional capacity of cultivated soils; 3) cultivated soils genetic and functional diversity preservation; 4) the fight against climate changes in terms of carbon sink and carbon stock.

Creating training courses for food producers aimed at making them understand the importance of respecting and preserving the soil as a means of food production will guarantee the growing awareness of the fact that the soil - and moreover the agricultural one - is a fragile resource and that it has to be preserved since it is renewable in extremely long periods of time and at unsustainable costs, even for those countries living in better socio-economic conditions.

- Integrated analysis of waters sustainable uses in order to guarantee irrigation practices and minimize the risk of surface waters and aquifers contamination and the loss of the aquatic biodiversity.

The challenge: Surface waters and aquifers contamination is a global issue and it is strictly connected with multiple pressures carried out in the territory - such as intensive agriculture and animal husbandry - and exacerbated by climate changes, and so by a variable and quantitatively reduced supply of water in the river systems. The basin of the main Italian river Po, is a hot-spot both at national and global level for water supply, animal reared density and organic fertilizer production, cultivated area extension with respect to the total area of the hydrographic sub-basin, use of irrigation waters, widespread distribution of artificial canals, hydrological food alteration through water transfer works and mechanisms, surface and aquifer water and pollution and greenhouse gas emissions. It is necessary to analyse the dynamics of the surface and aquifer waters in the hydrographic basins on the right bank of Po, which are characterized by a variable permeability of soils, surface flow irrigations, high-density animal reared and, as a consequence, a surplus in the organic fertilization. The specific focus of the research is on the part of these basins which is crossed by the zone/strip of the resurgences, particularly vulnerable to the irrigation loop. This loop is a drop-down mechanism fastening the horizontal and vertical relocation of micro and macro-pollutants from the terrestrial area to the aquatic one, through a sliding irrigation on permeable soils. Aquifer waters feed during the irrigation and their vertical sliding enable large amounts of solutes (like nitrate) to be widely transferred – through river-aquifer connections - from its fertilized soils to resurgence waters or rivers. The moulding of surface aquifers dynamics around the zone of the resurgences, the analysis of multiple pressures (nitrogen soil system budget, irrigation type and volumes), and contaminant levels (nitrate, nitrous oxide, herbicides, pesticides) and microbial processes in the saturated and unsaturated zone are also important.

Competences: the University of Parma has been dealing for about fifteen years with multilayer analysis in hydrographic basins, dot-like loads evaluation and pollutants diffusion, and nutrients mass balance. Our University has specific competences in the hydro-geological, pedologic, chemical and ecological field: it will allow for analysing water resource quantitatively and qualitatively, and evaluating critical areas with respect to the territory use and features and the current climate changes.

Solutions: integrated analysis - at a hydrographic basin level - of the water resource availabilities and quality, and of needs and pressures related to the agro-livestock activities will allow for individuating hot-spots and hot-moments where and when it will be possible to carry out adaptation strategies towards climate changes and so to gather the available economic resources together.

The hot spots are areas in which production activities will experience a decreasing availability of water and in which it will be necessary to overhaul the way the area is used because of the quality and the quantity of the available water. It will be essential to carry out actions promoting a sustainable agriculture in nature (different kinds of irrigation, diversification in cultivations, etc.).

The Hot-moments are periods of the year in which the combination between water resource exploitation and weather-climate conditions could put at risk both the quality of river and underground systems, and the agricultural productivity.

- Food production for the less well-to-do populations of our Planet (Italian, European and Global populations)

The challenge: according to the specificity and competences of all the parties concerned, the key point of this project plan could be identified in the food production for all the people with lower economic resources. The project is addressed to developing countries, urban suburbs and countrysides of our country and of other countries - both “rich” and with unequal levels of development countries (like Argentina, Brazil) - and it aims at combining the employment of agricultural resources, zootechnics and local fishing with the development of systems for reuse of the agricultural and food industry by-products that can effectively make these processes cost-effective.

In order to give substance to this kind of food, it is required to shift from a local economy model - which is typical of tradition and didn't prove adequate in sustaining populations of many countries - to the development of sustainable - both economically and towards the environment- technologies allowing for raw materials or processed food preservation. This would guarantee an acceptable level of nutrient intake to the populations, both in a time-related way (reducing the impact of the seasonal nature of the primary production), and in a space-related way, allowing for the transportation and exchange of new food resources. At the same time, new solutions for business models will have to be shaped: they will have to be suitable to different socio-economic and cultural conditions.

Competences: the University of Parma has been holding a front line position for some years now in the development of projects dealing with food products and innovative packaging, the standardization of production processes, the assessment of different kind of diet nutritional profiles and the management of distribution processes associated to food consumption. We are dealing with issues upon which several groups of research have built an internationally recognized expertise proved by publications on front-line journals and several research projects.

Solutions: about the actions require thinking, developing and making suggestions about a new development model interested in a safe and sustainable processed food production and packaging which, starting from local economies, aims at turning raw material into food, learning from what went wrong. with the development model now in use in rich countries and so avoiding reproducing a no longer sustainable model.

Along with the research scheduling, it is also very important to create ad hoc training programmes, which are necessary in response to the creation of 1) new consumers, 2) new producers, 3) new ways and processes for food distribution. In this context, training courses related to production reliability, food storage, food distribution and preparation, and nutritional quality should be scheduled. These courses could be addressed to small local producers. The fact that there are new different realities of food production and distribution shows the need of training new professionals with specific competences in the essentials of reliability and food nutritional aspects.

- Production of traditional and non-traditional quality food

The challenge: the term “quality” indicates a multitude of complex and articulate technical meanings, which are difficult to summarize. The term “quality” acquires different meanings (cost, taste, ease of consumption, nutritional/dietary value, etc.) according to the intents of the ones using it. What the economically stable Western consumer looks for in food is all connected with alimentary reliability, benefits for his/her health and subjective quality, which has to do with peculiar tastes perception. This last one is often influenced by the spread of “winning” food models.

If dealing with this type of consumer, the effect of ethical aspects related to production and consuming on perception should not be ignored, along with the impact that knowing the geographical origin of ingredients and food has on general perception.

This need often becomes a powerful driver for food choices (biologic, vegan, zero-mile product, local product, etc.) requiring now a new approach to the consumer behaviour and food education knowledge on the one hand, and a support to production on the other.

The attention towards food reliability and “quality” also has to face up with the new “fast” consumption models, involving vast segments of the population, like lots of young people no longer interested in “traditional” content of food but choosing ease of consumption and financial value instead.

At the same time, more and more consumers prefer models related to the interest in ethnic food, and even in this case a severe in-depth study on reliability should be carried out. In many cases - also as a consequence of migratory processes - new models deriving from a process of “contamination” between once far-off food cultures have been developed. The second generations of immigrants are starting to develop mixed food models that are likely to become more and more important in the future.

The change in food models and production strategies imposes an assessment of the new choices impact on products reliability and perceived quality.

Competences: the University of Parma has been holding a front line position from some years now in the development of projects dealing with PDO and traditional food products and in the development of molecular analysis of the traceability and authenticity of raw material used in the supply chain. At the same time, several technological competences relating to the study of innovative processes and products and the relative processing and packaging plan have been developed. Even in this case, the competences relating to the assessment of the nutritional profiles of different types of diet and for the distribution processes relating to food consumption can be considered adequate. We are dealing with issues upon which several groups of research have built an internationally recognized expertise proved by publications on front-line journals and by the participation in several institutional research projects supported by private sponsorships.

Solutions: it is about thinking, developing and suggesting a model of development of PDO and non-PDO quality food (healthy, safe, and sustainable food) production and packaging, also starting from studies on a raw material produced by respecting quality and sustainability standards.

Even in this case it seems appropriate to develop training courses related to production reliability, packaging, food storage, food distribution and preparation, and nutritional quality. The fact that there are new different realities of food production and distribution shows the need of training new professionals and non-professionals that will have to do with these aspects of the food of the future.

- Development of healthy dietary patterns

The challenge: the connection between health and a healthy diet is a fact; several studies carried out in the last few years confirmed the nutritional and functional food value itself and the possibility for certain foods to prevent pathologies. Along with the malnutrition of the less wealthy populations, there is the arising of problems caused by wrong dietary patterns.

The World Health Organization (WHO) confirms that unhealthy diets and lack of physical activity constitute the main risk factors for chronic diseases. Taking into account the diet only, the main goals to be reached both at individual and population level are:

- balancing the energy provided by the diet and the one burned with physical activity.
- limiting the energy introduced by total fat, reducing the saturated fat consumption
- increasing fruit and vegetables consumption
- limiting simple sugar consumption
- limiting salt or sodium consumption

According to this, there are lots of suggestions about how having a healthy diet, from the more traditional Mediterranean diet to the new suggestions, like the New Nordic diet: it can be considered a means for reaching a “happier life in relation to the food we consume”. Which may be the healthiest patterns in relation to consumption typologies?

After individuating the healthiest patterns, it is important to analyse reasons, barriers and behaviours leading or distancing every consumer to or from these patterns. It is also essential to individuate effective tools for public policy and “evidence-based practice” recommendations addressing the stakeholders and promoting knowledge and the adoption of these dietary patterns by consumers.

Competences: the groups of research in the field of nutrition from the University of Parma have developed from some time now the different necessary competences to face this challenge. It is about matters upon which several groups of research have built an internationally recognized expertise proved by publications on front-line journals and the participation on several institutional research projects supported by private sponsorships.

The interaction with other groups of research specialized in the field of technology (food production technology study), microbiology (food and gut microbiome study), genetics/toxicology (study upon genetic polymorphisms in relation to eating habits and state of health, genes activity modulation from different foods and their components) and chemistry (foods composition study) would allow to strengthen the existing competences and to suggest challenges as hard as the ones already existing in this field. The social and psychological competences of our University could be highly supportive as well.

Solutions: it is about defining coherent models of connection between health and a healthy diet for the different typologies of consumers characterizing the global scenario.

Even in this case, it seems appropriate to develop ad hoc training courses that may provide a dissemination of the acquired knowledge.

- Food production for specific groups of consumers

The challenge: the raise in the average age of the population from Western countries imposes a reassessment of food reliability and health contents.

The increase in the elderly percentage corresponds to a rise in consumers with a weaker immune system and specific diet needs (less salt, less fat, more vitamins, more mineral salts, etc.).

Cardiovascular diseases and nervous and cognitive system degenerative disease are more and more common among the population also due to the increase in life expectancy.

Defining functional diets that can deal with these kinds of problems and possibly reduce the negative effects could be a remarkable issue of health interest.

Also creating “fortified” foods so to make up for the main and specific needs that arise as age increases is an issue that requires in-depth studies.

It is necessary to understand these consumption patterns and interpret this social tendency even as a necessity for developing more “reliable and proper” foods.

Competences: the groups of research in the field of nutrition from the University of Parma have developed from some time now the different necessary competences to face this challenge. It is about issues upon which the “Nutrition” group of research has built an internationally recognized expertise proved by publications on front-line journals and by the participation in several both institutional and supported by private sponsorships research projects.

In this case, too, the interaction with other groups of research specialized in the field of technology (food production technology study), microbiology (food and gut microbiome study), genetics/toxicology (relation between damage to the DNA and ageing on the basis of diet by using ad hoc cellular models) and chemistry (foods composition study) would allow for the strengthening of the existing competences and would suggest challenges as hard as the ones already existing in this field. The social and psychological competences of our University could be highly supportive as well.

Solutions: it is about defining coherent models of connection between health and a healthy diet for different typologies of “elder” consumers.

Once again, it seems appropriate to develop ad hoc training courses that may provide a dissemination of the acquired knowledge.

- Studying a strategy for limiting the new “emergences” or the onset of new food hazards

The challenge: in the past few years, an increase in new medical emergencies whose transmission may be caused by foods emerged.

This “new” situation is the result of an overlapping and a combination of biological, industrial and social in nature problems, that have modified and that will effect the two concepts of “danger” and “risk” for food products and food use water in the future.

Here are some examples: just keep in mind they are not comprehensive and must be further analysed:

- antibiotic resistance
- algal toxins and mycotoxins
- chemical dangers transmitted by contact with food matrices
- allergens
- dioxins
- acrylamide
- etc.

Competences: the groups of research in the field of chemistry, inspection, vet, microbiology and biology from the University of Parma have developed from some time now different and in-depth

competences dealing with food reliability (hazard analysis and characterization, risk analysis, risk management). It is about a competence which has been recognised both at national and international level and which has been proved by publications on front-line journals and by the management and the participation in several both institutional and supported by private sponsorship research projects. Even in this case, the interaction with other groups of research specialized in the field of technology (food production technology study) and nutrition (risk assessment related to different foods quantitative assumption in relation to the diet typology) would allow to strengthen the existing competences and suggest challenges as hard as the ones already existing in this field. The social and psychological competences of our University could be highly supportive as well.

Solutions: it is about defining coherent models of producing and managing raw material and processed food which are necessary to recognise and limit the onset of new food hazards, and to reduce the risks that are already known but expanding in relation to the modification of production and distribution models.

Even in this case, it seems appropriate to develop ad hoc training courses that may provide a dissemination of the acquired knowledge.

- Sustainability and valorisation of by-products and process rejects

The challenge: a significant part of the food produced gets lost or wasted. This implies a useless consumption of the resources used during the production phase and additional costs for the transformation and disposal ones. Processes sustainability can and must be improved not only with regard to production intensification and reduction in environmental impact, but also and above as regard waste reduction by using recovery and transformation cost-effective strategies and models. Recovering rejects and by-products means studying new ways of creating new quality products from residual biomasses cost-effectively, through new processes, new methodologies and the relative machines and plants, with a low environmental impact and a high efficiency (also at energetic level) that will have to be assessed during the whole life-cycle (Life-Cycle Assessment).

Competences: the University of Parma has been holding a front line position for several years now as regards the development of projects aiming at enhance residual biomasses. It has been proved by publications on font line journals and several financially supported European projects of research having our University as front line partner or even as their aide. It surely allows to build networks of advanced collaboration with centres of research and industries from all over Europe. The main competences have to do with the characterization and development of methodologies aimed at biomasses recovery from fruit, vegetables, dairy products and meat production and development potential for novel machinery and technologies for enhancement and recovery processes. In addition to the direct enhancement and recovery of biomasses, University of Parma holds a position between the key players in the indirect enhancement, that is the biomasses use aimed at allowing for the growth of useful organisms, like seaweed and insects, or microorganisms, like bacteria and yeasts. Having organised an European Project and two financially supported projects about this issue, University of Parma is an acknowledged leader both at national and European level in the use of insects for the indirect enhancement and it is also the one and only Italian University to be an associate member of the International Platform for Insects as Food and Feed. University of Parma holds a front line position in spreading, developing and integrating the concept of “One Health” between the

students (even in non-sanitary areas), at procedural level and at an operational and decision-making level thanks to research and third mission activities.

Solutions: the University of Parma promotes and sustains front line researches in this field dealing with:

- development of technological strategies in order to use the fractions recovered from fake food, by raising their additional value.
- enhancement and use of residual biomasses in order to allow for the growth of organisms, like seaweed and insects, or microorganisms. They will have to be enhanced by making them become feed or food in a subsequent step.
- recovery of specific molecules and/or their fractions through low-impact selective methods.
- development of food and feed ingredients from the recovered fractions.

These studies - carried out in collaboration with research and industrial partners - will provide operational solutions for recovering by-products food chain and making them become new products which will be usable in different contexts, with a raise in the added value and a decrease in the environmental impact.

It will be useful then to face the relative competences pointed out previously (study of a strategy aimed at limiting the new “emergences”/ the onset of “new” food hazards); to make sure that the new products are not a source of risk (new allergens, contaminants, etc.). Knowing more about these goals will provide our University an added heritage, will allow for the support of local companies (and more). The acquired knowledge will be also transmitted to our students in the active courses offered by our University.

The development and the continuation of the scientific research aiming at preventing food contamination (even of edible game) thanks to the support of medicines and metallic and environmental polluters residuals also seem very much important and of current interest along with the local and national promotion of actions aiming at raising awareness in the final consumer about the importance of healthy food chain and about consciously choosing at zero risk products.

Consumption models with greater sustainability

The Challenge: according to FAO, sustainable diets are eco-friendly, so they contribute to food and nutrition safety and to a healthy life for present and future generations. Sustainable diets contribute to the protection and respect of biodiversity and ecosystems. They are culturally acceptable, affordable, accessible, adequate, safe, and nutritionally healthy and, at the same time, they optimise natural and human resources. Therefore, the sustainability of diets embraces different aspects such as the environmental impact connected to all the supply chain processes, including the consumption and the waste disposal, the nutritional intake and the socio-economic aspects of the different consumption

patterns. At the same time, large quantity of food (equivalent to thousands of euros of food) are discarded daily. Food waste concerns not only domestic consume, but also production and transformation industries, distribution and catering.

The hypothetical solutions also require a different organisation of the supply chain of food production and promotion from the point of view of logistics, distribution, labelling, management of the different deadlines according to the different uses,

and, before that, from the point of view of packaging.

What are the interventions (public strategies - e.g. informational campaigns -, or private - e.g. brands, sustainability logos) that can encourage a more sustainability-oriented consumption model? Which suggestions can be made for operators in the supply chain for a more effective and rational management of food production and distribution in terms of sustainability?

Competences: At the University of Parma there are research groups that have developed skills related to sustainability in the field of food production, also through the reorganisation of the food supply chain. This competence is recognised at national and international level. With regards to the reorganisation of the food supply chain, the University of Parma takes part in the SORT Project (Italian acronym for wasted food unpacking, stocking and tracing), conceived in the Smart Cities and Social Innovation program, approved by the Ministry of University and Research. In this case the interaction with other research groups involved in the production, distribution and consumption of food would allow for the reinforcement of the existing skills.

Solutions: the aim is to define coherent production and management patterns for raw and processed food which are essential to achieve productive sustainability, also considering the development of unpacking systems aimed at extracting a good from its primary packaging and directing it towards the concentration point.

Development of new food from non-traditional sources (algae, protein from microorganisms, insects etc.)

The Challenge: the protein-based sources not commonly used by Western consumers can be numerous. These matrices can be used, after modifications with appropriate technological interventions, also through the intervention of microorganisms (fermentative processes), individually or after blending for creating new food products. This potential should not be considered only with regards the food currently on the market, but also in relation to the formulation of completely original products.

The use of these alternative sources requires an in-depth evaluation of health hazard, potentially related to raw material and to a risk analysis in the end products. At the same time, the perception of consumers and the level of acceptance of these new products must be carefully analysed to facilitate their effective placement on the market.

Competences: University of Parma has research groups that have developed skills in this field on many occasions and from different perspectives. These skills are still under development, but they have already obtained results of considerable interest. The interaction with other research groups in the field of technology (study of food production technology), microbiology (study of food microbiome and food fermentability), genetics (genetic improvement of microorganisms for the production of beneficial molecules for health), chemistry (composition study) and nutrition would increase existing skills and challenges in relation to the safety and acceptability of these products. The social and psychological skills of our University could be a great support to understand the availability of different categories of consumers with regards to these products.

Solutions: it is necessary to consider whether these raw material can be proposed as a source for the development of innovative foods that can suggest new production and consumption sustainable patterns.

Development of an International Collection of Food-borne Microorganisms.

The challenge: microorganisms are distributed in every ecosystem and biotic component of our planet, including soil, water, atmosphere, man, animals, plants and other living creatures. Each ecosystem is characterised by specific microbial populations and it is frequently functional to preserve the ecosystem and its survival. Microbial genera and species, adapted to specific ecological niche, have natural and acquired characteristics, quite often peculiar ones, which constitute a unique heritage for knowledge and development. These characteristics can be studied, characterised, preserved and used for the implementation of safety in different areas: agriculture, food, environment, pharmaceuticals, medicine and technology. Foods can also be considered as dynamic and complex ecosystems, and represent the most frequent way in which microorganisms come into contact with our organism.

Besides the microorganisms that cause food diseases and those that cause food alteration, all around the world many research groups study and analyse the positive aspects of the interactions between microorganisms and life taking place in the food we consume daily. These interactions go beyond the documented probiotic efficacy of certain microorganisms at the intestinal level, reaching body districts more unexpectedly correlated to the presence of microorganisms in the human body. In spite of the importance of microorganisms and the positive effects of their use in the food sector, there is no national or European coordinated, regulated and shared management of the biodiversity heritage of “food microorganisms”, of which Italy is particularly prosperous.

Networks of microbial collections are being created in all continents and Asia, especially, has a particularly efficient infrastructure: in Japan, on 29 October 2010 the Nagoya Protocol was born (in effect on 12 October 2014): it deals with the Access to Genetic Resources and fair sharing of benefits arising from their use and is addressed also to universities as users.

There is no centralised collection of microorganisms in the University currently. There are different collections preserved for laboratory use. The food microbiology research working group from the Department of Food and Drugs has a collection of many bacterial biotypes of food origin.

Competences: the food microbiology research working group of the University of Parma has developed different and further analysed skills related to the understanding, selection and enhancement of the food microbiota, referring particularly to the microbiota of typical food production. At the same time, in different research contexts (such as hazard analysis and characterisation, risks analysis and risks management), safety aspects related to the presence of undesirable microorganisms in food have also been developed. Until now, there are agri-food microbiologists, industrial microbiologists, environmental microbiologists, veterinary microbiologists, clinical microbiologists, taxonomists and geneticists of microorganisms working at our University. These various and different topics go from the taxonomy to the metabolic complexity of agricultural and natural environments, from complexity of food ecosystems to the genetics of complex microbial communities, from a functional interdependence of microbial associations to the challenge of take advantage of the microbial diversity in industrial environments and from bioinformatics to the advanced molecular biology. This is a recognised competence at national and international level, proved by publications in front line journals and by the management and participation in various institutional and private research projects.

Solutions: the establishment of a University microbial collection and its conservation are considered a great benefit for the preservation of biodiversity but also for the food-industry application potential (from safety to protection of PDO products, to the development of new products and industrial processes in the food manufacturing).

In order to apply the Nagoya Protocol, currently realised partially in Europe, a latest national collaboration has shown how -in the most remarkable universities - there are working groups in the field of Microbiology, or in the agronomic and nourishment field, requiring staff who dedicates only to the maintenance of microbial collections, both taxonomic and of technology transfer.

A well-structured and aware management of microbial biodiversity present in foods would make the University of Parma an excellence, a national and international reference point for conservation, knowledge and scientific, technological and industrial transfer of such wealth.

Employment of GMO technologies in the food production

The challenge: the global area of GMO cultivations increased from 1.7 million hectares in 1996 to over 185 million hectares in 2016, distributed in about 30 countries around the world, many of which are development countries. The leading nation is USA, followed by Brazil, Argentina, India and Canada. Together, these countries cover more than 90% of the world's area dedicated to GMO cultivations. However, within the UE, there is a complex system of rules controlling the marketing and the labelling of these products. In Europe, field production is limited almost exclusively to GM corn produced in Spain. In spite of the wide spread of GM cultivation, the number of genetic traits introduced is very limited and inferior than what might have been assumed in the past. The production of soya (herbicides tolerant, HT) and insects-resistant corn (engineered with gene sequences from *Bacillus thuringiensis*, Bt) is also important. In addition, new frontiers have recently been opened, and they are represented by new types of plants produced through cisgenesis and genomic editing techniques.

The debate on food produced by genetic engineering is always intense and disputable both in terms of regulations, different in each country, and in terms of public opinion. The elements underlying different opinions are not always based on certain scientific evidences.

Can GMO techniques for food production be developed or not? What factors need to be considered in order to develop these productions and making them more suitable to the public opinion point of view? This decision can only be political, but the research in this field can help to clarify some aspects on the issue aiming at producing a more balanced and informed argument, in the wider context of a greater involvement of stakeholders and public in the choices with ethical, economic, social consequences on society.

The potential of GMO techniques could be determining in order to produce safe and healthy food in the future for all the inhabitants of the planet, with production methods not consuming the natural sources of supply and not damaging environment and the ecosystem. What are the proposals?

Competences: at the University of Parma there are research groups in the biological and genetic field that have developed further analysed knowledge in the field of molecular characterisation and modification of plants, animals and microorganism, studying their interactions with the biotic components of soil and their effects on biodiversity in general. Often these research groups have developed an internationally recognised excellence, proved by front line magazines publications and various research projects. On the basis of this fact, it is considered possible to develop new skills in the production of GMO foods.

In this case, the interaction with other research groups in the technology field (study of food production technology), microbiological (study of food microbiome and their fermentability) and chemical (composition study) and nutrition ones would be essential. It would also allow existing skills to be enhanced and it would suggest challenges in relation to the safety and acceptability of these products.

The University social and psychological skills could be a support of great potential in order to understand the availability of different categories of consumers with respect to these products.

Solutions: development of the research in this area to clarify some aspects related to the production of GMO food to favour a more balanced and informed argument, in the wider context of stakeholder and public involvement in choices with consequences (ethical, economic, social) on society.

Analysis of demand and policies for the spread of information about nutritional patterns

The Challenge: over the last few years, food preparation and fruition along with the nutrition processes have been the focus of the attention for researchers, business managers, journalists, experts and representatives of national and international public institutions. At the same time, the amount of nutritional information and its repercussions on society, available in traditional and digital media, has increased. Because of such a significant increase of the information available to everyone, as a whole, there was not a complete and transparent accuracy in the realisation of the transmitted contents or a constant scientific feedback. As a consequence, the significant effort to increase awareness and attention on issues of social importance (just think about the excess or defect malnutrition, the issue related to food waste, the relevance of production processes and the constant improvement of the

intrinsic quality of products and supply chains in our country system) has perhaps not produced the expected results. Consequently, it is necessary to develop a coherent project of research interventions to support an overall policy of greater involvement of citizens on the issues taken into account, through an analysis of factors that affect people's decisions. The objective just mentioned is also particularly relevant in our country, as it is well known, is one of the main processors of food products at a European level, holding a consolidated tradition in the field, over 200 typical productions and a recognised leadership in certain relevant food sectors (think about wine, fruit and vegetables, pasta, cured meat and dairy products).

On this subject, several areas can be guarded. Four of them are shown below.

The first area of investigation concerns the behaviour of the final demand with regards to nutrition and the processes related to the products choice and preparation. In this context, the analysis of the consumer focuses on the factors that impact on food choices in terms of quality and how selected products are used.

The second field of research analyses the use of digital tools in food orientation processes and the choices realised by the citizen/ consumer in order to obtain accurate information on recipes, selection and preparation of purchased products.

The third field refers to communication models used by institutions, enterprises, agricultural and production associations, consortium and media to inform and involve the public in a process of greater awareness of the relevance of nutritional factors. It is about analysing and understanding whether communicative and rhetorical models used in different fields are effective and coherent with the objectives pursued and whether the components are based on objective and verified hypothesis or not.

Relating to analysis models and narrative reworking concerning food, a further area of analysis regards the communication policies implemented by firms (and consortium) of the agricultural food supply chain of our country. It is important to understand whether the choices adopted in terms of communication tools and models intended to qualifying the characteristic "Made in Italy" are appropriate and effective for different (and international) people, not necessarily aware of the authenticity and value of the original productions and the systems connected with them.

Competences: at the University of Parma there are specific skills on the subject of the processes of analysis of behaviours related to the final demand and actions that can be adopted by the main operators in the supply chain and that can be used to increase awareness.

The experience gained over the years on the evolutionary policies of vertical marketing channels (manufacturer, distributor, service operators) and on the interface processes between supply and demand allows the University of Parma to be an essential point of reference at national level on several subjects mentioned above.

Solutions: the development of a coherent and advanced patterns on the processes regarding the expectations and perceptions of the food "consumer". The definition of a coherent plan supporting information and communication campaigns promoted by institutions, firms and service operators, based on the effectiveness and consistency compared to the size of objectification of factors for distinguish products (quality, sustainability, food safety, ethics, etc.). The support to industrial and distribution firms about the creation of "storytelling" focused on ways of consumption of food with an appropriate nutrition, to be conveyed through both digital and physical media (particular attention

to points of sale). Advanced modelling in terms of analysis and design of social media in order to increase awareness and skills for consumer related to nutrition and awareness of consumption processes (with the specific reference to the youngest ones).

And then identification and shaping a well-structured communication proposal in support of the “Made in Italy”, conveying “clear and authentic” factors towards foreign targets of potential consumers, not necessarily informed and/or aware of the cultural and food patterns characteristic of our country.

The development of suitable methods for the assessment of food hazards and risks (new ones)

The challenge: the production of new food leads, inevitably, to new risks for the consumer. These risks must be analysed and managed in order to protect the consumers’ health. The current risk assessment and risk management methods are onerous, environmental and ethical unsustainable. The aim is to develop innovative methods in order to achieve high levels of safety, with lower economic and environmental cost for overall improvement and in order to export such systems even in countries with less developed economies.

Competences: at the University of Parma there are research groups that have developed in-depth knowledge in the development of new analytical methods (biological, chemical, molecular, physical...). These research groups have also developed a recognised excellence, proved by publications in front line international journals.

Solutions: developing both analytical methods and rapid, sensitive, reproducible, repeatable and, if possible, economic bio-toxicological tests, suitable for risks assessment in food production.

Implementation of 4.0 Industry methods in food plants

The challenge: during these years, food industry will be rapidly involved in the transformation towards the Industry 4.0 production model. By this definition, we mean the entirety of methods and technologies of the fourth industrial revolution, in which the main aspect is the total and integrated digitalisation of the production process. On the basis of this new model for industrial production there is the recent improvement of new technologies, called enabling technologies, such as digital automation, big data, artificial intelligence, collaborative robotics, the Internet of Things, but also advanced materials and technological treatments and additive manufacturing. The food industry must be able to use the potential of the 4.0 Industry model.

Competences: the University of Parma has been working for a long time in the field of food plant engineering, as evidenced by the presence of a dedicated degree course. Moreover, research groups from the Engineering areas of the University of Parma have already developed different and complex skills related to various enabling technologies of the 4.0 Industry model, that since 2017 have been united in the laboratory SmartProductionLab 4.0 of the Department of Engineering and Architecture. As far as automation and robotics are mentioned, there are skills in the development, construction and testing of high-performance industrial robots, besides the abilities on SCADA supervision systems, high-dynamic digital drives, on the design of mechanisms for packaging, on sensors. There

are unique skills in the field of custom software development for real-time and large-scale simulations, and software for artificial vision. There are also skills in the field of control and optimization of processes, with management engineering methods. The University of Parma is also active in the Internet of Things field, through the spin-off RFID Lab. There are application experiences of software tools, materials, construction technologies and advances technological treatments (laser texturing of surfaces) developed within EU and Emilia-Romagna POR-FESR projects, aimed at increasing the food systems energy efficiency and safety.

Solutions: in the food industry, the implementation of 4.0 Industry methods can have several results. First of all, the introduction of the state of the art in terms of automation and high-dynamic robotics would allow an increase of the production, especially in the packaging phases. At the same time, the complete digitisation of the process would allow the achievement of higher levels of safety at all production points, and the use of big-data methodology and IoT would provide an evolution in product traceability and process control. The software implementation of plant models (digital-twin) would provide the possibility to optimise the lay-out and topology of production lines in order to maximise the productivity. In addition, the implementation of modern simulation techniques for Computational Fluid Dynamics (CFD), Finite Element Analysis (FEA) and Multi-Body Dynamics (MBD) problems would allow for a high level of detail in the simulation and optimisation of food plants and processes that, with the adoption of innovative materials, construction technologies and surface treatments, would allow food plant engineering, and therefore the transformation industry that uses it, to move towards increasingly extreme performing features and to limit construction, maintenance and operational costs, with innovative solutions and an increasing reliability and safety.

Consumer acknowledgement of novel food

The challenge: on the basis of the so called Third mission of the University - as the entirety of activities aimed at efficient interaction with the territory, analysis models and narrative re-elaborated version related to nutrition and its research - a wide range comply with politics and humanistic knowledge.

The Food Project of Parma main challenge is the food of the future. The consumer acknowledgement of novel food - often held back by emotional perceptions, media, tradition but also by taste and age - necessarily going through history, identity and shared memory - can find an effective communication in the symbols and images of art and history.

Competences: at the University of Parma researchers have developed in-depth knowledge in the humanistic field dedicated to the development of models of analysis and narrative reworking related to nutrition.

Solutions: for this purpose it would be appropriate to publish in a small specific serie didactic material, reference books, and plan through conferences, exhibits, publishing industry, the different issues faced by the University of Parma in terms of Food. Starting from the different researches, it would be a good idea to create a program, in a sort of thematic container, that could be entitled “Food in the territory of taste” or “Art and nourishment in the territory of taste” or even “In the territory of Taste: culture and nourishment” ...

“Ethic” breeding/farming

The challenge: the EFSA panel for “Animal Welfare” (<http://www.efsa.europa.eu/en/panels/ahaw>) has established that the “intensive” animal production is characterised by stress, suffering and disease conditions and, in general, by animal welfare failure. Consumers have a request, too: that animals should be well-treated in the production of foodstuff; a good animal welfare protection contributes, directly and indirectly, to the healthiness and quality of food products. In the Emilia Romagna, beef sector represents more than 10% of gross production that can be sold in the regional livestock; the pigment sector represents the 20%; the dairy cattle sector over 40% and the poultry sector the 30% (source: <http://agricoltura.regione.emilia-romagna.it/produzioni-agroalimentari/temi/allevare-animali>).

Therefore, it is necessary to train, to increase and to spread theoretical, practical and technical skills in the topic of well-being able to put set up a fair animal management and a fair human-animal communication.

Competences: in the University of Parma, in the field of veterinary and zootechnical, several professors and researchers have already developed different skills essential to face this challenge. Moreover, among the University’s professors, there are several European experts in Porcine Health Management and Bovine Health Management. The close collaboration with various livestock farms (in particular dairy cattle and pigment farm) and with veterinary health service of AUSL, provides opportunities to supervise the implementation of law (national and community) on welfare and to suggest innovative and concrete strategies to improve animal welfare in breeding.

Solutions: 1) Research: the development of studies aimed at identifying the risks factor for animal welfare of dairy cattle and pigs in the local breeding; the development of studies to improve welfare conditions and productivity (“reconcile the consumer concerns with market need”); 2) Didactics: the creation of educational courses to train professionals able to deal with the challenge of ethical breeding (I, II, III level, Masters, specialisation school, European Residency of EBVS..?); 3) Third Mission: the role of the farmer, in establishing the improvement of welfare conditions is central in optimising animals life quality, and consequently, not only their welfare but also their productive response. Without it, of course, the breeding is not eco-friendly. The spread of the concept of well-being and the collaboration in identifying/revisioning the factors that affect it negatively are two crucial aspects.

Sustainable farming

The challenge: in the field of livestock/animal husbandry, it is necessary to apply an incisive research of sustainability in environmental, economic and social terms. To do so, the introduction of ethic concepts (work and health distribution, respect for animal welfare) and ecological ones (research for reduce the environmental impact) in the area of the economic management of livestock, in order to ensure the redrafting/reshaping of the hedonistic idea - which has been the only inspiration for the management of agricultural and livestock farms – would be essential, too.

Competences: at the University of Parma, professors and researches have a considerable experience in terms of genetic selection of animals, assessment of production efficiency and animal nutrition. Moreover, several studies in relation to molecules study of natural origin for animals welfare, which also organic agricultural make full use of, have been carried out.

Recently, several European projects with this kind of purpose have been carried out among them the Susmilk project (FP7KBBE), aimed at optimising the dairy chain; the Cowficiency project (H2020-MSCA-RISE), aimed at improving the efficiency of protein nutrition and Organic-PLUS project (H202-RIA), aimed at solving problems related to agriculture and organic farming.

Solutions: the development of studies oriented to optimising the food rations for ruminant animals, in order to maximise the exploitation of locally produced forage resources and reducing environmental impact through a supply chain approach that takes into account the transformation of the food into the final product and its quality. Within milk ruminants, the subjects of these studies go from study of higher protein forage varieties to the digestibility of protein and fibre (essential for the formulation of high forage diets) and its metabolism, up to the assessment of the expression of genetic variants of casein and the resulting dairy yield of milk in relation to the breed bred.

Studies aimed at optimising the nutrition of mono gastric animals in livestock, intended to find options to plant food whose use produce competition with the human species. These studies take into account by-products and residues from industrial food processing, in addition to foodstuffs close to expiration, that should be reassessed with more innovative sanitising techniques and also the possibility of using genetic strains, more appropriate for their exploitation. Studies pointed towards solving problems related to the organic farming practice, concerning the research of solutions that reduce the need of supplements and synthetic antimicrobials, in addition to bedding/litter originated from organising farming. These studies, as well as reducing the circulation of potentially damaging molecules in the ecosystem, can increase the demand in strictly agricultural inputs for the employment in the primary sector, potentially hesitating for a greater social sustainability.

Studies oriented to the application of high-tech solutions in the field of livestock, in order to facilitate the operation of nutrition, milking, cleaning and assessment of digestive efficiency, in terms of “precision farming” and “precision feeding”, aimed at optimising the use of resources, saving food and improving the quality of milk.

Recognition and coordination of international regulations related to Food issues and study of their implementation

The challenge: the international right deals, directly and indirectly, with various issues related to food, its production and processing and the fundamental rights attached to it. In the same field, especially regardless more technical aspects, EU regulation is increasingly present and effective. First of all, among the issues considered, it can be taken into account the rule of protection of the environment and biodiversity, the rules that requires a sustainable use of resources and those that aim to fight climate change and desertification. Secondly, the rules intended to protect the fundamental rights of the individual, such as the right to proper food, right to water, the right to a healthy environment, the right to be informed. Moreover, the so-called “cultural rights” cannot be ignored. A certain traditional food or its preparation represents the identity of a culture, as such deserving of protection. Eventually, international and European law for the protection of animal welfare are

becoming more and more important (e.g. the traits promoted by the Council of Europe on transport, breeding and killing of farm animals or in matters of community and union legislation). Finally, it is necessary to consider bioethics issues that can arise in relation to many aspects, for example new technologies and animal exploitation. For this reason, it is necessary to enforce an appropriate legal regulation. Some of the rights, ensured by international a union deeds, could go against the pursuit of other legitimate objectives (for example a regulation that imposes food safety standards in contrast with traditional food preparations). The majority of the normative sources and the goals pursued create problems of coordination and overcoming the eventual contrast through a delicate balance of the various requirements.

Competences: the research groups of the University of Parma from the legal field deal with problems related to environmental defence in its various forms and the protection of fundamental rights, addressed in the different disciplines of jurisprudence. Especially, in the context of PRIN projects, in-depth issues related to sustainable development, the impact of biotechnological innovations on human rights, the protection of cultural rights and the defence of biodiversity, the right to water, the right to information and the national and European right to production and control of food have been examined. The aspects related to bioethics, concerning national and comparative law, lie in the study and the analysis within the activities of the University centre for the studies in bioethics and the European and international affairs centres, both characterised by a strong international connotation.

Solutions: the systematically recreation of the regulatory framework resulting from the multiple deeds of international and EU law, for the Food issues, is the requirement to overcome problems related to relation and coordination between the different sources and suggest solutions in order to respect and reconcile the various needs and purposes.

In the developing of this task, the evolution of the State's law and practice, the contribution of jurisprudence of the various international authorities and development at a soft law level should be taken into account. With the verification of the law in force and its it will be possible to identify in how many areas the law is still lacking, incomplete or ineffective.

Possible additional cross-cutting themes to be developed:

- increasing the raw materials production potential
- innovating the production technology along the entire supply chain to improve the products safety and security, their storage and distribution
- developing cheaper production methods, in order to reduce the food cost
- reducing waste and garbage
- developing sustainable production models through principles linked to "circular economy" models
- using the potential of automation and mechanisation (robotics) to increase production and rationalise the use of resources (energy, process water, steam, etc.)

using new growth techniques through aquaponics/hydroponics systems applicable both in urban contexts and in contexts where soil is poor or climatic conditions are extreme

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