



FEEDING ON FUTURE

**Towards a productive, sustainable,
resilient, healthy and responsible
food system universally accessible
in Catalonia**





FEEDING ON FUTURE

**Towards a productive, sustainable,
resilient, healthy and responsible
food system universally accessible
in Catalonia**



Consell Assessor per al Desenvolupament Sostenible (Catalunya), autor

[Mengem futur. Anglès]

Feeding on future : towards a productive, sustainable, resilient, healthy and responsible food system with universal access in Catalonia. – First edition. – Títol original: Mengem futur : per un sistema alimentari productiu, sostenible, resiliente, saludable, responsable i d'accés universal a Catalunya. – Bibliografia

ISBN 9788439397632

I. Títol II. Títol: A la part superior de la portada: Report 1/2018

1. Seguretat alimentària - Política governamental - Catalunya 2. Aliments - Indústria i comerç - Política governamental - Catalunya 3. Catalunya - Política alimentària

338.439.6.02:663/664(460.23)

The Advisory Council for the Sustainable Development of Catalonia (CADS) is a body which advises the Government of Catalonia on issues relating to sustainability. Created in 1998, it is currently under the Ministry for Foreign Action, Institutional Relations and Transparency. According to Decree 41/2014 of 1 April, on the Advisory Council for the Sustainable Development of Catalonia, the Council's functions are the following:

- a) Advising the Government of Catalonia on issues affecting sustainable development, especially on building the principles of sustainability into policy, regional and sectoral planning instruments, draft legislation and regulations, and in the strategic projects and initiatives led by the Government.
- b) Assessing the strategic policies for sustainable development put forward by the Government of Catalonia, especially those related to energy, water, food security, climate change and the green economy, and to formulate proposals for these areas
- c) Encouraging the transfer of knowledge between the Government, the academic world and civil society in the field of sustainable development.
- d) Advising the Government on the design and implementation of measures to raise awareness about sustainability.
- e) Encouraging the involvement of economic and social sectors in the development process in Catalonia.

© Government of Catalonia

Ministry for Foreign Action, Institutional Relations and Transparency
Advisory Council for Sustainable Development

Members and rapporteurs: Carles Ibáñez, Joan Vallvé and Montserrat Viladrich

Members participating in information gathering and discussion: Ferran Rodés (president), Xavier Bellés, Puri Canals, Sergi Ferrer-Salat, Maria del Carme Llasat, Rafael Mujeriego, Josep Oliver, Isabel Pont, Pep Salas and Josep Maria Serena

Technical team: Fina Ambatlle, Raquel Ballesteros, Meritxell Rota (report coordinator), Antoni Vicens and Arnau Queralt (director)

Administrative support: Mercè Garcia

Translated by: t&s = Traducciones y Tratamiento de la Documentación, SL

Graphic design and editorial production: Official Journal and Publications Organisation of the Government of Catalonia (EADOP)

First edition:

Print run: 100 copies

ISBN: 978-84-393-9763-2

Legal Deposit: B 23989-2018



This work maybe used freely, but is subject to the terms of the Attribution-NonCommercial-NoDerivs Creative Commons Licence: it may be redistributed, copied and reused provided that authorship is acknowledged and it is not used for commercial purposes. The full terms of this licence are available from: <https://creativecommons.org/licenses/by-nc/4.0/legalcode>

This English translation should be quoted as:

GOVERNMENT OF CATALUNYA. MINISTRY FOR FOREIGN ACTION, INSTITUTIONAL RELATIONS AND TRANSPARENCY. ADVISORY COUNCIL FOR SUSTAINABLE DEVELOPMENT (2018). *Feeding on Future. Towards a productive, sustainable, resilient, healthy and responsible food system universally accessible in Catalonia*. Report 1/2018. Barcelona: Government of Catalonia. Also available online at: <cads.gencat.cat>.

CONTENTS

PROLOGUE.....	5
1. INTRODUCTION.....	7
2. INTERNATIONAL AND EUROPEAN CONTEXT.....	9
2.1. Food supply to the world: global challenges in a world with scarce resources.....	9
2.2. European food supply in a changing global environment.....	11
3. FOOD SECURITY IN CATALONIA.....	13
3.1. Guarantee the food supply: through a productive, sustainable and resilient system.....	13
3.1.1. Maintain agricultural workforce levels to guarantee production	14
3.1.2. Conserve and recover land for agricultural activity, especially the most fertile land.....	18
3.1.3. Recover biodiversity to guarantee ecosystem services.....	20
3.1.4. Conserve the genetic diversity of domesticated plants and animals.....	22
3.1.5. Recover the use of pastures as a feeding source for livestock by promoting extensive livestock farming	24
3.1.6. Guarantee that the management of fisheries is compatible with the recovery of fish stocks and is ecosystem-based.....	25
3.1.7. Increase the production of foods from sustainable aquaculture	28
3.1.8. Increase efficiency in the use of basic resources for the correct functioning of the agrifood system.....	29
3.1.9. Maintain a high coverage rate through the export of high added-value products and diversify commercial trade.....	36
3.1.10. Increase resilience to climate change.....	38
3.1.11. Make responsible use of antimicrobial drugs to counter increased resistance.....	40
3.1.12. Control and reduce the consequences of emerging pests and diseases.....	41
3.2 Ensure adequate food: through healthy and responsible consumption universally accessible.....	42
3.2.1. Adjust consumption to dietary requirements.....	43
3.2.2. Reduce food waste.....	47
3.2.3. Continue to maintain a high degree of food safety throughout the chain, from production to consumption.....	50
3.2.4. Ensure that everyone has the necessary resources for nutritious food.....	54

4. CONCLUSIONS.....	56
4.1. Food supply in a changing global environment.....	57
4.1.1. Maintenance of the productive base.....	57
4.1.2. A sustainable food system.....	57
4.1.3. A food system resilient to global change.....	58
4.2. Food consumption.....	58
4.2.1. A healthy diet.....	58
4.2.2. Responsible food consumption.....	59
4.2.3. A food system universally accessible.....	59
4.3. Governance of the food system.....	60
4.4. Research, the key to the food of the future.....	60
5. MAIN RECOMMENDATIONS	61
6. REFERENCES.....	65
7. PARTNERS.....	71

PROLOGUE

The 2030 Agenda for Sustainable Development, approved by the General Assembly of the United Nations in September 2015, sets out, ending hunger, achieving food security and improved nutrition, and promoting sustainable agriculture as one of its global goals for 2030.

By 2050, the world population will have increased by 32% compared to 2015, exceeding 9.8 billion inhabitants. This growth, the increase in purchasing power of large sections of the population that are in currently developing countries and the change in diet that this may bring about has led the FAO to estimate that there will be a gradual increase in global food demand as high as 60% by 2050. This, alongside the pressure that it may place on increasingly scarce natural resources, the impacts of climate change and the global change in food and agriculture production, has sounded the alarm over a possible world food crisis of vast dimensions.

Catalonia's food system is, and will be, subject to changes that occur on the world food market. However, the pressures to ensure food for the population of Catalonia are also, and will be, internal: the burden society places on resources may place current production capacity at risk. Nevertheless, there are significant opportunities that should be identified and exploited, arising from future consumption and production trends, including a greater interest in a healthier diet and for sustainable, local production.

In this context, the CADS has analysed the main challenges facing Catalonia to guarantee, in the mid and the long term, that its population has physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.

What we eat today will affect our development as persons, and the decisions we make, or fail to make, today in relation to all the policies that are involved in agricultural and livestock production (from that which is strictly agricultural up to that which is urban and educational) will affect our food in the medium- and long-term. And this is where the title of this report stems from: "Feeding on Future".

The report, developed over many months and corroborated and substantiated by a broad group of experts to whom we give thanks for their selfless collaboration (see the full list at the end of the document), finishes with a set of strategic recommendations directed towards the entire Government of Catalonia, and which are summarised here:

- 1) Maintain the production capacity of the food system.
- 2) Progress towards more sustainable production methods.

- 3) Strengthen resilience to disruptions such as climate change, emerging diseases or the growth in antimicrobial resistance.
- 4) Encourage healthier diets consistent with the traditional Mediterranean diet of Catalonia.
- 5) Reduce food waste, to have more food available for everyone, avoiding the unnecessary use of resources and reducing the generation of waste.
- 6) Ensure that everyone can access food in sufficient quantity and quality.
- 7) Have in place an integrated food strategy.
- 8) Encourage research and innovation practices within the sector.

Achieving a productive, sustainable, resilient, healthy and responsible food system universally accessible requires progress in the drafting and approval of the National Agreement for Food Policy, an instrument that has already been announced by the Government of Catalonia, which must contain an overall vision, strategic goals and priority lines of action on the future of food shared by the different players in the Catalan food system.

The CADS recommends, in this report, that the National Agreement for Food Policy is developed through cross-sectoral strategy, with well-defined and measurable goals and lines of action. In this respect, the Catalan Food Council may be a good tool to drive and stimulate the Agreement and the strategy deploying it.

We hope this report is of use to the Government of Catalonia.

Ferran Rodés i Vilà, president

Carles Ibáñez i Martí, member (rapporteur)

Joan Vallvé i Ribera, member (rapporteur)

Montserrat Viladrich i Grau, member (rapporteur)

1. INTRODUCTION

Feeding the population has, historically, been a concern of paramount importance. Over recent times, it has continued to be a focal point for the majority of governments worldwide, and the international community has adopted measures to address this challenge.

In 1974, the governments participating in the World Food Conference organised by the United Nations (UN) concluded that “every man, woman and child has the inalienable right to be free from hunger and malnutrition in order to develop their physical and mental faculties”.

Subsequently, at the World Food Summit in 1996, a further step was taken in the common effort towards global food security and, amongst other matters, the definition of *food security* was agreed upon, which the CADS has used as an element for analysis in this report: “**food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life**”.

More recently, in 2000, in the [Millennium Development Goals](#) approved by the UN General Assembly, amongst others targets a commitment was reached to reduce by half the percentage of the world population who suffer from hunger between 1990 and 2015.

Fifteen years later, in September 2015, the UN General Assembly approved the [2030 Agenda for Sustainable Development](#), which sets out 17 global goals and 169 associated targets to be achieved by 2030. Once again, the concern for guaranteeing food security continues to be present, with one clear objective: end hunger, achieve food security and improved nutrition and promote sustainable agriculture (SDG 2).

By 2050, as indicated in the UN’s latest forecasts, the world population will exceed 9.8 billion inhabitants (UN DESA, 2017). This means, therefore, that it will increase by 32% compared to 2015, primarily in developing countries.

This growth and the increase in the purchasing power of broad sections of the population with the change in diet this may bring about point to a highly-significant increase in the demand for food at a global level, which the FAO estimates will be 60% (Alexandratos and Bruinsma, 2012). This fact, together with the pressure that this may have on increasingly scarce natural resources, plus the effects of global change, have led many international institutions to warn about the risk of a global food crisis, of vast dimensions.

Catalonia’s food system is not isolated from this world context outlined above, nor is it a closed system (as demonstrated by the fact that in 2016 it exported agrifood products with a value

of EUR 9.627 billion and imported products worth EUR 9.696 billion¹). In this context, any potential changes that occur on the world food market have, and will have, a major impact on the Catalan food system.

Possible pressures in guaranteeing food for the population of Catalonia are also internal: the burden society places on resources may place current production capacity at risk. The loss of fertile soils, the availability of water and the decline in biodiversity and its ecosystem services are just some of the issues that need to be addressed to ascertain their impact on food and agricultural production. At the same time, however, there are major opportunities that will arise from future consumption trends, with greater interest in a healthier diet and sustainable, local production.

This report seeks to analyse the main challenges and to put forward strategic proposals for action, resulting in a guarantee for the population of Catalonia, in the mid and long term, of having physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life².

In short, therefore, this report addresses one fundamental issue: food security in Catalonia. It should be noted on this point, that the concept of food security is used as a synonym for sufficiency. The CADS is aware that here in Catalonia, just as in the majority of Romance-language-speaking countries, this term is also used extensively as a synonym for safety. Nevertheless, in this document, it will only be used in this latter sense in Section 3.2.4.

With this objective, the CADS report analyses the main challenges posed to guarantee the food supply to Catalonia in future situations that are more or less complex, but not exceptional, and the role the current consumption model will play.

This CADS report does not include in its analysis any situation arising from a hypothetical serious food crisis of a one-off nature, an occurrence that would need to be addressed through specific measures by the Government of Catalonia with a contingency plan (especially for those situations arising from large-scale international tensions, lengthy droughts, the depletion of some forms of energy that would be difficult to substitute in the short-term, and others).

Likewise, this document does not directly deal with the current situation or the future role of the Catalan agrifood industry in regard to food security in Catalonia. The CADS believes that the agrifood industry is a key sector for the economic development of Catalonia and the Catalan primary sector, whilst also influencing the food supply system and consumption model. Notwithstanding this, given the breadth and complexity of the subject, the Council has deemed it best not to deal with this sector directly or that of food distribution in this report, and to make an *ad hoc* reflection on the matter later.

¹ GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Comerç exterior agroalimentari. Catalunya 2016». Statistics. Online: <<http://agricultura.gencat.cat/ca/departament/estadistiques/alimentacio/comerc-exterior/>> [DOA: 16 January 2018].

² Definition of food security agreed upon at the World Food Summit in 1996.

2. INTERNATIONAL AND EUROPEAN CONTEXT

The analysis of food security in Catalonia must necessarily be framed within a broad set of environmental challenges, socioeconomic dynamics and geopolitical initiatives at a world and European level. This section presents, in a highly-summarised manner, the most important ones.

2.1. Food supply to the world: global challenges in a world with scarce resources

Over recent years, various international institutions have been sounding the alarm over the pressures that the major demographic growth and changes in diet associated with an increase in income of a large part of the world population may exert on natural resources that are ever-more scarce and, furthermore, over the challenges that phenomena such as climate change and all its consequences pose for agrifood production.

At a world level, poverty is the most significant cause of food insecurity: 815 million people suffer from chronic undernourishment (FAO, 2017) and 2 billion from nutritional deficiencies. It is estimated that the situation will worsen over coming decades, owing to the fact that higher rates of population growth are forecast in areas that currently have the highest levels of undernourishment³.

These 2 billion people with nutritional deficiencies contrast to the 2 billion that are overweight (that already affects 39% of people over the age of 18 worldwide). It should be noted that overweight and obesity have a marked socioeconomic dimension: they are found most notably in the richest zones of the poorest countries and in the poorest zones of the richest countries (Dinsa, 2012).

According to the latest forecasts available from the UN, in demographic terms, two very clear and significant trends will continue worldwide in the period between 2015-2050: there will be a major increase in population, rising from 7.3 to 9.8 billion inhabitants (with significant growth in Africa and Asia, with 1.3 billion and 750 million new inhabitants respectively) (UN DESA, 2017), and a concentration of this population in urban areas, which will be home to 70% of the population of the planet by 2050.

³ One example is sub-Saharan Africa, where predictions indicate a doubling in the number of inhabitants by 2050, which will represent 20% of the world population (Alexandratos and Bruinsma, 2012).

This [transition towards a more urban society](#), together with the expected increase in income of much of this population (in currently developing countries), is creating a [major change in diets worldwide](#), which some authors consider a trend towards westernisation of their diets (meaning greater consumption of meat, eggs, fish, sugars and dairy products and, by contrast, a reduction in demand for pulses and cereals).

Meanwhile, at a world level, [approximately one third of foods produced for human consumption are lost or wasted \(FAO, 2011\)](#): broadly speaking, these losses occur mainly during their production in developing countries and as waste during consumption in developed countries.

Against this backdrop, [the FAO points to the need by 2050 to increase worldwide agricultural production by 60% compared to the period between 2005-2007](#) (in that destined for food use as well as non-food use). [The global transition towards a western diet poses great pressures on the environment \(HLPE, 2016\)](#), most notably through pollution and the depletion of freshwater supplies, an increase in greenhouse gas emissions, the mass destruction of natural areas (especially rainforests) and the extinction of species.

The scale of the aforementioned challenges — the increase in food demand and access to food — will be compounded by climate change, a phenomenon that is changing the weather conditions of the planet and that impacts on the main elements of food production. As indicated by the Intergovernmental Panel on Climate Change (IPCC), negative impacts on crop yields will be more common than positive impacts, even though predictions point to an increase in production in Northern and Alpine Europe, the North-West of the USA and the North China Plain (IPCC, 2014).

With regard to one essential resource, [water](#), it should be noted that irrigated crops, even though these represent only a fifth of the cultivated land area, provide for 50% of the world's agricultural yield. In this context, it is necessary to bear in mind that a growing number of countries are reaching alarming levels of water scarcity, especially in the Middle East and the North and East of Africa and Asia, and it is predicted that the situation will worsen in other areas of the world, such as the Mediterranean.

Meanwhile, the increase in frequency and magnitude of [extreme weather phenomena](#), as demonstrated by floods and droughts, amongst others, may result in a reduction of up to 25% of the crop yields worldwide, generating major increases in the price of foods (IPCC, 2014). In fact, it is estimated that over recent years a 19% rise in prices has already occurred as a consequence of these phenomena.

The effects of climate change on food security and access to water, as the scientific community has been signalling, may be the cause of major migratory movements around the world, placing more pressure on countries receiving these people (IPCC, 2014).

According to the FAO, to increase food production by the 60% that their predictions indicate will be required, it will be necessary to: (1) [increase crop yield at a worldwide level](#) (a situation that, according to their calculations, would permit 85% of this demand to be met); (2) [advance in the intensification of sustainable agriculture](#); and (3) [increase the amount of agricultural land](#). The FAO estimates that, by 2050, this expansion of agricultural land will occur in developing countries (with 120 million new hectares), in contrast to a reduction of cultivated areas in developed countries, estimated at 50 million hectares.

In this context, over the last decade a [highly-significant development has been observed: that of land grabbing](#), the transnational purchase or long-term agricultural land leases (470,000 km² between 2005 and 2009 alone). This strategy, consisting in the acquisition of basic production elements (land, but also water) in third countries (essentially developing countries) has multiple objectives, amongst which are the guarantee of food security for its population (through the delocalisation of food production) and livestock fattening, as well as the generation of biofuels, and others.

As a consequence of this practice, in some developing countries the cultivable land bought or leased by foreign players, whether they be governments (such as those of the USA, China, Middle Eastern countries and some EU member states) or large business corporations and investment funds, is almost 100% of their total arable land.

Another challenge to bear in mind is [the competition between food crops and non-food crops \(especially for the production of biofuels\) in arable land](#). Between 2007 and 2008, approximately 10% of the world production of coarse grains⁴ was given over to the production of ethanol, and according to OECD forecasts (2010), assuming that countries will continue from 2019 to 2050 with the same policies on biofuels, it is reckoned that the use of land for energy crops will continue to rise.

For the purposes of food security, it is estimated⁵ that the rapid expansion of biofuel production up to 2050 could give rise to a highly significant increase in the number of children of pre-school age in a situation of malnutrition (3 million in Africa and 1.7 million in Southern Asia).

In this respect, the international agreement on climate change approved in Paris at the beginning of December 2015 makes a clear reference to biofuels and sets out that “achieving the greenhouse gas emission reduction goals cannot threaten the production of foods”.

Finally, another major challenge that is not inconsequential is the [genetic erosion of agrobiodiversity](#)⁶: 90% of animal protein consumed originates from only a dozen animal species, and only four crop species provide half the calories of plant origin in the human diet.

2.2. European food supply in a changing global environment

The European Union is the largest producer and exporter of foods in the world, and is self-sufficient in meat, dairy products and cereals. At the same time, however, it is also the second largest importer of foods in the world (mainly fish, vegetables, fruit and ingredients for animal feed). It is also highly dependent on the import of energy and basic resources for agriculture (such as fertilisers). Even so, in monetary terms, the European balance of trade in relation to the majority of basic foodstuffs is positive and it is reckoned that the EU has sufficient food available thanks to local production and imports.

⁴ The OECD defines coarse grains as those that are not wheat or rice and that are primarily used for animal feed or beer production. You can see the definition here: <<https://stats.oecd.org/glossary/detail.asp?ID=369>> [DOA: 11 January 2018].

⁵ International Food Policy Research Institute (IFPRI): <<http://www.ifpri.org/>> [DOA: 11 January 2018].

⁶ The genetic erosion of agrobiodiversity is understood as the loss of diversity in genetic matter in cultivated plants and domesticated animal species that humans have selected over the years to obtain foods and other products.

Likewise, the majority of homes in the European Union have access to the necessary quantity of quality foods, even though approximately 50 million citizens of the EU-28 (9% of its population) have difficulties obtaining it. This situation varies greatly between one state and another, ranging from 3% in Holland or Sweden to 40% in some parts of Bulgaria. Conversely, an increase in the incidence of obesity and episodes of food safety have also been observed (from a health perspective), these latter perhaps owing to an improvement in systems of detection. Finally, the estimated average amount of food waste in the EU is 173 kilos per person per year, representing 20% of the total of food produced there (Stenmarck, 2016).

Currently, there are no clear figures on food self-sufficiency in Catalonia. The levels of product trade with the rest of Spain are not accurately known and, moreover, data published on these figures relating to feeding the population are approximations. There is also no clear notion of what rate of self-sufficiency is desirable for Catalonia. It would be useful to have the full figures to be able to make a reliable estimate and have a technical and social debate on the rate of food self-sufficiency and its implications.

With regard to the stability of the food system in the EU, the main threats are damage caused by climate variability, financial crises and price volatility, energy crises, food security threats that can affect the supply and distribution chain, and food safety crises, including diseases that may affect crops and animals and specific problems within the processing chain (Hubbard, 2015). Amongst the stability factors, mention should be made of the trend towards more sustainable diets and greater consumption of local products, as well as of the modest population growth.

3. FOOD SECURITY IN CATALONIA

At the World Food Summit in 1996, as noted in the introduction of this report, it was agreed that food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. This definition consists of four variables (FAO, 2013), that the CADS has used in this report as elements for analysis:

- **Availability** of sufficient foods, of appropriate quality and with adequate diversity, supplied through the domestic market or imports.
- **Access**, both physical and economic, to the necessary resources for a nutritious diet.
- **Utilisation** of foods to enjoy an adequate diet with regard to nutrition and security health-wise.
- **Stability**, which averts the risk of losing availability, access to correct use of the foods through sudden shocks or cyclical events, due to natural, market or political causes.

After identifying the challenges arising from these variables, the CADS believes it is clearer to group them under two key pillars of the food system: food supply (including availability and stability) and consumption (access and utilisation).

- 1) Guarantee the food supply: through a productive, sustainable and resilient system.
- 2) Ensure adequate food: through healthy and responsible consumption universally accessible.

Although food availability was the sole dimension taken into account in initial analyses on food security, there is now a consensus that access of the population to these foods and their consumption of them are equally essential. Below we describe in more detail, and develop further, the challenges that arise in the attempt to fulfil these two pillars of the food system for the population of Catalonia.

3.1. Guarantee the food supply: through a productive, sustainable and resilient system

To have sufficient food available, of an appropriate quality and with adequate diversity, is a necessary condition to achieve food security and will, therefore, be the first dimension studied in this report.

It should be remembered that the objective of this study is to analyse food security in Catalonia, a concept that must be distinguished from self-sufficiency. The latter concept is useful to ascertain up to what point Catalonia can meet its dietary needs with its own internal produc-

tion. Nevertheless, in the globalised world we see today, the stress cannot be placed solely on domestic production.

Nowadays, the food systems in practically every country are open systems, which impact one another and where products and services are exchanged. Food supply is achieved through domestic production and imports from other countries. Guaranteeing food supply requires not only bolstering food production for the domestic consumption of a country, but also remembering that importing certain products may be more advantageous than actual domestic production, both economically and socially. However, it is essential to calculate future potential risks concerning these imports and have alternatives in place to guarantee food security, otherwise we cannot remain distanced from the debate about the desirable rate of self-sufficiency (FAO, 2015) and what, in relation to this matter, the concept of food sovereignty means. **At all events, the CADS considers that it is strategic for Catalonia to preserve a certain capacity of self-sufficiency and that, therefore, the productive base should be maintained, an element that should be central to Catalonia's food policy.**

On the other hand, the loss of biodiversity affects the function of the ecosystems and, consequently, the services they offer, many of which are essential to obtain food: pollination, natural pesticides, maintaining nutrient cycling, fish production and other fishing resources and clean water to irrigate and for our general use are some examples. Similarly, it is also crucial to improve efficiency in the use of energy and nutrients. In this regard, beyond measures that can be taken in agricultural practices, of which there are many, indirect issues, such as the consumption model and management of organic waste, need to be addressed.

Finally, strengthening resilience to climate change and establishing measures to stall resistance to antimicrobial agents, as well as controlling and reducing the consequences of pests and emerging diseases, are considered important challenges with regard to our production system's stability.

In this section, these challenges are analysed and proposals put forward in relation to both, assuring a certain level of self-sufficiency and also maintaining the capacity to import.

3.1.1. Maintain agricultural workforce levels to guarantee production

To guarantee the food supply to the population, it is essential to maintain a productive base that also has a territorial function and a role in conserving the landscape and ecosystem services. For this reason, it is absolutely essential that there are farmers, livestock breeders, fishermen, etc. who want to make food production their profession, running agricultural holdings or farms that are profitable, modern and sustainable.

In Catalonia, the number of agricultural holdings is decreasing: between 1999 and 2013 numbers have fallen from 72,006⁷ agricultural holdings to 57,299⁸. It should be noted, however, that they have increased in size, as can be seen in Table 1.

⁷ STATISTICAL INSTITUTE OF CATALONIA (IDESCAT). Information prepared from figures from the agricultural census: «Dimensió de les explotacions segons la SAU». Online: <<https://www.idescat.cat/pub/?id=censag&n=485&lang=en>> [DOA: 16 January 2018].

⁸ STATISTICAL INSTITUTE OF CATALONIA (IDESCAT). Information prepared from figures from the survey on the structure of agricultural farms and holdings by the Spanish National Statistics Institute (INE): «Farms. 2003-2013. By size of the total surface». Online: <<https://www.idescat.cat/pub/?id=aec&n=427&lang=en&t=2013>> [DOA: 16 January 2018].

Comparing the agricultural censuses from 1999 and 2009 (the last two available), it can be observed how the number of holdings of more than 20 hectares in utilised agricultural area (UAA) has increased, whilst there has been a large decline in the number of smaller farms. This means, therefore, that even though the number of farms has declined, their size has increased, improving competitiveness and efficiency. This trend is substantiated by data obtained in surveys on the structure of agricultural farms and holdings in 2013⁹.

Table 1. Number of agricultural holdings, by size, in UAA hectares¹⁰ (1999-2013).

Hectares	Number of holdings									Total
	<1	1-2	2-5	5-10	10-20	20-50	50-100	+ 100		
1999	10,463	9,537	15,968	12,715	10,657	8,656	2,665	1,345	72,006	
2009	1,772	8,654	14,409	11,063	9,612	8,756	3,003	1,578	58,847	
2013	1,507	9,273	15,397	9,618	8,605	8,177	3,067	1,657	57,299	

Source: Statistical Institute of Catalonia (*Idescat*). The figures from 1999 and 2009 have been prepared by the authors, based on data from the agricultural census, whilst those from 2013 have been so based on data from the Survey on the structure of agricultural farms and holdings by the Spanish National Statistics Institute (INE).

This improvement in farm productivity is corroborated if Table 2 is analysed, where it can be observed that between 1997 and 2007 there was an increase in the number of holdings with a higher gross operating margin (calculated in European size units, or ESU¹¹).

The number of farms with a margin of between 0 and 2 ESU decreased from 14,723 in 1997 to 10,634 in 2007. Conversely, farms of more than 100 ESU increased from 1,171 in 1997 to 3,438 in 2007. Table 2 shows that the value of the gross margin generated by these farms in particular increased, rising from 203,516 ESU in 1997 to 809,944 in 2007, which in monetary terms is from EUR 244,219,200 to EUR 971,932,800.

Even though the productivity of Catalan agricultural holdings and farms has increased over recent years, greater efforts need to be made to improve their competitive capacity in the current global world. This will necessarily have to occur through an increase in the value-added products from these farms and also through a reduction in the fragmentation of these productive units, which will provide an increase in opportunities for innovation, competitiveness and negotiating power.

The utilised agricultural area (UAA) remained relatively stable from 1999 up to 2013. A reduction in the number of cultivated hectares occurred especially in drylands, with an increase in the expansion of permanent pasturelands (see Table 3).

⁹ Table 1 shows information obtained from the extensive agricultural censuses conducted by the INE every 10 years (1999 and 2009), where all farms are recorded. Additionally, every three years surveys are carried out on the structure of farms; in this case the population of interest is by sample.

¹⁰ Table 1 shows information obtained from the extensive agricultural censuses conducted by the INE every 10 years (1999 and 2009), where all farms are recorded. Additionally, every three years surveys are carried out on the structure of farms; in this case the population of interest is by sample.

¹¹ A farm has an economic size of one ESU if its total gross margin is EUR 1,200.

Table 2. Agricultural holdings per gross margin in ESU (1997-2007).

Number of holdings					
Gross margin (ESU)	1997	1999	2003	2005	2007
From 0 to < 2	14,713	15,228	13,186	12,709	10,634
From 2 to < 4	10,848	10,895	9,538	8,550	8,707
From 4 to < 8	11,903	11,511	9,647	10,264	9,439
From 8 to < 16	13,155	10,935	9,149	8,179	7,983
From 16 to < 40	12,411	11,712	9,467	8,742	8,949
From 40 to < 100	4,506	5,278	6,062	5,790	5,923
Over 100	1,171	1,345	3,038	3,243	3,438
TOTAL	68,707	66,904	60,087	57,477	55,073
Gross margin (ESU)		Total gross margin in ESU			
From 0 to < 2	17,389	17,025	15,310	14,539	12,163
From 2 to < 4	32,537	31,809	28,139	24,775	24,975
From 4 to < 8	68,068	66,608	54,327	59,291	54,328
From 8 to < 16	150,327	125,520	104,477	96,152	94,157
From 16 to < 40	308,870	296,025	244,822	226,334	227,006
From 40 to < 100	266,653	314,492	378,007	360,657	377,397
Over 100	203,516	254,504	659,781	721,250	809,944
TOTAL	1,047,360	1,105,983	1,484,863	1,502,998	1,599,970

Source: Statistical Institute of Catalonia (Idescat). Survey on the structure of agricultural holdings.

Table 3: Utilised agricultural area, UAA (1999-2013).

	1999	2003	2005	2007	2009	2013
UAA hectares	1,153,437	1,148,501	1,162,230	1,166,542	1,147,532	1,125,268
Arable land (crops)	813,682	797,835	784,069	790,301	792,425	767,633
Dryland	586,025	566,765	546,647	566,321	561,466	540,578
Irrigated land	227,657	231,070	237,422	223,980	230,960	227,054
Permanent pastures	339,754	350,666	378,161	376,241	355,107	357,635

Source: Statistical Institute of Catalonia (Idescat), using data from the survey on the structure of agricultural farms and holdings by the Spanish National Statistics Institute (INE).

The data for 2013 come directly from the INE.

At the same time, however, the sector is aging. Between 1999 and 2013, the number of heads of farms who were younger than 35 fell to less than half, from 4,708 to 1,907. By contrast, over the same period, the heads aged 65 or over increased, rising from 16,395 to 20,181 persons. Meanwhile, the numbers of people employed in the agricultural sector fell: while in 1999 there were 74,011 annual work units (AWU)¹², in 2013 there were 56,045. This does not represent a

¹² AWU: work of one person supplied full time for one year of activity.

negative figure *per se*, as it may be an indicator of an increase in the mechanisation or automation of agricultural processes. This trend, however, cannot continue indefinitely, as it would culminate in the disappearance of the Catalan agricultural sector as we know it today, with an increase in salaried workers and a concentration of ownership.

In order to keep the agricultural population in Catalonia, it will be necessary to find a balance between the increase in size of current agricultural holdings that facilitates the introduction of innovations and an increase in productivity with the consequent improvement in the well-being of agricultural workers, whilst avoiding a loss of control of production factors by present-day actors.

It would, therefore, be necessary to provide processes for productive units to integrate into cooperatives, businesses or other commercial entities that would provide the optimum conditions to enhance the competitiveness of these current productive units and the added value of their products. Solutions will need to be multiple, given the great diversity of the Catalan primary sector.

It should be kept in mind also that in order to better defend prices against transformation industries and distributors, it is important to boost the unification of this fragmented productive structure. In this regard, it is necessary to oversee competition in agricultural markets to reduce differences in the negotiating power of the different agents and prevent unfair imbalances in pricing and the distribution of margins.

One positive note is the incorporation of women into agricultural holdings and farms who, although further efforts are needed to achieve equality, rose from 18% as heads of farms in 1999 to 24% in 2013.

In Catalonia, therefore, there are increasingly fewer agricultural holdings and farms, but these are larger and more productive in the sense that the gross margin generated with fewer workers has grown significantly, but with heads consistently older, although with a greater presence of women running these holdings.

Recommendations

1. Improve the organisational capacity of the primary sector so that it facilitates the introduction of competitive innovations, permits them to improve their position in the food and agricultural chain and streamlines the design of joint solutions for the various challenges that need to be addressed.
2. Promote and facilitate obtaining high value-added products and synergies with other activities such as tourism and gastronomy.
3. Oversee competition in agricultural markets to prevent unfair imbalances in pricing and the distribution of margins.
4. Support and provide the rural environment with health, educational, cultural services, etc., and also communications infrastructures (such as broadband coverage throughout Catalonia) that are necessary in order to pursue a professional project and enjoy an adequate standard of living.
5. Reinforce training, knowledge transfer and skills learning to promote the excellence of agricultural professionals and the leadership of profitable and sustainable holdings and farms, as well as an improvement in the system of quality technical and accounting advisory services for the agricultural population.

6. Enhance the prestige of the professions of farmer, livestock breeder, shepherd and fishermen through a communications and training strategy that will reach out to young Catalans, so that they perceive themselves, and we perceive them, as businesspersons. In regard to this, measures to bring the life of the rural world to city people may contribute to youngsters and the not-so-young viewing a professional career in farming as a possible alternative.
7. Continue supporting the incorporation of women as heads of agricultural holdings and farms.
8. Define and apply a Catalonia-specific strategy to facilitate access of new producers to the land, especially for those who are incorporating for the first time into agricultural activity.
9. Encourage consumers to want to know the origin of the products from Catalonia and appreciate their value and distinguishing characteristics, through visits to the holdings and farms, direct or short-circuit sales and local produce.

3.1.2. Conserve and recover land for agricultural activity, especially the most fertile land

One of the basic elements in the production of food is the availability of land with suitably fertile soil conditions. According to the Idescat¹³, the utilised agricultural area or UAA (that includes cropland and permanent pastures) decreased by 15,000 hectares¹⁴ between 1997 and 2013. However, with regard to land used specifically for crop cultivation, this area decreased by more than 100,000 ha¹⁵ in the same period.

This is the same trend that can be seen in the fourth edition of the Land Cover Map of Catalonia¹⁶: between 1993 and 2009, the land area used for crops decreased by more than 170,000 hectares¹⁷, while forest and urban land area increased¹⁸.

In the Barcelona Metropolitan Area, between 1956 and 2009 cropland decreased by more than half, going from 140,000 ha to fewer than 60,000 ha¹⁹. The majority of these hectares — now given over to other uses — presented conditions that made them particularly suited to agricultural production.

As not all the land in Catalonia is equally suitable for cultivation, an evaluation of its productive capacity is called for to preserve that which is most suitable. Furthermore, the loss in quality of this land must be avoided, whether through erosion, salination, compaction, contamination, etc., also avoiding over-fertilisation that may result in eutrophication of surface waters and contamination of aquifers.

¹³ STATISTICAL INSTITUTE OF CATALONIA (IDESCAT). «Agricultural surface. 2003-2013. By type». Information based on figures from the survey on the structure of agricultural farms and holdings by the INE. Online: <<https://www.idescat.cat/pub/?id=aec&n=422&lang=en&t=2013>> [DOA: 16 January 2018].

¹⁴ Whilst in 1997 there were 1,140,480 ha, in 2013 there were 1,125,268 ha.

¹⁵ More specifically, 119,664 ha (in 1997 in Catalonia there were 877,297 ha of crops, whilst in 2013 there were 767,633 ha).

¹⁶ GOVERNMENT OF CATALUNYA; CENTRE FOR RESEARCH ON ECOLOGY AND FORESTRY APPLICATIONS (CREAF). «Land Cover Map of Catalonia». Barcelona: Government of Catalonia. 4th ed. Online: <<http://www.creaf.uab.es/mcsc/usa/index.htm>> [DOA: 16 January 2018].

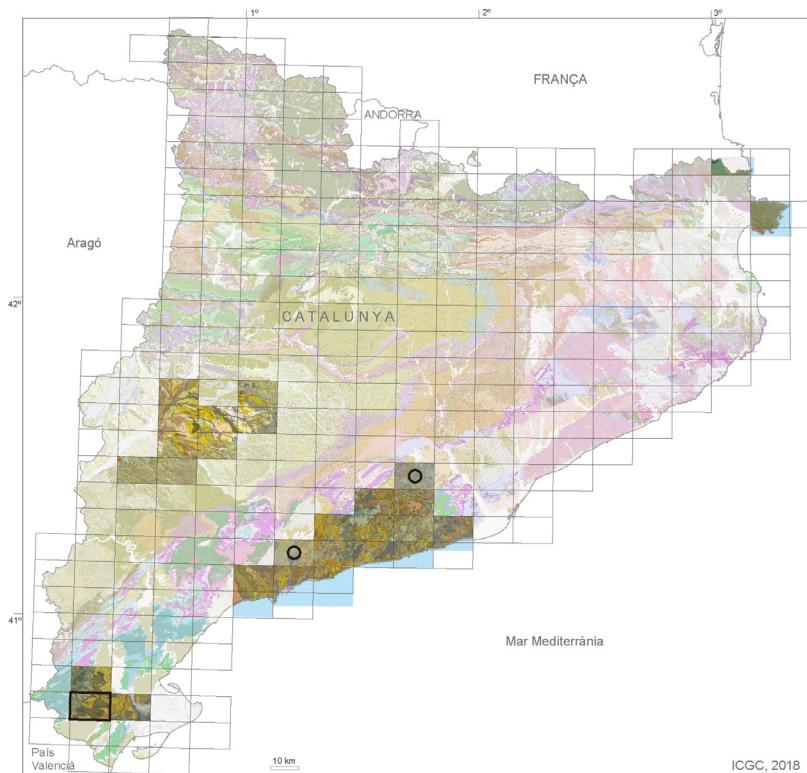
¹⁷ This decreased by 171,577 ha (-15.5%), going from 1,106,783 to 935,206 ha.

¹⁸ Forest cover increased by 104,466 ha, and urban area grew by 65,052 ha.

¹⁹ This went from 140,410.88 ha in 1956 to little more than 59,267 ha in 2009.

There is currently insufficient information on soil types in Catalonia, their quality and fertility, or their suitability for specific uses. However, the Ministry of Agriculture, Livestock, Fisheries and Food is drawing up a Soil Map of Catalonia at a scale of 1:25,000 to ensure detailed maps of soils are available for areas of the greatest agricultural interest. This project, which is currently being developed by the Cartographic and Geological Institute of Catalonia, has maps of soils in the area irrigated by the Urgell canals, other irrigated lands in Lleida, the lower stretch of the Ebro River and part of L'Empordà and El Penedès (a total of 600,000 ha)²⁰.

Figure 1: Grid of the Soil Map of Catalonia (scale 1:25.000).²¹



Source: INSTITUT CARTOGRÀFIC I GEOLÒGIC DE CATALUNYA. «GT IV. Mapa de sòls 1:25.000». Online: <<http://www.icgc.cat/ca/Administracio-i-empresa/Descarregues/Cartografia-geologica-i-geotematica/Cartografia-de-sols/GT-IV.-Mapa-de-sols-1-25.000>> [DOA: 2 March 2018].

Using this study on soil quality and fertility, a plan for the conservation and improvement of the soils in Catalonia should be drawn up and implemented, with clear goals and specific measures: for example, the increase in organic matter content and the capacity for water retention, the recovery and improvement in the soil biota to improve its structure, carbon storage and the recycling of nutrients, plus the control of salinity, erosion and contamination.

The Parliament of Catalonia is currently devising legislation on agricultural areas that seeks to regulate and establish mechanisms to protect soils of particular agricultural interest and to develop protecting tools.

²⁰ GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Mapa de sòls». Online: <http://agricultura.gencat.cat/ca/departament/dar_publicacions/dar_publicacions_monografiques/dar_mapa_sols> [DOA: 17 January 2018].

²¹ In stronger colours, pages published with cartographic information.

Recommendations

1. Set out specific regulations for the protection of land for agricultural use, especially in zones where there are more fertile soils, as a strategic factor to guarantee food for the population.
2. Complete and publish the Soil Map of Catalonia 1:25,000, prioritising the pages on areas of greatest agricultural interest.
3. Promote and consolidate the concept of agricultural parks in Catalonia.
4. Draw up and implement a plan for the conservation and improvement of soils in Catalonia, with clear goals and specific measures.
5. Promote cultivation techniques that facilitate the conservation and increase in organic matter in soils, including direct sowing, grazing, or the application of mulches which, as well as improving soil quality, will help mitigate climate change.
6. Promote the diversification of crops and educate the consumer to demand a diversity of foods in their diet and on the market. On this point, chefs, and especially those with a public image, can collaborate by bringing this issue to public attention.
7. Develop measures to return wastelands that have good productive quality to agricultural activity and prevent them from being abandoned.
8. Maintain control of basic assets to produce foods, such as agricultural land and water, against speculative acquisition processes and the control of agricultural resources that are occurring across the world.

3.1.3. Recover biodiversity to guarantee ecosystem services

Biodiversity of agricultural systems is necessary for the correct development of the natural processes that sustain agriculture; in this regard, biodiversity is not only fundamental in the context of the crop, but also in the context of the landscape.

The trend towards monocultures and a simplification in the structure of the landscape plays a negative role in agricultural sustainability, which should be reversed as far as possible with a strategy suitable both for the mid and the long term. In this context, it must be remembered that the conservation and recovery of agricultural biodiversity is a priority in European Union policies, especially in the countries included in Natura 2000.

There are many ecosystem services that agricultural activity benefits from, which are free and often little known or valued.

One of these is pest control. Often, organisms that feed off crops are kept in balance by others that control them naturally. But if these beneficial animals or microorganisms (predators, parasites, pathogens) disappear, pests remain without their natural enemies, and proliferate. It is then that agricultural production becomes more dependent on chemical products and others coming in from outside the system, and is more vulnerable to external disturbances.

Biodiversity also plays an essential role on the soil, rich in microorganisms, fungi, animals and plants that intervene in the matter cycle making the necessary nutrients available to plants, such as, for example, nitrogen, or improving water retention capacity and reducing erosion. On this point, abusive use of herbicides in many parts of Catalonia should be reversed as it

accelerates soil depletion, making it more sterile and more easily eroded while reducing its organic matter content. It is essential to recover the natural fertility of the soils and reduce dependence on chemical fertilisers and herbicides.

Pollinators are vital for the production of fruits and seeds in many crops. Fruit trees, vegetables and forage crops depend on the presence and abundance of bees (including the honey bee and many other species of wild bee), plus other pollinating insects. In Europe, it is estimated that 84% of crop species are pollinated by insects and other fauna (UNEP, 2010).

Over recent years, across the entire planet a reduction in the diversity of wild bees has been observed. In certain countries in North America and Europe (although not in Spain) there have also been significant losses of honey bee populations.

The reasons for these declines are multiple. Firstly, for a long time they have suffered the deterioration of their natural habitats due to fragmentation, degradation and destruction caused by human activity. In addition, intensive agricultural practices based on monocultures and the application of some phytosanitary products (such as neonicotinoids) has also had major effects on pollinating insects. In the case of the honey bee, invasive species have also appeared such as the Varroa mite *Varroa destructor* and more recently, the Asian hornet (*Vespa velutina*), as well as new diseases caused by the international trade in bees.

To support populations of pollinators and natural pest enemies, it is essential to maintain a broad diversity of plants and floral resources in agricultural zones. Both the ruderal flora that grows along the edges of fields, as well as the vegetation in nearby natural or semi-natural zones, help maintain the populations of insects that are beneficial to agriculture.

At present, there are no studies on the situation of pollinators in Catalonia, but faced with the worrying information coming from international sources (IPBES, 2016), a study needs to be carried out to ascertain whether the crops in Catalonia that depend on pollination by insects are showing any pollination deficiencies.

It is important to understand that biodiversity is essential to guarantee an efficient ecosystem service that is sustainable over time. For example, rich pollinator communities allow complementarity, as the different species are more or less efficient under different circumstances. At the same time, rich communities facilitate redundancy, so that if a species is not abundant in any one year, another can provide a similar service. In other words, biodiversity enables us to avoid the risk of depending on one single species for a specific function.

Recommendations

1. Make advances in the reduction of pesticide use, especially those that are most toxic to persons and the environment, in favour of agricultural practices that improve plants' health and the presence of natural pest and pollinator enemies. In this regard, it is recommended that integrated farming as a basic quality standard of agricultural production be extended, and that differentiated production systems such as ecological agriculture be promoted.
2. Encourage practices that improve soil fertility, such as the application of organic matter, crop rotation or green fertilisers.
3. Use biodiversity sown in seasons (rotations) and space (companion planting) to increase productivity and reduce the need for fertilisers and pesticides.

4. Maintain and recover open spaces using extensive livestock farming in harmony with their environment.
5. Maintain and enhance the diversity of crops and natural spaces with regard to the landscape, conserving a functional mosaic that is beneficial for agricultural production, the conservation of natural values and landscape improvement, stimulating other economic activities (for example, sustainable tourism).
6. Increase information available to the consumer on the benefits of more sustainable production systems to increase the consumption of foods that they offer.
7. Improve public food procurement by buying local, sustainable foods to foster the creation of production and distribution structures; increase the numbers of the population who know them and consume them.
8. Boost research into production techniques that most respect the environment, and promote a coordinated system of research in this field that leads investigation and experimentation and that is a point of reference for technical and policy-making decisions.
9. Study biodiversity in agricultural environments in Catalonia in greater depth and, especially, the situation of crop-pollinating insects.
10. Achieve the conservation and recovery of biodiversity goals as set out in European Union directives, especially in Natura 2000 areas.

3.1.4. Conserve genetic diversity of domesticated plants and animals

Genetic erosion is also a way of losing biological diversity that has occurred through the gradual substitution of traditional varieties and native species for a relatively low number of commercial varieties and species that are often more productive but uniform and, usually, less adapted to their environment.

At present, according to the FAO, out of 30,000 edible terrestrial plants, only 7,000 are cultivated or harvested by humans for food, and only 5 cereals provide 60% of food energy to the world population; and with regard to mammals and domesticated fowl, only 14 species provide 90% of livestock resources²².

This loss represents the disappearance of an agricultural and cultural legacy that, once gone, cannot be recovered. Furthermore, it results in there being fewer characteristics to choose from when selecting the best individuals, in order to reflect needs that will undoubtedly change in the future. The availability of the best varieties and species adapted to future conditions is dependent on having a broad genetic diversity from which the best choices can be made.

In Catalonia, out of a total of thirteen native species renowned for their production, there are some, such as the Rиполеса and the Xisqueta sheep and the Pyrenean Brown cattle, that have been sufficiently successful and have been integrated into competitive farms, whilst others,

²² FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO) (2015). *Genetic Resources and biodiversity for food and agriculture. A treasure for the future.* Infographic. Roma: FAO. Online: <<http://www.fao.org/resources-infographics-infographics-details/en/c/174199/>> [DOA: 15 January 2018].

such as the Pallaresa cattle, of which there remained only 30 heads in 2010, were subject to activities aiming to promote their recovery²³.

It is necessary to develop programmes to preserve native species in order to increase their numbers and prevent their extinction, especially through systems that enable agricultural holdings rearing these breeds to be economically viable. A major challenge is to limit the impact of product standardisation rules imposed by major distribution companies.

With regard to phytogenetic resources, as each zone has selected its seeds to adapt to its own conditions and tastes, there is a great diversity, even though they are used less than in the past. Although there are up to 21 organisations in Catalonia working in the field of crop biodiversity conservation and 21 *ex-situ*²⁴ plant collections, there are still many varieties that have not been identified or collected in a seed bank. It is necessary, therefore, to encourage the identification and classification of traditional varieties throughout Catalonia, together with their conservation, use and commercialisation²⁵.

Recommendations

1. Periodically draft a report on the conservation status of Catalonia's phytogenetic resources and native species.
2. Protect Catalonia's phytogenetic resources by identifying and classifying the local varieties distributed across the territory, storing them in germplasm banks, seed banks and using other *ex-situ* methods, as well as *in-situ* techniques, and promote their use and commercialisation.
3. Make a firm commitment to create a Catalan germplasm bank that from its head office will oversee and coordinate all the banks working at a local level.
4. Facilitate access for farmers to the germplasm bank and promote the fair distribution of benefits arising from the use of phytogenetic resources.
5. Develop programmes to preserve native species through systems that enable agricultural holdings breeding them to be economically viable.
6. Develop programmes of genetic improvement, gastronomy and economic promotion that will boost commercialisation of traditional varieties and species.
7. Establish mechanisms for limiting the impact of product standardisation rules imposed by major distribution companies. In this regard, it is important to educate the consumer to appreciate the diversity of products, as this diversity promotes a broader variety of crops and greater gains in agricultural production.

²³ Figures provided by the Ministry of Agriculture, Livestock, Fisheries and Food of the Government of Catalonia.

²⁴ Figures provided by the Ministry of Agriculture, Livestock, Fisheries and Food of the Government of Catalonia.

²⁵ In 2013, therefore, the Ministry of Agriculture, Livestock, Fisheries and Food approved an Action Plan for Crop Biodiversity with the aim to foster the recovery, conservation, use and commercialisation of local varieties in Catalonia and raise awareness about them. Since 2012 Catalonia has also had a catalogue of local varieties, a public database featuring local varieties of agricultural interest in Catalonia, in which 16 varieties are currently registered.

3.1.5. Recover the use of pastures as a feeding source for livestock by promoting extensive livestock farming

Even though pasture area has increased over recent decades²⁶, the numbers of livestock that make use of it has been declining: in Catalonia, there are increasingly fewer ruminant animals such as cattle and goats being reared, with a major reduction in sheep stocks, which between 2000 and 2016 decreased by half, falling from more than one million heads to little scarcely over 500,000²⁷.

Conversely, the production of monogastric animals increased over this period, in both hens and chickens²⁸ and, especially, pigs. More specifically, and in relation to this species, the number of animals counted on the census has risen from 6 million to over 7.5 million. In fact, Catalonia is a major pig producer with 27% of the total on the Spanish census for these animals (which is also the highest of all the EU-27).

Monogastric animal feed is primarily based on cereals and oilseed meal, the principal non-transformed product imports²⁹. According to data from the Observatori del Porcí (Pig and Swine Observatory), the ratio of production in Catalonia and the import of these products to feed the swine is 1:6 (Government of Catalonia: Pig and Swine Observatory 2011).

Meanwhile, most of the meat output production, especially in the case of pork, is destined for export. In fact, it is calculated that half of the pig meat produced in Catalonia is intended to be sold externally (Babot, 2015), a trend that continues to grow³⁰.

Therefore, with a reduction in numbers of animals making use of pastures (agricultural areas in the majority of cases not competing with agricultural crops), and an increase in livestock production for which it is necessary to import the bulk of the feed, the livestock sector in Catalonia is increasingly dependent on international markets for raw materials.

These international markets are subject to tough competition which, in a world that has ever more inhabitants and a population needing more agricultural products, as both foodstuffs and otherwise³¹, will only continue to grow. Also to be borne in mind are the new financial instruments linked to commodities, which affect their prices and determine their entry onto

²⁶ The area of pastureland has increased from 129,051 hectares in 1993 to 169,600 ha in 2009. Source: GOVERNMENT OF CATALUNYA; CENTRE FOR RESEARCH ON ECOLOGY AND FORESTRY APPLICATIONS (CREAF). «Land Cover Map of Catalonia». Barcelona: Government of Catalonia. 4th ed. Online: <<http://www.creaf.uab.es/mcsc/usa/index.htm>> [DOA: 16 January 2018].

²⁷ The cattle count rose from 716,416 heads in 2000 to 620,176 in 2016; that of goats, from 97,593 to 71,517, and that of sheep from 1,174,531 to 533,289. Source: GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Estadístiques ramaderes». Online: <<http://agricultura.gencat.cat/ca/departament/estadistiques/ramaderia/>> [DOA: 19 February 2018].

²⁸ In 2008 in Catalonia there were 58,482,307 places for hens and chickens, and in 2016, 62,952,114. Source: GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Nombre explotacions i places bestiar». Online: <<http://agricultura.gencat.cat/ca/departament/estadistiques/ramaderia/nombre-explotacions-capacitat/>> [DOA: 19 February 2018].

²⁹ In 2016, 5,361,281 tonnes of cereals were imported and 2,469,707 tonnes of oilseed and industrial meal were imported. Source: GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Comerç exterior agroalimentari. Catalunya 2016». Online: <<http://agricultura.gencat.cat/ca/departament/estadistiques/alimentacio/comerc-exterior/>> [DOA: 16 January 2018].

³⁰ In 2015, pork exports in Catalonia increased by 11% compared to 2014 (Babot, 2015).

³¹ For the production of biofuels, cosmetic products or for medicinal purposes.

the international market, as well as so-called land grabbing, which can affect the international agricultural raw material market.

Meanwhile, there are numerous studies that associate the meat and milk from grazing herbivores with higher concentrations in Omega-3 polyunsaturated fatty acids, beneficial to health (Daley, 2010 and Bastien, 2011, and other sources).

Recommendations

1. Increase research on the most sustainable grazing practices on the grounds that grazing results beneficial in terms of providing ecosystem services, with a key role in fire prevention, the reduction of evapotranspiration in river valley heads, the conservation of biodiversity and benefits to health through the consumption of products from animals feeding on grass.
2. Intensify measures to support livestock grazing activity to boost its positive externalities.
3. Promote the optimisation of the quality value of these animal products and their transformation (dry-cured sausages, cheese, milk, etc.) and commercialisation, promoting their traditional use in cooking and, at the same time, innovation in new formats for consumer convenience.
4. Encourage professionalism in the activity of grazing.
5. Respect and encourage transhumance, for the benefit of the landscape, energy-wise and animal welfare, amongst other reasons.

3.1.6. Guarantee that the management of fisheries is compatible with the recovery of fish stocks and is ecosystem-based

The production of fish across the world has increased by 3.2% annually over the past five decades, above the world population growth rate (1.6%). This increase in production is basically due to a major increase in aquaculture production and inland fishing, whilst since the 1990s marine fish landings have remained stable (FAO, 2016).

Fish stocks, however, have decreased dramatically: whereas in 1974 the proportion of marine stocks assessed to be fished within biologically sustainable levels was 90%, by 2013 this percentage had dropped to 68.6%. This means that 31.4% of marine stocks assessed are considered fished at biologically unsustainable levels and are, therefore, over-exploited (FAO, 2016).

In the Mediterranean, 96% or less of the benthic fish stocks assessed (those that live on the seabed) are overfished, whilst for pelagic fish (those that live in the water column) such as sardines and anchovies, this percentage is 71%³².

³² EUROPEAN COMMISSION (2014). COM (2014) 388. *Communication from the Commission to the European Parliament and the Council, concerning a consultation on Fishing Opportunities for 2015 under the Common Fisheries Policy*. Brussels: European Commission. Online: <<http://eur-lex.europa.eu/legal-content/ES/TXT/PDF/?uri=COM:2014:388:FIN&rid=5>> [DOA: 17 January 2018].

Added to this is the fact that the Catalan fishing fleet, which conducts its activity primarily in the Mediterranean, has declined over recent years³³. In 2016, 28,947 tonnes of fishery products were caught, less than half of the 66,322 tonnes landed in 1994, the year when catches in Catalonia began to undergo a gradual decrease³⁴.

Conversely, consumption of these products has remained more or less stable, between 170,000 and 190,000 tonnes (the latest figures available are from 2015, with a consumption rate 182,619 tonnes)³⁵.

It is clear, therefore, that catches of fishery products in Catalonia are a long way off meeting domestic consumption demand, and that the majority of fish consumed is from Spain, the European Union and other non-EU countries (Bosch, 2013).

Aquaculture does not meet this demand either, with a production of 7,993 tonnes in 2016 (together marine fish, inland fish and molluscs)³⁶. It is therefore necessary to reflect upon how to successfully reduce this gap between consumption and production without depleting fishing resources.

In this context, on 30 March 2017 the MedFish4Ever³⁷ Declaration was approved in Malta, through which the states around the Mediterranean coast committed to implement an action plan for cooperation and for the sustainable development of fishing in all states over the next 10 years, following scientific recommendations to ensure the sustainability of resources and the recovery of stocks.

In Catalonia, a new governance model for commercial fishing is being put in place, based on joint management. This joint management in decision-making involves the collective participation of the fishing sector, scientists, environmental organisations and the relevant administrative bodies. Specific examples, and with highly-positive results, are joint management plans for the sandeel, Palamós prawns and the Roses hake.

It must be remembered that illegal fishing, which is not controlled or regulated, is a reality, and must be eradicated from all fronts. Other issues include fish rejection, recreational fishing and the impacts that fisheries exert on commercial and non-commercial species under conservation risk that are caught by fishing vessels as by-catch, such as birds, turtles and marine mammals. This activity, which goes beyond regulated commercial fishing, also has a major im-

³³ In 2016 in Catalonia there were 814 fishing vessels recorded on the census: that is, 535 fewer than ten years ago. Source: GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Situació de la flota pesquera (a desembre de 2016)». Online: <http://agricultura.gencat.cat/ca/ambits/pesca/dar_flota_pesquera/dar_estadistiques/dar_situacio_flota_pesquera/> [DOA: 16 January 2018].

³⁴ GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Evolució de les captures de pescas subbastada». Statistics. Online: <http://agricultura.gencat.cat/ca/ambits/pesca/dar_flota_pesquera/dar_estadistiques/dar_situacio_flota_pesquera/> [DOA: 16 January 2018].

³⁵ GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Dades de consum a Catalunya». Statistics. Online: <<http://agricultura.gencat.cat/ca/departament/estadistiques/alimentacio/consum-alimentari/>> [DOA: 16 January 2018].

³⁶ GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Dades de producció aquícola 2016. Statistics». Online: <http://agricultura.gencat.cat/ca/ambits/pesca/dar_aquicultura/dar_estadistica_aquicultura/dar_produccio_aquicola/> [DOA: 16 January 2018].

³⁷ MINISTERIAL CONFERENCE ON THE SUSTAINABILITY OF MEDITERRANEAN FISHERIES (2017). *Malta MedFish4Ever Ministerial Declaration*. Malta: Ministerial conference on the sustainability of Mediterranean fisheries. Online: <<https://ec.europa.eu/fisheries/sites/fisheries/files/2017-03-30-declaration-malta.pdf>> [DOA: 16 January 2018].

pact on fishing stocks and must be taken into account when laying out measures to improve the situation of sea fishing.

Recommendations

1. Adopt pertinent measures so that fishing resources are managed in a sustainable way.
2. Promote joint management fishery committees with representation from the sector, experts and government representatives in order to ensure the sustainable management of fishing resources.
3. Increase and improve compliance with fishing legislation, and also strengthen the regulation of fisheries and recreational fishing activity, the fight against bad practices and illegal and undeclared fishing with closer monitoring and greater controls in ports and at sea.
4. Push for an improvement in selective fishing (with the regulation of fishing gear, the establishment of closures per species, etc.) in order, in particular, to avoid landing fish that have no commercial use and to reduce rejection to the maximum.
5. Promote the consumption of fish species that currently have no commercial value, either for use in the food industry or for direct consumption by the public, introducing them into restaurants, markets and cookery displays.
6. Recover the tradition of seafood cuisine and the gastronomic culture of fish that is typical of Catalonia, which is highly rich in the diversity of sea produce.
7. With regard to imported fish products, make international certification programmes for sustainable fishing more widely known, such as the Marine Stewardship Council (MSC) programme, and encourage a preference for their consumption over non-certified produce.
8. Promote the training and formation of associations of recreational fishermen, to foster their co-responsibility in fish management with a view to obtain more accurate catch figures.
9. Incorporate the impacts of other activities into fisheries management, such as recreational fishing.
10. Raise awareness amongst the population on the status of the principal commercial stocks in Catalonia and the measures being taken to manage them correctly.
11. Promote the traceability of fish products and inform consumers of their right to be offered such information (different origins, fishing gear and production methods) on the labelling.
12. Boost research in the field of marine biology and improve data collection.
13. Promote the creation of marine reserves to regenerate over-exploited fish species.

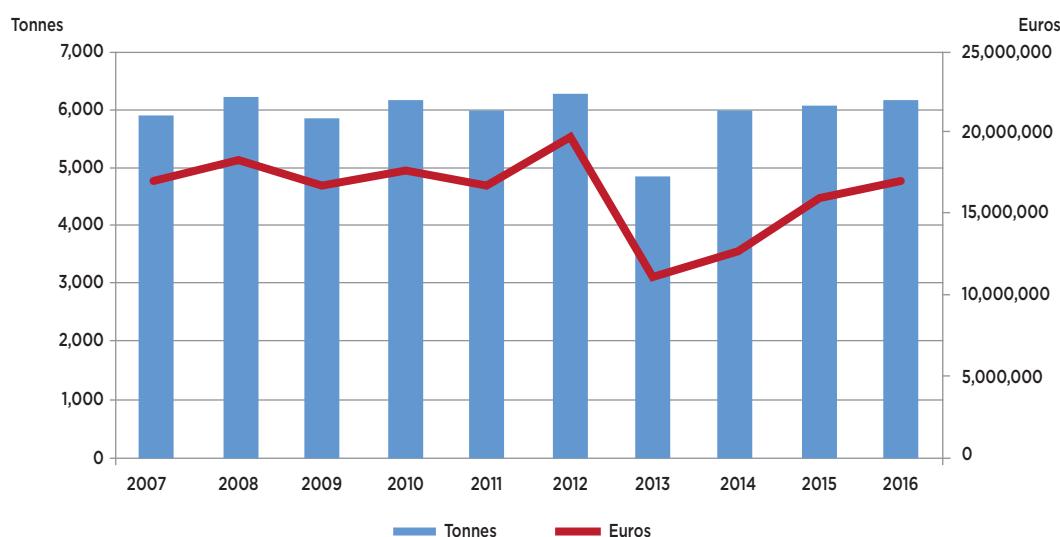
3.1.7. Increase the production of foods from sustainable aquaculture

An alternative to imports are aquaculture products. In fact, since 2014 aquaculture (mainly inland) has already been providing half the fish that is destined for human consumption worldwide. The growth in this sector has been extraordinary, as in 1974 aquaculture represented only 7% of it (FAO, 2016).

Catalonia, however, has not seen aquaculture develop to the same extent. Here it is a small sector and, apart from the mollusc and tuna farms in the Ebro Delta, initiatives launched over recent decades have not managed to prosper.

In 2016, aquaculture generated 7,993 tonnes of products, of which 2,100 tonnes were marine fish (bluefin tuna, sea bream and sea bass), 4,000 tonnes were bivalve molluscs (mussels, Pacific oysters, clams, European razor clams and cockles) and 1,800 tonnes were inland fish (sturgeon and trout).

Figure 2: Evolution of marine aquaculture production in Catalonia in the period 2007-2016 (in tonnes and euros).



Source: Government of Catalonia. Ministry of Agriculture, Livestock, Fisheries and Food. «Evolució de la producció aquícola». Statistics. Online: <[http://agricultura.gencat.cat/ca/ambits/pesca/dar_aquiculture/dar_estadistica_aquiculture/dar_evolucio_produccio_aquicola/](http://agricultura.gencat.cat/ca/ambits/pesca/dar_aquicultura/dar_estadistica_aquicultura/dar_evolucio_produccio_aquicola/)> [DOA: 2 March 2018].

Aquaculture is a useful alternative to reduce the effects of overfishing. In fact, the European Commission has chosen aquaculture as one of the main lines of focus for blue growth. It should be remembered, however, that this type of production is still a livestock farming activity, dependent on the input of extraneous matter and energy, and with environmental effects on the surroundings. And with regard to this, one of the issues to be resolved is feeding aquaculture fish with wild fish, where efficiency needs to be improved and alternative solutions found.

The fact that in Catalonia this still remains a small sector with potential for development presents a good opportunity for it to be done using sustainable production systems. One possibility to be studied is the combination of different types of production, such as integrated multi-trophic aquaculture, which includes organisms from different trophic levels of an ecosystem (for example, fish, shellfish, seaweed) in such a way that the by-products of one become inputs for another.

Recommendations

1. Increase awareness and scientific information available on the impact generated by aquaculture, especially at a marine level, and optimise production methods to reduce it.
2. Restrict the harvesting of specimens of wild species and their subsequent fattening to conditions that do not negatively affect fishing stocks.
3. Promote the development of non-intensive aquaculture, which has a low environmental impact and is a net producer of proteins.
4. In the context of the global environmental crisis, encourage feed that leaves a minimal ecological footprint in the countries of origin where fish feed for aquaculture is produced.
5. Study the development of integrated multi-trophic aquaculture and other low-impact technologies such as aquaponics or the biofloc system in Catalonia.
6. Promote research into the mechanisms bivalves and other herbivore or detritivore species have developed to adapt to the effects of climate change.
7. Make the cultivation of exotic species conditional on favourable scientific evidence to prevent future impacts on ecosystems and marine, river and lake species.
8. Study the viability of developing algaculture in Catalonia.

3.1.8. Increase efficiency in the use of basic resources for the correct functioning of the agrifood system

Pressure on natural resources is continuously increasing; it is therefore essential to move towards a more sustainable use of these and gradually detach agricultural productivity from the use of these resources, improving efficiency and applying agro-ecological and circular economy principles.

3.1.8.1. Water

Water is a vital element for agriculture, which uses 72% of all water consumed in Catalonia³⁸. With this water, 32% (265,834 ha) of Catalonia's cultivated areas (a total of 834,751 ha) are irrigated, whilst the remaining 68% (568,917 ha) is dryland³⁹. More than half of the agricultural demand for water is concentrated in the Segre system (54%), followed by the final stretch of the Ebro river (29%), and the remainder corresponds to the internal basins (17%) (ACA, 2014).

Catalonia has a Mediterranean climate with irregular rainfall and hot, dry summers. This water shortage may be further upped by climate change. As signalled in the Management Plan for the River Basin District of Catalonia 2016-2021, it is predicted that there may be a potential

³⁸ Agriculture consumes 2,038 hm³/year of the 2,830.4 hm³/year of total water consumption. Livestock also consumes water, but it is primarily indirect consumption through the irrigation of primary matter to feed the livestock. The consumption of water by livestock in 2014 was 42.6 hm³/year (Government of Catalonia: DTES, 2016).

³⁹ GOVERNMENT OF CATALUNYA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Distribució general de la superfície de Catalunya 2015». Statistics. Online: <http://agricultura.gencat.cat/web/.content/de_departament/de02_estadistiques_observatori/02_estructura_i_produccio/00_distribucio_general_superficie_catalunya/documents/fitxers_estatics/Distrib-sol-2015-DEFINITIU.pdf> [DOA: 16 January 2018].

water deficit in the Muga and Ter-Llobregat systems. In the case of Muga, it is estimated that a complementary source able to provide 0.25 m³/s would be needed (which could increase to 1.0 m³/s in the future) and, in the case of Ter-Llobregat, the amount needed as a complementary source is 2 m³/s today (and up to 6 m³/s in the future⁴⁰).

Within this context, measures for savings and efficiency are essential. Indeed, Catalonia has already begun to make progress in this regard, especially after the 2005-2008 drought period. Thus, between 2007 (ACA, 2014) and 2014 (Government of Catalonia: DTES, 2016), total water consumption decreased from 2,965 hm³ to 2,830 hm³. The use of water for irrigation has also seen improvements, and consumption fell from 2,114 hm³ to 2,038 hm³ in the same period.

However, it should be mentioned that there is no reliable record-keeping system for agricultural water consumption in Catalonia, meaning that there is no accurate information on consumption trends. Still, the irrigation system used on 61% of irrigated land is still surface (by flood irrigation), whilst systems that are potentially more efficient, such as sprinkler and drip, constitute only 12% and 26% respectively (Government of Catalonia: DARP, 2012).

There is, therefore, plenty of margin for improvement in this area (Government of Catalonia: CADS, 2015). In this regard, it is important to bear in mind the relationship between irrigation systems and use of energy, and also to integrate this factor into the criteria for increasing irrigation efficiency.

Likewise, the opportunities that non-conventional water sources can offer to ensure availability of the resource should be taken into account, such as regenerated water or rainwater. Indeed, according to Catalan Irrigation Plan 2008-2020 (revised text, 2012), only 755 hectares are irrigated with water from treatment plants.

Groundwater is also a source of water that could be of much use in some zones of Catalonia. Currently, 77% of land is irrigated with surface water, whilst groundwater is used for 19.9% of the irrigated⁴¹ area, primarily in the internal basins. The aquifers in urban areas and deep aquifers are especially useful, with great care always being taken, however, not to over-exploit them, thus giving way to a balanced use between these groundwater sources and surface water sources (Mas-Pla, 2012).

The current context of climate change must also be borne in mind, which will increase the difficulties to ensure this resource. According to the *Third Report on Climate Change in Catalonia*, an increase of 0.8° C in temperatures is predicted for the period 2012-2021, and of 1.4° C for the period 2031-2050, which will increase evapotranspiration, especially in those basins that have been experiencing reforestation since the 1950s. This fact, together with the trend (although unproven) towards a decrease in rainfall, will reduce water resources on average by 11% in 2021 and 18% by 2051 (Mas-Pla, 2012).

Faced with this situation, an improvement in the efficiency and use of non-conventional sources (regenerated water, for example) will be essential to ensure the resource. Forest management

⁴⁰ The prediction of 6m³/s is for the period between 2033 and 2045 (ACA, 2017).

⁴¹ These sources are complemented by drainage water in irrigatable zones (2.4%) and water from treatment plants, which, with 755 hectares, represent 0.24% of the total.

in the basins will also be key, especially in the Pyrenean valley heads, which must be considered critical areas for water supply (Mas-Pla, 2012).

Furthermore, it is necessary to impact on the planning and development of crop types that will result in higher productivity in relation to water consumption, discouraging crops with very high water consumption and little added value (for example, sweetcorn or alfalfa for export).

It is also necessary to make advances in the improvement of water quality to be able to keep water resources available for agricultural use, reducing pollution that spreads throughout the basin (for example, preventing the increase in water salinity of Ebro and Llobregat rivers). Finally, attainment and maintenance of ecologically-sustainable water flows in all rivers in Catalonia must be ensured while granting technical standards, in accordance with current legislation.

Recommendations

1. Take firm steps towards improving efficiency and use of water for irrigation using economic and technological instruments (such as those used, for example, in precision agriculture) that optimise the use of resources.
2. Consider the opportunities that non-conventional water sources can offer, such as regenerated waters or rainwater collected on roofs or impermeable surfaces, as an alternative to guarantee the resource.
3. Set out a system for the integrated management of all water resources to combine the best availability at all times.
4. Promote research, development and technological innovation in all aspects related to water resource management, efficient use of water and use of non-conventional water sources, so that the need may turn into an opportunity that will place Catalonia at the lead of this technology at a global level.
5. Improve integrated water resource management with the support of tools that aid decision-making, such as short-term and seasonal forecasts.
6. Ensure sustainable forestry management best suited to the basins to reduce losses there through evapotranspiration.
7. Promote crops that consume less water and have greater added value.
8. Prevent deterioration in water quality through agricultural use by reducing contamination spread throughout the basin.
9. Attain and maintain ecologically sustainable water flow in all rivers in Catalonia.

3.1.8.2. Energy

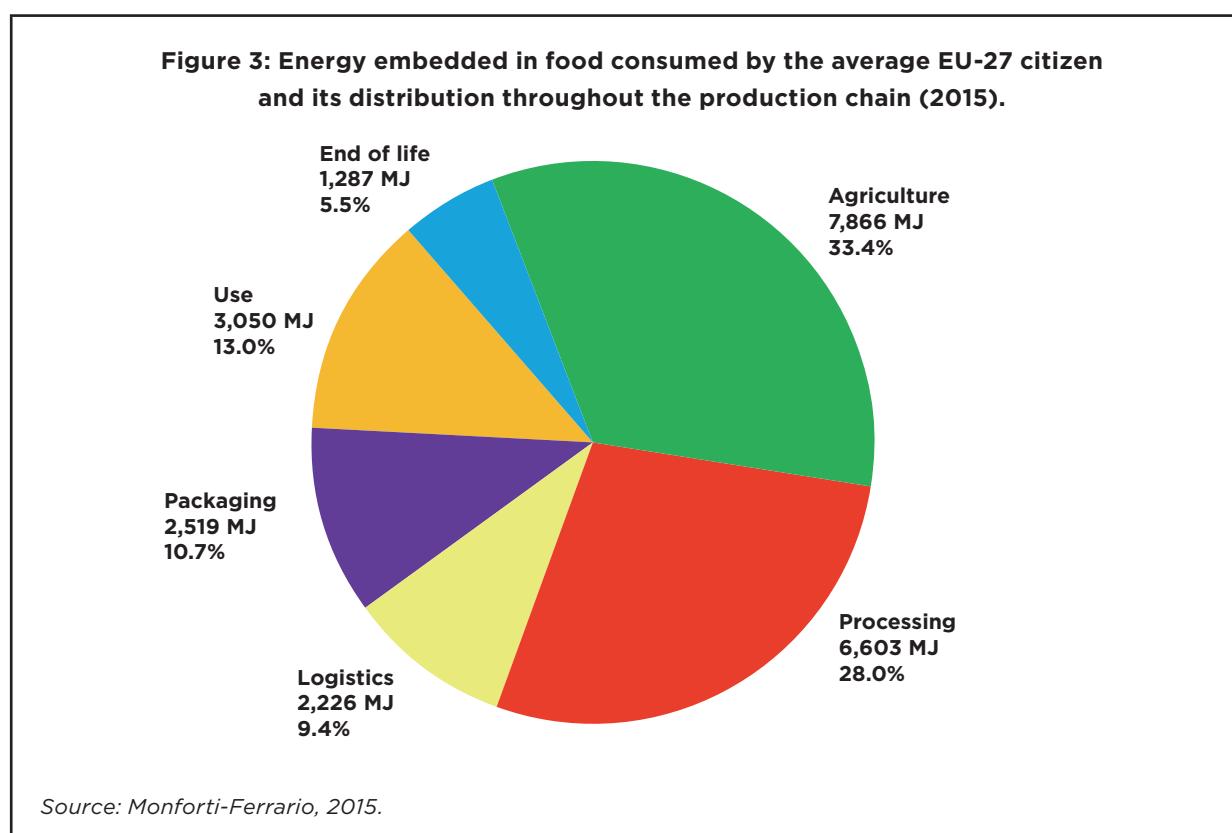
At present, agricultural and fishing production requires oil and other fossil fuels. According to the Catalan Energy Institute, agriculture, livestock breeding and fishing are responsible for 3.8% of the total energy consumption in Catalonia (ICAEN, 2016), primarily used for agricultural machinery, to pump water in some irrigation systems, to operate farms and boats, etc.

Implementing measures to reduce the use of fossil energy, and spreading the use of renewable energies, will contribute to making the agrifood sector more sustainable. In parallel, greater energy sustainability will make the agrifood system less vulnerable in the face of future energy crises (for example, higher oil prices).

Apart from this direct consumption of energy, the agricultural sector also consumes energy in an indirect way, especially through chemically synthesised fertilisers and pesticides. In fact, there are studies that indicate that energy used in the production of fertilisers is greater than that used in farm work⁴². Avoiding unnecessary fertilisation, increasing fertilisers' efficiency, and substituting the use of chemical fertilisers for organic fertilisers would considerably reduce energy use in farming.

Likewise, it should also be remembered that obtaining animal protein demands more resources than obtaining protein from plants. Thus, to produce 1 kg of high-quality animal protein, 6 kg of plant protein are necessary: that is, more land requires more energy and more water. Thus, to produce 1 kcal of plant protein, 2.2 kcal of fossil energy are required: to produce 1 kcal of animal protein, 25 kcal of fossil energy are required (Pimentel, 2003).

However, if the entire food system is taken into account, agricultural and livestock production represents only one third of the total energy consumed in the food production chain. Almost half the energy consumed in the food system is so during industrial processing, logistics and packaging (see Figure 3) (Monforti-Ferrario, 2015).



⁴² The Research Centre for Energy, Environment and Technology (CIEMAT), in its study entitled *Análisis del ciclo de vida de combustibles alternativos para el transporte*, states that energy used in the manufacturing of fertilisers on the targeted wheat and barley crops is greater than that used on farm work (in the case of wheat, 52% is used in fertilisers' manufacturing and 37% on farm work; and for barley, figures are 59% and 41% respectively) (Lechón, 2005).

Therefore, beyond any measures that may be taken in agricultural, livestock and fishing production, it is the transformation and distribution system that will determine to a large degree the amount of energy used in the production of foods.

In this regard, proposals have been set out to make advances in savings, efficiency and use of renewables in the industry and transport of agrifood products, both in the transformation as well as in the conservation systems.

Similarly, it is essential to remember the potential of agricultural holdings and farms as sources for the generation of renewable energies across the rural environment. Beyond small-scale solar and wind energy, there are numerous opportunities for using biomass as an energy source, ranging from biogas to the burning of pruning waste and the clearing of forests. In countries such as Germany and Denmark, where there is legislation in place that offers remuneration for feeding biomethane into the natural gas grid, there are many highly successful examples and a similar move should be made towards this model.

In addition, consumers' decisions in relation to the foods they choose can make a four-fold difference to the use of energy (Monforti-Ferrario, 2015). Reducing the kilometres involved in the transport of foods contributes to reducing energy use. Nevertheless, on this matter there is still some debate, as efficient transport systems can be less energy demanding than local production in greenhouses or food preservation through refrigeration (this needs to be studied case by case in accordance with lifecycle assessment). At all events, consumption of local and seasonal products is a good criterion to reduce use of energy in foods supply.

Similarly, reducing consumption of more complex foods (meat products and highly processed products), reducing food waste and boosting consumption of organic products can considerably reduce energy embedded in foods. This can also be applied to the consumption of water of and other natural resources, clearly demonstrating the role of consumers' preferences, over whom a sound agrifood policy could play a positive role.

Recommendations

1. Implement measures to reduce direct consumption of energy and increase use of renewables in agricultural and livestock production and vessel operations.
2. Avoid unnecessary fertilisation and increase fertilisers' efficiency; substitute chemical fertilisers for organic ones.
3. Make advances in savings, the efficiency and use of renewables in the industry and the transport of agrifood products, both in their transformation as well as their preservation.
4. Promote energy generation across the rural environment through the production of renewable energy at the holding or farm itself (solar, biogas, biomass, etc.).
5. Promote habits of food purchase that are less intensive in the use of energy and other natural resources, such as reducing consumption of highly processed foods, buying local and seasonal produce and reducing food waste.

3.1.8.3. Nutrients

Nitrogen, phosphorous and potassium are the principal nutrients for plants and are, therefore, essential for primary production, from where plant foods and raw materials are obtained to rear livestock.

Whilst traditionally they were incorporated into the soil primarily through the application of organic fertilisers, with the green revolution came chemical fertilisers that allowed for the application of these nutrients directly in a mineral form.

Nitrogen is found in significant quantities in the atmosphere, but the process of nitrate synthesis requires hydrocarbons and energy. Phosphorous, meanwhile, is of mineral origin and is a finite resource that may become a major limiting factor for agricultural production in the 21st century (Peñuelas, 2013). Moreover, phosphate mines do not exist in Catalonia or in practically any other part of Europe, being mainly concentrated in Morocco and China.

Potassium is also of mineral origin, and in Catalonia its major sources are the mines at El Bages. Even though Catalonia is currently producing and exporting potassium, it should be remembered that potassium still remains a finite resource.

This predicament has resulted in various European studies and initiatives delving into the future of food security as regards these nutrients' availability, in particular phosphorous's, stressing the need to be very vigilant on this issue⁴³.

Agricultural activity over recent years has put large quantities of these nutrients into circulation through direct application as chemical fertilisers or as present in livestock faeces. In fact, nitrogen and phosphorous released into the environment have already exceeded biophysical limits at a global level (Steffen, 2015). In Europe, rates of reactive nitrogen that have been released into the environment have more than tripled since 1990, with major impacts on the quality of water, air, the balance of greenhouse gases and ecosystems (EEA, 2017).

In Catalonia, there are some zones where the high concentration of these nutrients causes serious environmental trouble through the contamination of waters and the eutrophication of aquatic ecosystems. In fact, according to figures from the Catalan Water Agency, contamination through nitrates of agricultural origin is a problem that affects most groundwater in the internal basins of Catalonia⁴⁴ and almost half of river stretches⁴⁵.

It is therefore essential to gather all relevant info and have it available to determine the correct amounts of fertiliser and thus avoid over-fertilisation, as well as to improve concentration of nutrients in animal feed so that livestock metabolism will benefit best from them, thereby reducing their content in animal faeces.

⁴³ For example, in the NPK report: *Will there be enough plant nutrients to feed a world of 9 billion in 2050?* (Malin-greau, 2012).

⁴⁴ It has been proven in 14 of these, and 17 more are considered at risk. It therefore affects 31 out of a total of 37 (ACA, 2017).

⁴⁵ 13% proven, 10% probable and 24% at risk (ACA, 2017).

But it is also important to reduce losses throughout the entire food system and ensure that resources are kept for as long as possible within the system, applying the principles of the circular economy⁴⁶.

In this regard, agriculture offers a great opportunity for the recovery of organic waste through composting and anaerobic digestion (which at the same time permits energy to be obtained) to allow for it to be once again incorporated into the production cycle, reducing the need for fertilisers of chemical or mineral origin.

Catalonia has available several organic waste sources (agricultural waste, livestock faeces, organic matter from municipal waste, etc.), but nutrients from many of these are not being recovered to be applied to the land, especially in the form of organic matter, which improves its quality. Systems of production and collection of organic waste should be developed that will permit recovery and provide a good-quality fertiliser. Setting out quality standards for organic fertilisers is an instrument to optimise their value and extend their use, thereby facilitating the substitution of chemical fertilisers for organic fertilisers.

A study should also be encouraged into the technical and economic viability of extracting nutrients, such as phosphorous, from organic waste missing the standards to be applied to land as a fertiliser.

Recommendations

1. Improve efficiency in the use of fertilisers and in the nutrition of livestock to increase the decoupling of agricultural productivity and use of nutrients.
2. Promote research and innovation of precision agriculture and livestock breeding and information technologies to ensure the optimum management of resources.
3. Promote tools and instruments for knowledge-transfer and advice to the production sector to improve efficiency in the management of inputs.
4. Foster methods that help conserve and increase the quantity of organic matter in the soil, such as crop rotation or alternative efficient cultivation methods, such as leguminous plants.
5. Develop systems for the production and collection of organic waste generated in Catalonia, which will permit its reutilisation and provide a good-quality fertiliser.
6. Assess the implications of a future scarcity of phosphorous in agricultural production in order to take the necessary measures to handle the predicament ahead of time.
7. Set out quality standards for organic fertilisers that permit the optimisation of their value and extended use, thereby facilitating the substitution of chemical fertilisers for the correct application of organic fertilisers.

⁴⁶ EUROPEAN COMMISSION (2015). COM (2015) 614 *Closing the loop - An EU action plan for the Circular Economy*. Brussels: European Commission. Online: <http://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF> [DOA: 16 January 2018].

3.1.9. Maintain a high coverage rate through the export of high added-value products and diversify commercial trade

The coverage rate⁴⁷ of the agricultural sector has shown a positive evolution over recent decades, rising from less than 50% in 1995 to practically 100% in 2016 (more precisely, 99.24%), as can be seen in Table 4. It is worth mentioning, however, that these figures do not include trade with the rest of Spain, which may alter them somewhat.

Table 4: Exports and imports by Catalonia from Group 1 (food, drink and tobacco), in thousands of euros (1995, 2007 and 2016).

Items	1995		2007		2016	
	EXPORT	IMPORT	EXPORT	IMPORT	EXPORT	IMPORT
Total	1,633,995.72	3,692,037.96	5,017,287.57	7,779,125.29	9,273,347.81	9,379,733.07
Meat products	324,113.41	259,765.56	1,384,817.82	530,457.93	3,100,064.64	501,217.07
Dairy and eggs	69,443.88	244,297.83	233,466.27	672,058.80	176,034.01	659,996.42
Fish products	62,260.65	405,907.52	189,348.13	687,930.28	317,529.86	840,533.32
Cereals	42,606.22	373,393.57	84,167.48	885,898.91	67,574.87	988,363.52
Fruit, vegetables and pulses	325,076.40	408,379.46	737,199.66	813,811.25	1,314,343.85	1,051,709.14
Sugar, coffee and cocoa	127,270.53	516,299.77	299,886.06	856,737.79	705,301.37	1,503,962.18
Ready-made foods	199,242.89	249,537.02	532,662.55	789,345.83	1,161,309.60	956,115.25
Drinks	213,274.56	166,034.14	738,028.25	490,661.37	920,748.86	572,473.37
Tobacco	18,324.88	305,299.03	25,780.92	315,222.60	11,485.73	126,729.04
Fats and oils	204,839.16	263,126.65	578,377.08	421,067.66	887,056.63	562,761.53
Oil seeds and oleaginous fruits	604.56	285,895.27	5,391.37	673,784.46	19,026.27	903,040.49
Animal feed	46,938.58	214,102.13	208,161.99	642,148.41	592,872.12	712,831.73

Source: Prepared by the authors based on international trade figures from the Ministry of Agriculture, Livestock, Fisheries and Food of the Government of Catalonia. «Comerç internacional». Statistics. Online: <<http://agricultura.gencat.cat/ca/departament/estadistiques/alimentacio/comerc-exterior/>> [DOA: 16 January 2018].

The export figures for agricultural and fisheries products in Table 4 for 2016 show that meat products made up almost a third of Catalan exports from this group. The subgroup of fruit, vegetables and pulses represented approximately 14% of exports. These are followed by ready-made foods, at 12%, and drinks (water, wine and beers, etc.) and oils and fats, at approximately 9% each.

In this context, the value of these industries and their major contribution to the Catalan economy should be highlighted, which are the main reasons why the balance of trade coverage rate is 100%. At the same time, though, it should be remembered that by concentrating more than half of export revenue on three types of agricultural and fisheries

⁴⁷ The relationship between the costs incurred through the purchase of imported products and the revenue generated through the sale of exported products.

products, in fact on one in particular (meats and offal), Catalonia is in a weak position to resist potential production setbacks, changes in consumption habits or geopolitical issues affecting consumer countries.

However, the current or potential rate of food self-sufficiency has not been pinpointed: that is, to what degree agricultural production in Catalonia meets or could meet the total food needs in the region. The best estimate sets the rate of agricultural self-sufficiency, excluding that provided by livestock, at 40%⁴⁸. This figure is obtained by dividing agricultural production by the amount of agricultural products consumed in any given country. Consumption is equivalent to production, plus imports from outside Spain and imports from the rest of Spain, minus exports to outside Spain and exports to the rest of Spain. The greatest difficulty in calculating rate of self-sufficiency is that there are no detailed figures on trade flows between Catalonia and the rest of Spain⁴⁹. Estimates are given in Table 5:

Table 5: Estimated rate of agricultural self-sufficiency in Catalonia.

Elements	Amount (<i>in millions of euros</i>)
Final agricultural production	1,445.3
Agricultural exports to the rest of the world*	2,626.0
Agricultural exports to the rest of Spain**	1,455.5
Agricultural imports from the rest of the world*	4,411.8
Agricultural imports from the rest of Spain**	1,802.3
Rate of self-sufficiency	40.4 %

Source: Reguant, Francesc (*Observatori d'Economia Agroalimentària. Association of Economists of Catalonia*).

* Indicates that the figures are from Data Comex 2015.

** Indicates that data come from the Interreg C Project 1995-2013 average.

A detailed study will be welcome that would allow for data to be more accurate. At all events, figures point to a potential shortfall in the rate of self-sufficiency in Catalan agriculture.

The food and drink industries in Catalonia, made up by around 2,500 companies, are the largest Catalan manufacturing industries in terms of employment (75,700 people) and turnover (25,160 million of euros) (Government of Catalonia: DEMC, 2016). They therefore play an essential role as generators of economic activity and jobs.

Agri-food products can be sold without any processing at all, with primary processing only or with secondary processing. The more the processing, the greater the value added to the products. In Catalonia, more than half the products exported have undergone primary processing, with an economic value in 2016 of EU 1,620 per tonne. Non-transformed products, with a value

⁴⁸ REGUANT, FRANCESC (2016). *Grau d'autoproveïment agrícola de Catalunya. Observatori d'Economia Agroalimentària (Agrifood Observatory)*, Association of Economists of Catalonia. Online: <<https://obealimentaria.wordpress.com/2016/11/13/grau-dautoproveiment-agricola-de-catalunya/>> [DOA: 17 January 2018].

⁴⁹ The best information available on inter-regional trade in Spain comes from the database of the Interreg C Project, which offers a 1995-2013 average and includes livestock and fish. This report has been drawn up by the CEPREDE Centre (Centre for Economic Forecasting) at the Universidad Autónoma de Madrid with the sponsorship of eight autonomous regions, including Catalonia.

of EUR 820 per tonne, represented 35% of the total, and those that had undergone secondary processing, with a value of EUR 2,660 per tonne, represented only 10% of the total⁵⁰.

Even though the majority of these exported products are transformed, something which already purveys them added-value, the value of exports still needs to improve. This could be done by increasing products' value per tonne through differentiated systems of production and/or origin and through increasing exports of products that have undergone secondary processing, with the highest added-value. With regard to this, the outstanding reputation enjoyed by Catalan cuisine could serve as a means to promote quality produce and gourmet products outside the region.

Recommendations

1. Have clear and full information available on the Catalan balance of trade, covering trade flows with the rest of Spain.
2. Define and pinpoint the rate of food self-sufficiency (current and potential) in Catalonia.
3. Diversify the variety of products intended for export to increase system resilience in the face of potential production setbacks, changes in consumption habits or geopolitical issues affecting destination countries.
4. Increase the added-value of exports through differentiated systems of production and/or origin, and also increase exports of products having undergone secondary processing.
5. Drive innovation in order to introduce new products onto the market in accordance with consumers' changing preferences (new packaging formats, ready-made meals, fourth range, functional foods, etc.), also incorporating sustainability criteria.

3.1.10. Increase resilience to climate change

Climate change is one of the main challenges that humanity will have to address over coming decades. On the one hand, this is owing to the need to take measures to mitigate it and keep the increase in the global average temperature to well below 2° C above pre-industrial levels, as indicated in the Paris Agreement.

On the other hand, it is necessary to anticipate and adapt to the consequences of climate change, which are already beginning to be noted. As is set out in the *Third Report on Climate Change in Catalonia*, the increase in temperature compared to the average for the period 1971-2000 in Catalonia could be of 0.8° C this decade, and of 1.4° C by mid 21st century (Calbó, 2016).

Also predicted is an increase in extreme temperatures, heatwaves, tropical nights, warmer nights and days, the longer duration of hot spells (especially in summer and in mountain zones) and the greater frequency and longer duration of periods of drought. Adding to this is the fact that the river basins have been increasingly reforested, which, with an increase in temperatures, will see a rise in evapotranspiration and, consequently, a decrease in water flows.

⁵⁰ Prepared by the authors based on international trade figures from the Ministry of Agriculture, Livestock, Fisheries and Food. Source: GOVERNMENT OF CATALONIA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD. «Comerç exterior agroalimentari. Catalunya 2016». Statistics. Online: <<http://agricultura.gencat.cat/ca/departament/estadistiques/alimentacio/comerc-exterior/>> [DOA: 16 January 2018].

This will result in droughts caused by weather phenomena, water shortages and agricultural activity to be more frequent and longer-lasting, meaning that water management will become a key element in our adaptation to climate change (Llasat, 2016).

The Mediterranean Sea is also experiencing the effects of climate change. In Catalonia, sea-water temperature has increased by 0.3° C per decade, water pH has decreased and sea level has risen by 4 cm per decade. These gradual changes, together with one-off episodes of excessive heat in the summer or an increase in the number of storms in the autumn, affect marine ecosystems and, therefore, the fishing and aquaculture resources that can be obtained from them (Pelejero, 2016).

All these changes have effects on natural systems, and, consequently, on crop and livestock farming systems. Added to this reduction in the availability of water resources is the potential emergence of new pests and diseases, a desynchronisation that is incipiently observed between the cycles of some insects and the flowering of certain species, and the effect the increase in temperature may have on livestock productivity and animal health.

This is why it is important to continue carrying out studies on the development, forecasts and effects of climate change on natural and socioeconomic systems in Catalonia, alongside the regular reports on climate change by experts which the Government of Catalonia and the Institute of Catalan Studies have been drafting since 2005, the third edition of which was issued in January 2017 (Martín Vide, 2016).

In parallel, it is also necessary to have in place strategies for adapting to climate change, such as the Catalan Strategy for Adapting to Climate Change 2013-2020 (Government of Catalonia: DTES, 2012), with specific measures for the agriculture and livestock farming and fishing sector, agreed upon by experts and representatives from the sector and integrated into Catalonia's agricultural policy, and on the use of the region's marine resources. It is also necessary to bolster mitigation strategies to reduce the global warming potential generated by the agriculture and livestock farming sector.

Recommendations

1. Improve knowledge on the development, forecasts and effects of climate change on ecosystems, crops, livestock, fishing, society and economy of Catalonia.
2. Implement strategies for the mitigation of and adaptation to climate change by the agriculture and livestock farming and fishing sector, agreed upon by experts and representatives from the sector, and integrated into Catalonia's agricultural policy, and on the use of the region's marine resources.
3. Train the different actors involved in the new technologies and practices associated with production to reduce climate change.

3.1.11. Make a responsible use of antimicrobial drugs to counter mounting resistance

Owing to the abusive and inappropriate use of antimicrobial drugs, bacteria that are resistant to these are growing at an alarming rate, a fact that poses a great risk to human health and to animal production⁵¹.

Each year in the European Union, 25,000 patients die of infections caused by drug-resistant bacteria. It is estimated that if resistance continues to mount at the current rate, between 2015 and 2050 it will cause the death of 10 million people worldwide every year⁵².

Even though the main cause of the emergence of antimicrobial resistance is the misuse of these substances for human treatment, the use of antibiotics in livestock production is also a contributing factor. In fact, across the whole of Europe⁵³ more antimicrobials are used for animal production than for human consumption. Spain (no data exist for Catalonia), with a consumption of 242 milligrams of active substance per kilogramme of meat produced, is well above the European average of 144 mg/kg, and ranks fourth among the countries that use them after Cyprus, Italy and Hungary (ECDC, 2015).

In 2015, the World Health Organization (WHO), alarmed by the worldwide problem that resistance to antimicrobial substances poses, approved a Global Action Plan to tackle antimicrobial resistance (WHO, 2015), a framework to be used by countries to develop their own national action plans.

At a European level, in 2016 the Commission presented its assessment of the first Action Plan against the growing threat of antimicrobial resistance, and in June 2017 the second Action Plan was approved, with the objective of reinforcing the work done and providing support to member states in the implementation and monitoring of their own national action plans. Since 2014, Spain has had a Strategic Action Plan to reduce the risk of selection and dissemination of antibiotic resistance (Ministry of Health, Social Services and Equality, 2015).

In February 2016, the Government of Catalonia published the latest *Informe de les zoonosis transmeses pels aliments i de la resistència antimicrobiana a Catalunya 2011-2013* (Report on foodborne zoonotic diseases and antimicrobial resistance in Catalonia 2011-2013), that sought to provide information on zoonotic diseases related to the food chain and present figures on the emergence of antimicrobial resistance in zoonotic pathogens and other agents. The results indicate that 80.85% of the isolated strains of *Salmonella*, 85.7% of *Campylobacter* and 70% of *E. coli* were resistant to some antimicrobial drug (ASPCAT, 2016a).

In 2016, in a statement released to mark the European Antibiotic Awareness Day, the Public Health Agency of Catalonia revealed the need to promote the development of strategic plans

⁵¹ Resistance to last-line antibiotics to treat pneumonia (carbapenems) grew from 6.2% in 2012 to 8.1% in 2015. Similarly, resistance was also reported to carbapenems and polymyxins (such as colistin), two groups of antibiotics considered the last option in the treatment of patients infected by bacteria that are resistant to other antibiotics. Source: European Commission. «Statement of Commissioner Andriukaitis on the occasion of European Antibiotic Awareness Day». Online: <http://europa.eu/rapid/press-release_IP-16-3805_en.htm> [DOA: 17 January 2018].

⁵² EUROPEAN COMMISSION. «Antimicrobial Resistance». Online: <https://ec.europa.eu/health/amr/antimicrobial-resistance_en> [DOA: 16 January 2018].

⁵³ The study includes EU member states plus Iceland, Norway, Croatia and Switzerland.

within the framework of integrated public health and animal health policies and to encourage a responsible use of antimicrobials⁵⁴.

Similarly, on 28 November 2016, at the Universitat Autònoma de Barcelona Research Park, the 8th Workshop on risk assessment in the food chain took place, dedicated to antimicrobial resistance and the joint approach to address the situation in Catalonia, which highlighted the need to boost education, information and coordination across Catalonia on this issue, and to create a strategic plan to monitor and control bio-resistance in Catalonia, with an aim to reduce the use of antibiotics.

Recommendations

1. Develop a plan to monitor antimicrobial use to gain an accurate picture on the use of these drugs and be able to monitor and assess the measures implemented to reduce their use.
2. Draw up and implement a national antimicrobial resistance plan that would include measures to reduce use of drugs by eradicating incorrect practices and promoting individualised antibiotic therapy, substituting them for alternatives (probiotics, prebiotics, bacteriophages, organic acids, etc.) and rethinking the animal production system to reduce the risk of diseases.

3.1.12. Control and reduce the consequences of emerging pests and diseases

At the start of 2017, an outbreak of avian influenza occurred in Catalonia that led to the sacrifice of more than 25,000 animals and the application of a series of restrictive measures lasting for months. A few days earlier, the first case of *Xylella fastidiosa* had been detected in the Balearic Islands, a bacteria that seriously affects olive groves and ornamental plants such as oleanders.

These are examples of how diseases that emerged a few years previously in locations far away from Catalonia can reach our region and create serious problems for agricultural and livestock production. In both plant and animal production, regulations and procedures have been put in place to prevent their entry or, where this is not possible, to prevent their propagation.

In a globalised world, with so much exchange of goods and circulation of people, in a context of climate change that presents conditions that are more suited to certain species, the risk that pests and diseases that affect other regions of the world may reach Catalonia is high. It should also be added that some of these diseases that are new to Catalonia and affect livestock can be transmitted to humans, potentially causing serious problems for human health. Indeed, according to the FAO, two out of every three emerging infectious diseases are zoonotic: that is, they are of animal origin.

⁵⁴ CATALAN PUBLIC HEALTH AGENCY (ASPCAT). L'ASPCAT apel·la a la responsabilitat en l'ús dels antibòtics per evitar la proliferació de bacteris resistent. Online: <<http://salutpublica.gencat.cat/ca/details/Article/18-de-novembre-de-2016-Dia-Europeu-per-a-lus-prudent-dels-antibiotics>> [DOA: 17 January 2018].

It is important to increase cooperation between countries to provide a coordinated international response, which should permit the identification and investigation of possible solutions to pests and diseases in their place of origin, as well as to contain the source of infections. At the same time, it is necessary to be prepared and have action protocols in place to prevent the proliferation of these infectious agents should they reach Catalonia.

Another matter to bear in mind is that more intensive production systems, such as monocultures or farms with a high number and density of animals, are more vulnerable to any infections that may appear, as propagation is faster. In the case of animal production, it should also be remembered that many emerging diseases are due to contact with wild animals, meaning that, in risk situations, measures must be taken to avoid the contact of such animals with domesticated ones.

Recommendations

1. Lay out a series of reference laboratories assigned the mission to identify emerging plant and animal pests and diseases, as well as invasive species that could put food production in Catalonia at risk.
2. Develop protocols to prevent the entry of emerging diseases and pests or, should this not be possible, to prevent their propagation.
3. Promote cooperation with other countries to provide a coordinated international response that should permit the identification and investigation of possible solutions to the pests and diseases in their place of origin, as well as contain the focus of infection.
4. Establish action protocols to prevent the proliferation of the infectious agents should they reach Catalonia.

3.2 Ensure adequate food: through healthy and responsible consumption universally accessible

As stated by the FAO in its definition of food security, the ultimate goal of the food supply system is that the population can have access to “sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life”.

According to data that the CADS has been studying, the problem of malnutrition in Catalonia is not structural. In general, in Catalonia food consumption outdoes the population's needs, whilst a large quantity of food is also wasted.

In parallel, however, there are still families that have difficulties accessing healthy, nutritional and sufficient food, who need to resort to the in-kind food supply work carried out by entities such as the Food Bank, many third sector organisations and government agencies.

Meanwhile, half of the Catalan population aged between 18 and 74 is overweight, with a higher rate among the more disadvantaged social classes and persons who have only primary education or none at all. A consequence of overweight is a higher risk of suffering metabolic diseases, such as cardiovascular and respiratory diseases, diabetes and some types of cancer.

To reduce the rates of these diseases, it is necessary to lower the intake of energy, saturated and trans fats, free sugars and salt, and encourage an increase in the consumption of vegetables, pulses and fruits, which is more consistent with our traditional Mediterranean diet.

And finally, in Catalonia every year more than 250 million kilos of food in homes and businesses and catering establishments are thrown away: in other words, the amount needed to feed 500,000 people ends up in the bin yearly.

For everyone to have access to adequate food, poverty must be eradicated. But there also needs to be sound education and information on food, and a recovery of the culinary skills and culture based on the Mediterranean diet. The challenges in the food system, therefore, are also related to consumption, and these issues are addressed in more detail below.

3.2.1. Adjust consumption to dietary needs

Worldwide, since the 1960s, we have been consuming more and more food. This is owing to the increase in population and the rise in the average amount of calories ingested *per capita* due to the change in dietary patterns over recent years, especially in developing countries, resulting in more products of animal origin (meat, milk and eggs), vegetable oils and sugar now being consumed. In fact, these three food groups make up 29% of the total of all foodstuffs consumed and it is estimated that this will reach 35% by 2030 and 37% by 2050. For a long time in industrialised countries, this percentage has been around 48%.

These changes in dietary habits have also been observed in Spain: whilst in the 1960s the diet was based on cereals, pulses, olive oil, potatoes, vegetables and eggs, nowadays much more meat, fish, milk and dairy products are consumed, even though consumption of these products over recent years has stagnated and even, in some cases, decreased. Meanwhile, there is an upward trend in consumption of fourth-range products and convenience foods, and also an increase in food consumption outside the home (Bosch, 2013).

One consequence of this diet, together with a sedentary lifestyle, is the high incidence of overweight and obesity, a problem that has major health repercussions. In Catalonia, almost half the population aged between 18 and 74 is overweight (Garcia, 2016).

In fact, 34.6% of the population of Catalonia are overweight and 14.7% are obese. More males (41.3%) than females (27.9%) are overweight, while obesity rates are similar for both sexes (14.1% of males and 15.3% of females). As the groups get older, in both sexes there are higher incidences of overweight. Overweight is higher amongst the more disadvantaged social classes and amongst persons who have only primary education or none at all.

The WHO has warned that overweight is one of the risk factors of non-communicable diseases, such as cardiovascular and respiratory diseases, diabetes and some types of cancer⁵⁵, and it

⁵⁵ WORLD HEALTH ORGANIZATION (WHO) (2017). «Obesity and overweight». Online: <<http://www.who.int/mediacentre/factsheets/fs311/en/>> [DOA: 18 January 2018].

Table 6: Comparison between the recommended and real consumption of the main food groups.

	Recommended average consumption per day	2016 real consumption per day
Bread, pasta, rice, potatoes	300 g	184 g
Fresh fruit	500 g	272 g
Vegetables	500 g	214 g
Meat	80 g	130 g
Fish	70 g	67 g
Eggs	45 g	22 g
Pulses	30 g	10 g
Pastries, chocolate and sugars	Occasional	53 g
Juices and soft drinks	Occasional	124 g

Source: Prepared by the authors based on figures from the Ministry of Health (Food Pyramid) and the Ministry of Agriculture, Livestock, Fisheries and Food of Catalonia (Consumption figures in Catalonia): [\[DOA: 2 March 2018\]](http://canalsalut.gencat.cat/ca/vida-saludable/alimentacio/piramide_alimentacio_saludable/). [\[DOA: 2 March 2018\]](http://agricultura.gencat.cat/ca/departament/dar_estadistiques_observatoris/dar_alimentacio_qualitat/dar_dades_consum_a_catalunya).

considers that one of the ways to help reduce this consists in decreasing the excessive intake of energy, saturated fats and trans fats, free sugars and salt, whilst promoting a higher consumption of fruit and vegetables⁵⁶. Similarly, overconsumption of meat is also unhealthy. In 2015, the WHO's International Agency for Research on Cancer published a report in which it assessed red meat as being "probably carcinogenic" and processed meat as "carcinogenic" for humans, signalling, however, that moderate meat consumption provides health benefits (Bouvard, 2015).

The reasons for this change in dietary habits are diverse. On the one hand, diet patterns have been imported from other regions to the detriment of the traditional Mediterranean diet of Catalonia and, simultaneously, we spend increasingly less time cooking; on the other hand, healthier foods are often more expensive than less healthy foods⁵⁷, meaning that, over the year, the additional expense of buying healthier products becomes an extra cost that can represent a major difficulty for many disadvantaged families to access a healthier diet. For this reason, fiscal measures that tax least healthy products or reduce the price of healthier ones, such as vegetables, pulses and fruits, could help change this situation.

⁵⁶ WORLD HEALTH ORGANIZATION (WHO) (2013). *Vienna Declaration on Nutrition and Noncommunicable Diseases in the Context of Health 2020*. Geneva: WHO. Online: [\[DOA: 18 January 2018\]](http://www.euro.who.int/__data/assets/pdf_file/0003/234381/Vienna-Declaration-on-Nutrition-and-Noncommunicable-Diseases-in-the-Context-of-Health-2020-Eng.pdf?ua=1).

⁵⁷ According to the study «Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis», a healthy diet increases expenditure on food by 1.5 dollars per day (Rao, 2013).

Indeed, on 22 March 2017, the Parliament of Catalonia approved the creation of a tax on bottled soft drinks, which came into force on 1 May 2017⁵⁸. It will be necessary to monitor the results of this tax, in both how it affects consumption of these products and its potential reduction of overweight, and also to study possibly extending a tax of this nature to other products in the future.

But it is not all about the cost. In fact, it is possible to replace less healthy and more expensive foods with healthier and cheaper ones. But to be able to make this choice, it is essential to be in a position to tell between them, by having the necessary education and information.

It is extremely important, therefore, to work towards healthy consumption of food by educating children and young people, both through the school curriculum and also through live experiences (for example, school canteens serving healthy menus where students can participate in the preparation of the food, school vegetable gardens, etc.), but also by educating adults, whether this be by providing information on healthy food at primary care centres, participating in workshops and visits to help understand the rural environment, living labs or growing food in the city.

In this regard, recently around the world (Paris, Berlin, Barcelona and other locations), public and private urban agricultural initiatives have been proliferating, set up on undeveloped sites, and also on terraces and building façades (i.e. both on walls as well as inside the premises)⁵⁹.

These activities, which are more than simply recreational, can also bring about environmental and social benefits, and are included in the set of policies that seek to improve the nutrition of the population and their access to foods and, occasionally, also increase the incomes of families and neighbours. Whilst it is true that they are not without controversy, as they pose environmental drawbacks such as the need to use drinking water for watering and they compete with other environmental uses for terraces and façades, these initiatives play a part in strategies that may contribute to maintaining a bond between the urban population and agricultural activity in the mid and the long term.

In March 2017, the Universitat de Barcelona's Observatory on Bioethics and Law, jointly with UNESCO, published a report entitled *Food information: ethical, legal and policy issues* (Plana, 2017). In this document, the authors highlight the difficulty the consumer faces to find accurate and clear food information and the lack of education on dietary matters amongst the population, which results in them having to "self-train" in all matters related to food. They also indicate that food advertising often confuses the consumer.

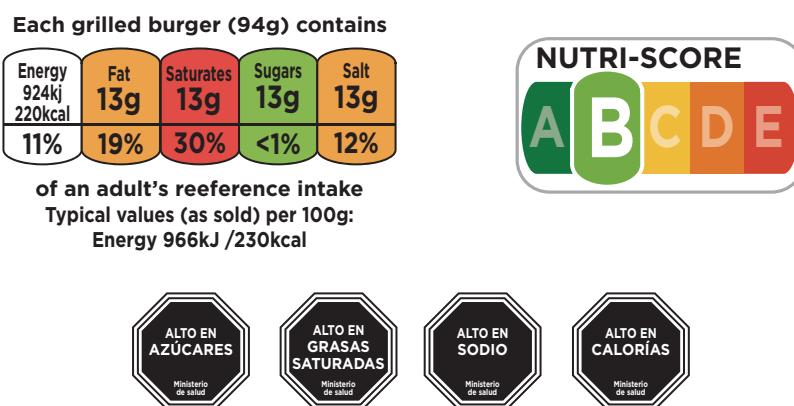
⁵⁸ Created by Law 5/2017, of 28 March, on fiscal, administrative, financial measures and the public sector and creating and regulating taxes on large commercial establishments, stays in tourism establishments, radiotoxic elements, bottled soft drinks and carbon dioxide emissions. This tax is of EUR 0.08 per litre, applicable to drinks that contain between 5 and 8 g of sugar per 100 ml, and EUR 0.12 for those that contain more than 8 g of sugar per 100 ml.

⁵⁹ See, for example, the initiatives «Terrats vius i cobertes verdes», by the Department of Ecology, Urbanism, and Mobility at the Barcelona City Council (<<http://ajuntament.barcelona.cat/ecologiaurbana/ca/que-fem-i-per-que-ciutat-verda-i-biodiversitat/terrats-vius-i-cobertes-verdes>>, DOA: 18 January 2018)], and «Mon projet d'agriculture urbaine en Île-de-France», by the Préfet of the l'Île-de-France Region (<http://driaaf.ile-de-france.agriculture.gouv.fr/IMG/pdf/Maquette_VF_cle475afb.pdf>, DOA: 18 January 2018]).

In this respect, an instrument that could be useful in making the nutritional information of foods accessible in a way that is visible, clear and easy to understand is the proposed ‘traffic light’-type of labelling that indicates the nutritional quality of foods in relation to saturated fats, sugar and salt on the front of the label, like the voluntary systems already running in the UK and France.

Since 2016 Chile has a similar working model to inform consumers when a food exceeds the limits set out by the Ministry of Health for calories, sodium, saturated fats or sugars, with a warning mark and the wording “High in...”.

Figure 4: Examples of nutritional labelling (above, UK and France; below, Chile).



Source: UK Department of Health (2016); France Public Health (2018); Ministry of Health of Chile.

Recommendations

1. Promote the culinary culture and gastronomic heritage of Catalonia, based on the Mediterranean diet, high in vegetables, pulses and fruits and moderate in meat.
2. Facilitate the reconciliation of work and family life so that families can have at least one meal together a day, go shopping together and cook.
3. Promote children’s and young people’s food education through the curriculum and live experiences (school canteens serving healthy menus, school vegetable gardens, etc.), and also that of adults, providing information on healthy foods (for example, at primary care centres) so that consumers can make choices that will most benefit their health.
4. Study the application of fiscal measures that tax least healthy products or reduce the price of those that are healthier, such as vegetables, pulses and fruits, to increase their consumption.
5. In relation to the previous recommendation, monitor and evaluate the results of the application of the tax on bottled soft drinks recently approved by the Parliament of Catalonia, in both its effect on the consumption of these products and in its potential reduction of overweight, as well as study the possibility of extending a tax of this nature to other products in the future.
6. Ensure that the advertising and the labelling of foods is accurate and verifiable and does not lead the consumer to choose foods for the wrong reasons.

7. Ensure that the nutritional information for foods is visible, clear and understandable on labels, such as, for example, through the use of a type of 'traffic light' system that indicates the nutritional quality of the foods in relation to fats, sugar and salt.
8. Guarantee the existence of points of sale or systems that supply fresh and healthy foods in all communities and districts in the city to bring these products closer to the consumer, promoting municipal markets, farmers' markets, and ensuring supplies of these foods in supermarkets, etc.
9. Encourage public procurement to supply foods to public catering facilities and canteens that are consistent with a healthy diet, to generate good habits and collaborate in the structuring of a system of production, transformation and distribution of foods that facilitates this.
10. Promote innovation in healthier convenience products.

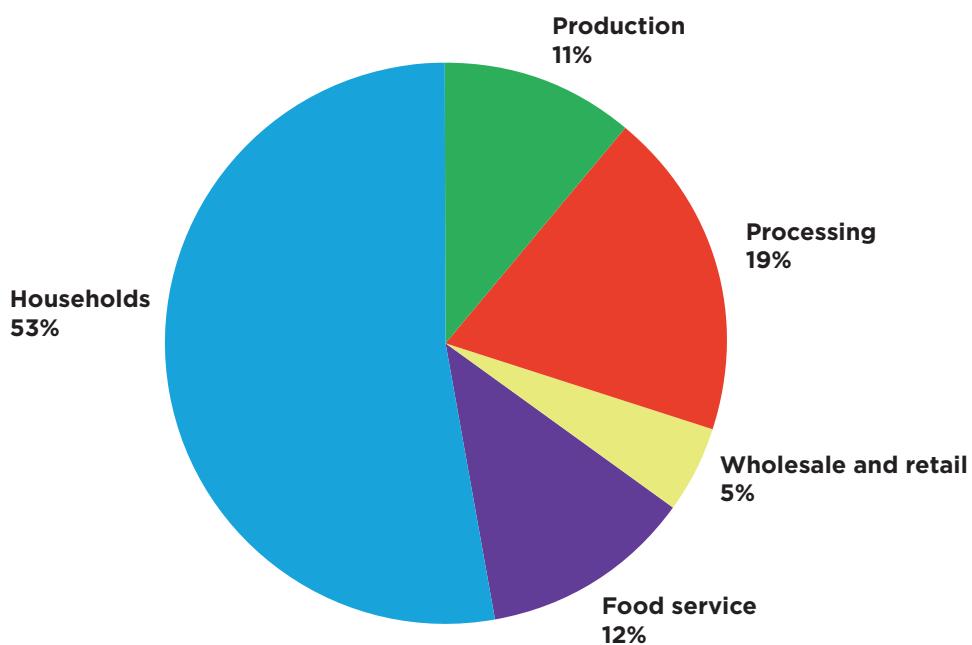
3.2.2. Reduce food waste

At all stages in the food chain there are products that are ultimately not consumed: agricultural products that are not harvested or are left in the field as they do not meet commercial standards or because the selling price is so low that it does not compensate for the work of picking them, transformation industries that stop using certain batches, distributors who throw produce away even though it can still be eaten, or mass catering companies that have more food readied than can be consumed. In parallel, food often accumulates in the fridges of consumers who bought too much, so it ends up in the bin.

Worldwide, a third of all food produced is wasted, a quantity that corresponds to 1.3 billion tonnes each year (FAO, 2011). In Europe, this figure is 88 million tonnes: that is, 20% of all the food that is produced. This quantity, primarily generated in homes, corresponds to 173 kilos of wasted food per person per year (Stenmarck, 2016).

In Catalonia, according to a study carried out by the Catalan Waste Agency and the Universitat Autònoma de Barcelona, in 2010 a total of 262,471 tonnes of food were wasted jointly by households, the hospitality trade, catering companies, retail grocery outlets and government agencies (without taking into account the losses incurred in wholesale distribution, the food transformation industry or on agriculture and livestock farms), which corresponds to 35 kg per person per year. This figure is equivalent to throwing out food that could sustain the whole of Catalonia for 25.5 days or that would feed more than 500,000 people for one year (ARC, 2011). The disparity between figures from the European Union (that indicate 173 kg of food are wasted per person per year) and from Catalonia (calculating this waste to be 35 kg) lies principally in the methodology used to obtain the data.

The European study counts the edible and non-edible parts of food as food waste, and also includes all the stages in the food chain. Conversely, the Catalan study only takes into account waste produced in households, in the restaurant industry, retail grocery outlets (supermarkets, markets and small businesses) and the demand from government agencies, but does not include waste generated from wholesale distribution, the food transformation industry or agricultural or livestock farms. In addition, it differentiates between the remains of edible foods (and non-separable parts) from those that are not. To properly compare figures it would therefore be necessary to establish a common definition of food waste and harmonise a calculation methodology.

Figure 5: Distribution of wasted food in the EU-28 at different stages in the food chain (2012).

Source: Stenmarck, 2016.

At all events, this waste involves an inefficient and costly use of resources that should be prevented. This wastage is not only the actual foods that are not made use of; it is also the waste of resources and the footprint generated during food production, whilst in turn, all the food waste then becomes refuse that the system needs to deal with.

Faced with this situation, the United Nations' 2030 Agenda sets out as one of the targets for its Sustainable Development Goals "to halve *per capita* food waste at the retail and consumer level and reduce food losses along production and supply chains, including post-harvest losses".

The Government of Catalonia also sets out, in the 2020 General Programme for Waste Prevention and the Management of Waste and Resources (PRECAT20), its goal to reduce food waste by 50% compared to 2010 levels in retail, hospitality, catering and domestic sectors, whilst proposing a target for the reduction of wastage in the primary and agrifood sectors before the end of 2018.

In Catalonia, the government and various bodies are working towards the reduction of waste. The work that the Food Bank carries out is worth a special mention, in recovering surplus food to distribute it amongst local organisations so it can reach the people who do not have the financial means to buy them. According to figures from the Barcelona Food Bank, almost half of the 17,914 tonnes of food (8,533 tonnes) that were distributed in 2016 came from the recovery of these surpluses (Food Bank Foundation, 2016).

Meanwhile, a draft law to take advantage of food surplus is currently at Parliament proposing to promote the re-use of food surpluses and urging the government to draw up a plan for Catalonia that will bolster re-use of food surplus.

In tackling the reduction of food waste, prevention must occupy a prime position, followed by re-use, which must be properly planned so as not to miss opportunities: in the first place, re-use for human consumption, and if this is not possible, for animal consumption, followed by composting, energy recovery, and, last of all, elimination.

In the document *Possibilitats normatives i fiscals per prevenir el malbaratament alimentari a Catalunya* (Regulatory and fiscal opportunities to prevent food waste in Catalonia) (Mestre, 2017), the ENT Foundation sets out a series of proposals to prevent food waste, such as establishing payment systems penalising the generation of food waste that would permit the internalisation of environmental costs for its management as waste.

Raising public awareness is also important to prevent food waste, with habits such as buying only that which is needed or cooking in bulk to be eaten at a later date. However, when analysing the problem of food waste and in setting out measures to reduce it, it is necessary to take into account the entire food chain, and it is important not to confuse the point where a specific loss or waste occurs with its cause. Thus, some of the losses that take place in the retail sale and consumption stages may have their origin in the preparation or harvesting. An example of this are the factors that play a role in the consumer's attitude, such as the best-before date and the commercial practice of offering 2x1, which drives people to buy foods that later cannot be used.

Even so, if it is not possible to prevent the generation of food surplus, re-using these products so that they can once again serve as human food⁶⁰ is the most suitable alternative⁶¹.

But the fact that re-use as human food is recommended for these unpreventable surpluses does not mean that it should necessarily be destined for persons with financial problems. These two are considered separate situations and the fight against waste mustn't be bound to the distribution of food to persons who cannot afford to buy them.

Indeed, various social organisations propose tying the recovery of foods to avoid waste with the creation of decent employment and the promotion of social integration enterprises (as is now done with used clothing), which would guarantee a redistribution circuit of foods rescued from the standardised food system to that of these entities.

⁶⁰ This is one of the Commission's goals in its fight against food waste and for food safety, of which various organisations and the Government of Catalonia are members, through the Public Health Agency of Catalonia and the Catalan Food Safety Agency.

⁶¹ The Government of Catalonia has published the *Guia de pràctiques correctes d'higiene per a l'aprofitament segur del menjar en els sectors de la restauració i comerç minorista*, in order to ensure that edible food surpluses that the restaurant industry and retail establishments cannot sell reach people who will benefit from them, through social organisations, in the best safety conditions (ASPCAT, 2013).

Recommendations

1. Measure, in an efficient and comprehensive way, the degree of waste that is produced at each stage in the food chain using a widely agreed upon calculation methodology.
2. Raise public awareness of the problem of food waste and its impact, especially among the economic and social actors maximally responsible for current waste levels and, above all, among younger generations, who hold the greatest potential for changing behaviour with regard to this problem.
3. Outline a framework of food quality and hygiene standards that would facilitate the donation of foods without putting their safety at risk.
4. Establish payment systems for the generation of food waste that would permit the internalisation of environmental costs for its management and encourage prevention.
5. Set out tax incentives for social innovation projects that participate in the reduction of food waste.
6. Provide tools so that any companies with food surpluses have the necessary incentives to transfer them to another user as human food and that, whatever the case, they are used in accordance with the food waste management priority.
7. Promote re-use of foods through the creation of decent employment and the promotion of social integration enterprises that guarantee a circuit that redistributes food recovered from the standardised food system to these organisations.
8. Organise a cross-sector round table discussion that includes all actors from the food chain and the organisations in this sector to set out a comprehensive strategy on the reduction of food waste through the entire production, commercialisation and final consumption food chain.

3.2.3. Continue to maintain a high degree of food safety throughout the chain, from production to consumption

The WHO defines diseases transmitted by food as those that, with our current knowledge, can be attributed to a specific food owing to the presence of a foodborne hazard⁶². The concept refers to both illness and disease caused by biological agents and those caused by all kinds of toxins.

Food safety is the condition that guarantees these will not cause harm to a consumer if food is prepared and consumed in accordance with the use it is intended for. To guarantee this, a global and comprehensive approach to the entire food chain, from production to consumption, is necessary.

Ensuring food safety came to the forefront of all European policies after the food crisis caused by bovine spongiform encephalopathy at the end of the 1990s and, with less impact, after the

⁶² A food hazard is any biological, chemical or physical agent present in food or in animal feed, or any biological, chemical or physical condition of a food or animal feed that may have a harmful effect on health.

outbreak registered in Belgium through the contamination of chickens and eggs with dioxins from animal feed.

These events prompted the European Commission to publish the *White paper on food safety* and, a little later, Regulation (EC) 178/2002, of 28 January 2002, establishing the European Food Safety Authority and setting out procedures in food safety matters. This regulation is the legal framework on which all subsequent legislation in the human and animal food sector in Europe has been established, such as the group of regulations and directives that comprise the so-called “hygiene package”.

One important tool is the Rapid Alert System for Food and Feed (RASFF), a warning system across the European Union that enables information to be shared between member states, the European Commission, the European Food Safety Authority (EFSA), Norway, Liechtenstein, Iceland and Switzerland. This system ensures that urgent warnings are sent, received and responded to collectively and efficiently. Thanks to the RASFF, many food safety hazards have been avoided before causing harm to European consumers.

Another of the WHO's lines of work is food safety. It advises member states on food safety risk management, helps share information in cases of emergency on this issue and halt the distribution of contaminated foods between countries through the International Network of Food Safety Authorities (INFOSAN).

In 2001 in Spain, the Spanish Agency for Food Safety and Nutrition was set up, and in 2002, the Catalan Food Safety Agency was created. All these three agencies (European, Spanish and Catalan) have been designed to assess and communicate hazards related to the food chain, and also to provide advice on risk management and policy decision-making processes on this matter.

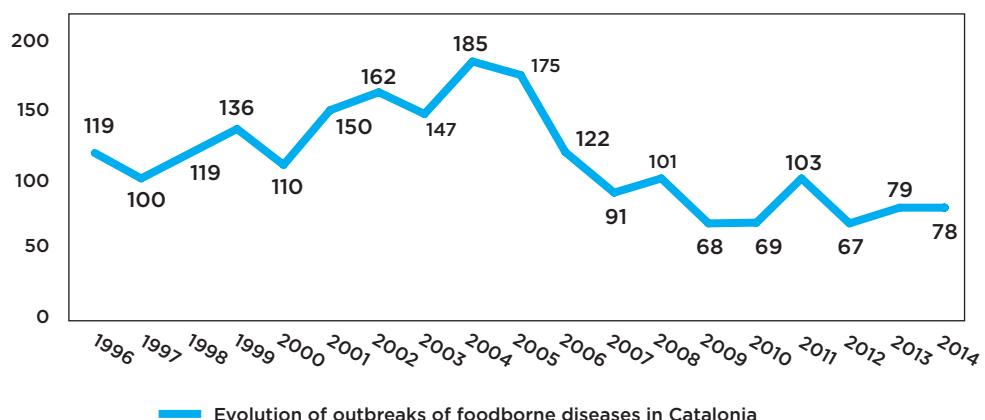
In November 2016, the Government of Catalonia approved the Food Safety Plan of Catalonia 2017-2021 (the third edition of this instrument), drawn up jointly with administrations, institutions, scientific societies, professionals and civil society.

In Catalonia, both the number of outbreaks of foodborne diseases and the rate per 1,000 inhabitants were at their highest in 2004. After that, they began to decrease considerably until 2007, when they stabilised.

The majority of these outbreaks are associated to the domestic environment and the catering industry. The principal causes are biological agents, primarily *Salmonella* and the Norwalk virus (norovirus). Mention should also be made of outbreaks through other agents striking sporadically but giving rise to serious health problems, such as outbreaks due to parasites such as *Trichinella* and *Anisakis*, and poisonous mushrooms.

Analyses of chemical pollutants show very high rates of conformity across practically all parameters and foods analysed, with only a few exceptions, such as the presence of cadmium in the sea snail, mercury in large fresh predator fish or polar compounds in frying oils (ASP-CAT, 2016b).

With regard to chemical residues in animals and food of animal origin, there is a research plan that seeks to control substances with an anabolic effect, non-authorised substances and vet-

Figure 6: Evolution of outbreaks of foodborne diseases in Catalonia (1996-2014).

Source: Catalan Public Health Agency, 2016b.

erinary drugs, as well as other substances such as pesticides, heavy metals, mycotoxins and environmental pollutants. Conformity levels are very high, at 99.92%. Non-conformity results were detected in 9 of the 12,649 samples examined (0.08%), 5 through antibacterials and 4 through heavy metals (ASPCAT, 2016c).

Finally, and in relation to the system set out to guarantee food safety in food chain activities (transformation and distribution), it should be mentioned that the rates of conformity concerning regulatory compliance are high; however, there is still room for improvement in the area of self-monitoring.

The situation of food safety in Catalonia is stable, with parameters comparable to the European average. This high degree of food safety at all stages in the chain must continue to be maintained, from production to consumption. In this regard, it is important to bear in mind the socioeconomic and environmental changes that occur and set out the necessary mechanisms to be able to continue guaranteeing that food will not cause any harm to consumers when faced with new situations, including:

- Adverse weather conditions such as a rise in temperature, changes in rainfall patterns and the increase in extreme phenomena. Similarly, new emerging biological threats owing to climate change and the decreasing availability of water need to be taken into account.
- The development of a circular economy, promoting an increase in recycling and the reduction of waste throughout the food chain.
- The growing complexity in global supply chains that are geographically dispersed and fragmented within a framework favouring free world trade.
- Alternative food chain systems (short circuits from the producer to the consumer), that are increasingly frequent.
- An increase in the use of functional foods.

- The development of new technologies in the food chain such as biotechnology, nanotechnology, GMOs and packaging, and emerging primary production technologies.
- A growingly aging population, with associated chronic conditions and greater sensitivity to foodborne illnesses (for example, listeriosis).

The elements that comprise the risk-analysis, evaluation, management and communication methodology are key tools for providing a response to new challenges and scenarios.

In Catalonia, a system of risk assessment must be maintained as a scientific basis for public policy on food safety. Management and communication of food hazards must continue to be based on an independent and appropriate risk assessment, with the objective of determining the problems and seeking potential solutions from a scientific approach that takes into account the opinions of international risk assessment agencies with the necessary adaptations to the particularities of Catalonia.

“Food culture” should be promoted (knowledge about how food is produced, safety tips, quality and nutritional information, etc.) in our present-day society so that the population is empowered to maintain a safe and healthy diet, eschewing sensationalist news of threats related to foods and food fads with no cultural or scientific basis.

It is important to incorporate knowledge about food and dietary and safety habits into primary and secondary education. But for children and adolescents to leave these stages of education with an internalised and practical understanding that they can make use of throughout their adult lives, education from closer culinary experiences is especially important, such as in school canteens and in the family.

The strategy, principles and criteria set out in the Food Safety Plan of Catalonia must be maintained in order to guarantee a food safety system that is integrated, modern, effective and robust, that guarantees the correct assessment, management and communication of hazards, and that offers the necessary guarantees to the population, whilst also being a supporting instrument for the prestige and international projection of agrifood products from Catalonia.

Recommendations

1. Continue to apply and improve the existing mechanisms in matters of strategic planning, assessment, management and the communication of food safety hazards.
2. Adapt established mechanisms to guarantee food safety taking into account new socioeconomic and globalising trends and environmental changes.
3. Facilitate compliance with food safety regulations in small establishments, guaranteeing food safety conditions whilst boosting its associated opportunities.
4. Promote awareness, amongst the population, of bad practices in food preservation as a source of unsafe food and of waste.

3.2.4. Ensure that everyone has the necessary resources for nutritious food

According to the *Informe sobre la malnutrició infantil a Catalunya* (Catalan Ombudsman, 2013), acute or chronic situations of childhood undernourishment due to socioeconomic reasons were not identified in Catalonia as a problem, even though they are sporadically observed.

Therefore, even though it can be considered that in Catalonia there is no structural problem of malnutrition, there are families that have difficulties in accessing healthy, nutritious and sufficient food. In fact, in 2015, 126,000 people (1.7% of the population) were not able to make a meal with meat or fish at least once every two days for financial reasons⁶³.

The economic crisis in recent years has increased and aggravated the number of situations where people have problems accessing adequate food. Figures from the Barcelona Food Bank reflect this: whereas in 2008 it assisted 58,381 people and distributed 8,245 tonnes of food, in 2016 it assisted 137,156 people and distributed 17,914 tonnes of food (Food Bank Foundation, 2016).

The Spanish Red Cross also warned that in 2015, 9 out of every 10 families benefitting from projects to combat poverty suffered some kind of food insecurity (Red Cross Vulnerability Observatory in Catalonia 2015) and highlighted the fact that food insecurity is directly proportional to families' income, to the sizes of family groups and also to the origin of the foods consumed in the home.

According to this organisation, severe food insecurity affects 25% of households without any form of income and decreases notably in families with incomes over EUR 700 per month. Similarly, the percentage of food insecurity increases 10 points in families where food comes primarily from products donated by social organisations or from help from family or other close people who can afford to cater for them.

According to report *Fam oculta a Catalunya, un obstacle en la igualtat d'oportunitats* (Bermejo, 2017), the intake of certain micronutrients (for example, vitamins A, D and E, iron, zinc and folic acid) was observed to be notably deficient in various nutritional studies carried out between 1992 and 2014 with the participation of the Catalan population. The report also warns of the difficulties of the population with a low socioeconomic level to follow a Mediterranean diet that includes a regular intake of fresh produce, fruit and vegetables in sufficient measure and variety.

Nowadays, to guarantee the right to adequate food the direct supplying carried out by organisations such as the Food Bank, third sector organisations and government agencies is paramount. Nevertheless, these palliative measures should only be used to tackle occasional situations, as lack of food for socioeconomic reasons must not be allowed to become a structural problem. It should be ensured that families have food security guaranteed through their own means and, therefore, do not have to turn to food distribution services to obtain their basic food supply.

⁶³ STATISTICAL INSTITUTE OF CATALUNYA (IDESCAT). «Població per nombre de privacions materials per sexe i edat. Catalunya, 2015». Online: <<https://www.idescat.cat/pub/?id=ecv&n=7647&t=201500&lang=en>> [DOA: 18 January 2018].

Also, a study by Càritas Diocesana in Barcelona, *Fràgils, l'alimentació com a dret de ciutadania* reports that, given that access to foods is quite often a problem of disposable income, work should be done so that people in situations of poverty have a minimum of financial income to enable them to access a standardised network that, in turn, would benefit the local economy. Help through in-kind food distribution, the study points out, should be temporary, when people do not have any income available from work or welfare benefits.

In this regard, the development of social integration enterprises linked to the recovery of foods that would otherwise be wasted can help meet these dietary and nutritional needs of people in an inclusive way, regardless of their needs or social situation.

These enterprises simultaneously promote environmental sustainability by reducing food wastage and the generation of waste, while creating jobs for people at risk of social exclusion or exclusion from the labour market (enabling them to return to the 'normal' labour market), raising awareness across society of food wastage and the sustainability of the current production system, and facilitating economic sustainability through their own means in order to guarantee the future continuity of the project.

Càritas Diocesana also points out that the existing food aid projects should be reconceptualised so that they take into account the cultural dimension of the population and are more inclusive, thereby boosting the empowerment of people. The projects to aid basic needs should be open to all society (not only designed for use by people in trouble) and based on solidarity, reciprocity and promotion of social cohesion.

Recommendations

1. Promote stable employment in a labour market with decent wages and measures for social benefits (pensions, unemployment benefits, etc.) that will bring about a decrease in poverty levels.
2. Promote food education amongst adults and children and the bonus of the Mediterranean diet, through schools, primary care centres, social services and organisations, and others.
3. Improve cooking skills to ensure a balanced diet at a moderate cost, which in many cases corresponds to the tradition of Catalonia.
4. Facilitate measures for the reconciliation of work and family life, along with the equal division of domestic chores within the family that will allow time to buy nutritional foods and prepare them.
5. Improve awareness of the phenomenon of hidden hunger in Catalonia.
6. Gradually replace the in-kind provision of foods with measures such as welfare benefits, making sales outlets sell products that are about to pass their sell-by date or that have some defect at lower prices (that could be used both by people who are in a situation of poverty and those who are not) and the development of social integration enterprises.

4. CONCLUSIONS

Guaranteeing food to the population has been and continues to be of paramount importance to ensure their wellbeing. For this reason, the majority of international institutions and governments around the world focus keenly on this. Nevertheless, food insecurity still affects millions of people: in 2015, 15% of the world population (815 million people) were suffering from malnutrition (FAO, 2017). Conversely, 13% (600 million adults) were obese.

The world population continues to grow and latest predictions by the United Nations signal that by 2050 it will reach 10,000 million inhabitants. This rise in population numbers, together with dietary changes already being observed in developing countries, suggests an increase of 60% in food demand worldwide (FAO, 2012). This increase, the pressure that this demand may cause on natural resources, which are ever scarcer, and the effects of climate change have led many international institutions to warn about the risk of a global food crisis.

It is within this context that the *Feeding on Future* report is framed, where the CADS identifies the challenges and proposes a series of recommendations to guarantee food security in Catalonia for the mid and the long term. This reflection is added to the initiatives that are being carried out by other European countries such as the UK (with the Global Food Security programme⁶⁴) and Holland, where in 2016 the Netherlands Scientific Council for Government Policy presented the *Towards a Food Policy* report (De Vries, 2014).

It should also be mentioned that the European Environment Agency has recently presented the report *Food in a green light - a systems approach to sustainable food* (EEA, 2017), where the system of food production, consumption and trade is analysed, highlighting its relation to health and the environment.

In this report, the CADS analyses two key pillars of the food system: (1) **food supply (availability and stability)** and (2) **food consumption (use and access)**. After analysing these two elements, it concludes the following:

⁶⁴ GLOBAL Food SECURITY PROGRAMME. UK. Online: <<https://www.foodsecurity.ac.uk/>> [DOA: 17 January 2018].

4.1. Food supply in a changing global environment

4.1.1. Maintenance of the productive base

- ❖ There are no reliable data on the rate of self-sufficiency in Catalonia to be able to provide a good estimate.
- ❖ A gradual and significant loss of agricultural land has been observed, as well as a concentration of holdings and farms, an increase in their size (situations that in general terms lead to a rise in their efficiency and competitiveness) and a process of aging throughout the sector owing to the lack of generational replacement.
- ❖ Catalonia has productive resources that require a system of management that is befitting of their strategic importance. Land, water, an active and enterprising primary sector, training and leading research centres, plus a modern and competitive food transformation sector, are key to maintaining food production and reducing dependence on international markets that are ever more exposed to increases in the global demand for foods and to global environmental change.
- ❖ Catalonia's productive capacity enables it to engage in commercial transactions that offer the consumer a broad range of food products that generate economic activity and jobs and permit the Catalan agricultural sector to continue being an important actor across several world agricultural markets.

4.1.2. A sustainable food system

- ❖ The proper functioning of ecosystems guarantees the preservation of several functions that are essential for food production. Amongst these ecosystem services are pollination, the supply of fish and other marine products and nutrient recycling.
- ❖ In a context of finite resources, the need is plain to manage productive resources strategically, with a holistic and long-term vision, applying the principle of precaution and the criteria of a circular economy.
- ❖ Competition for agricultural land with more lucrative, short-term financial activities, the scarcity of water made worse by climate change, the loss of biodiversity, the over-exploitation of fishing stocks, livestock production that is increasingly detached from the land, plus other factors, all these reinforce the need to make changes in the current production system.
- ❖ Water is a crucial factor in food production, and in a climate context like ours the importance of adopting highly-efficient practices and irrigation techniques is apparent, along with the use of non-conventional water sources such as, for example, regenerated water.
- ❖ As for nutrients, the report points out the need to make improvements to benefit most when using them, and also to make use of own means to feed livestock (especially pastureland). It also warns about the need to prepare in advance for a phosphorous shortage that we may suffer in coming decades.
- ❖ Energy consumption is a key factor in all stages of the food chain, in both production and the transformation and consumption of foodstuffs. In this context, the increase in energy efficiency and the use of renewable energy are crucial for a more sustainable food system. We must be prepared for a new oil shortage crisis and inflated prices.

4.1.3. A food system resilient to global change

- ❖ In a globalised world, with a growing consumption of energy and natural resources, and in the face of climate change, major environmental disturbances may arise that will put the stability of the food system in Catalonia at risk.
- ❖ Amongst these disturbances are pests and other diseases, such as the outbreak of avian influenza detected at the start of 2017 in Catalonia.
- ❖ Bacterial growing resistance to antimicrobial agents, owing to their abusive use, is generating increasing alarm.
- ❖ Potential geopolitical changes in key countries that supply us foods or that we trade our products with may significantly affect the balance of the food system in Catalonia. Market diversification and production planning are factors to bear in mind to guarantee the system's resilience.

4.2. Food consumption

4.2.1. A healthy diet

- ❖ A balanced and healthy diet is the basis for good health and, furthermore, is a characteristic of the Mediterranean diet, which includes plenty of foods of plant origin, with small portions of fish, lean meats and eggs.
- ❖ Since the 1960s, homes in Catalonia have undergone a change in eating habits, increasingly consuming more products of animal origin, vegetable oils and sugars. The consequence of this new diet, together with a sedentary life style, is a high incidence of overweight and obesity, one of the risk factors for non-communicable diseases, according to a WHO warning.
- ❖ The culinary culture and gastronomic heritage of Catalonia, based on the Mediterranean diet, and the reconciliation of work and family life so that families can have at least one meal together a day contributes to the adoption of healthier eating habits, with diets containing plenty of vegetables, pulses and fruits.
- ❖ The use of tax instruments that penalise least healthy foods, together with sound education and information for the consumer, are effective mechanisms to promote healthier consumption habits.
- ❖ Safeguarding the hygiene of food throughout the food chain is essential to guarantee food security for the Catalan population.
- ❖ With regard to the production system, there are two key issues that are directly related to health in humans: zoonotic diseases and resistance to antimicrobial drugs. Herds of livestock that continually increase in numbers across the world, with intensive production systems that are highly dependent on drugs and globalised trade flows, portray a system that is highly fragile if measures are not taken in different areas.

4.2.2. Responsible food consumption

- ❖ Worldwide, a third of all food produced is wasted. In 2010 in Catalonia, together households, the catering industry and retail shops, threw a total of 262,471 tonnes of food away, the equivalent amount that could sustain the whole of Catalonia for 25.5 days or that would feed 500,000 people for a year.
- ❖ In a world where 815 million people suffer from malnutrition (FAO, 2017), this waste of unused resources is unacceptable for environmental, ethical and humanitarian reasons.
- ❖ Catalonia is working to reduce food wastage, and the General Programme for Waste Prevention and the Management of Waste and Resources (PRECAT) includes the goal set out in the United Nations 2030 Agenda to halve *per capita* food waste both in the retail sales and the final consumption stages. Even so, there is still work to be done.
- ❖ Disseminating information on the impact of food waste amongst sectors of the population and implementing mechanisms imposing economic penalties for the generation of food waste that would promote its prevention are essential to eradicate food waste. Similarly, the potential impact of food recovery systems designed to guarantee a short redistribution circuit is underlined, both in terms of the creation of decent employment and the creation of social integration enterprises.
- ❖ The importance of adopting consumer habits that help maintain the productive base in Catalonia and that provide support to systems to obtain more sustainable foods is also remarked.

4.2.3. A food system universally accessible

- ❖ Food is a right included in the Universal Declaration of Human Rights of 1948 and, even though progress has been made in achieving this worldwide, there is still a long road to go, as no-one can be left behind, especially in developing countries.
- ❖ Even though Catalonia cannot be said to have a structural problem of undernourishment, there are families that have difficulties obtaining healthy, nutritious and sufficient food. The reasons are primarily, but not exclusively, financial and all the necessary instruments should be developed so that access to a good diet is universal.
- ❖ The job of providing foods that organisations such as the Food Bank, third sector organisations and government agencies carry out is still highly necessary to guarantee the right to adequate food for certain social groups in Catalonia. These actions, of a palliative nature, allow for the resolution of sporadic situations, but do not allow for the structural problem to be addressed, as is lack of food for socioeconomic reasons.
- ❖ Food education, the promotion of cooking skills and the setting of measures for the reconciliation of work and family life help families have access to healthy food at a moderate cost.

4.3. Governance of the food system

- ❖ Catalonia has various policies and instruments relating to the food supply system and several relating to consumption. It is true that on some key issues, such as the Common Agricultural Policy and the Common Fisheries Policy, the directives and measures are specified by other agencies. However, even in these cases, there is room to manoeuvre and a certain capacity of influence when choosing which should be used.
- ❖ Catalonia has the power to define policies and measures on many issues. In fact, progress is being made in many of these, such as actions to promote organic agriculture, improvements in irrigation efficiency, the recent creation of a tax on bottled soft drinks, and the set of measures coordinated by the public administration and organisations to aid families in trouble to access healthy and sufficient food, to list but a few.
- ❖ The food supply system influences consumption patterns, and therefore also health. In the same way, the educational system may stimulate farming careers and healthy dietary habits; the waste management system may impact on the agricultural production model, and, in turn, on climate change. This all demonstrates, once more, the importance of the integration of all policies bearing on food security.
- ❖ The integration of rural and urban development policies is crucial in order to progress towards a food system as described in this report. The countryside, less populated and the main producer of food, needs to participate in the debate and establish cooperation with the urban world, often unaware of the origin of food but which, through its consumer choices, impacts back to a large extent.
- ❖ Around the world, initiatives of primary production can be observed in cities, such as urban market gardens (of public or private ownership) or crops on buildings themselves (whether on terraces or façades), which can contribute, amongst other purposes, to maintaining a bond between the urban population and agricultural activity. Similarly, cooperatives for the consumption of organic foods are reinforcing this relationship and make differentiated agricultural projects viable.

4.4. Research, the key to the food of the future

- ❖ In this strategy for the sustainability of the food system, the challenges that the CADS raises in this report require solutions of basic research and technological innovation that also have a social dimension. Research and innovation must be the driving forces to be able to tackle the challenges successfully.
- ❖ Catalonia has first-rate research centres and universities in agrifood matters. The Institute of Agrifood Research and Technology (IRTA) is key, as are all the universities in Catalonia, each one with its own area of expertise and a broad perspective on the food system.

5. MAIN RECOMMENDATIONS

This report draws together multiple recommendations grouped around two key pillars of the food system: (1) food supply (availability and stability) and (2) food consumption (use and access). However, the CADS considers it appropriate to revisit all of them, taking into account the conclusions noted in the previous section and presenting a summarised list of strategic recommendations, outlining the direction of the proposals by the Council in [Feeding on Future](#).

The CADS believes that to guarantee food security in the mid and the long term it is necessary to:

1) Maintain the production capacity of the food system

To make this possible, the CADS recommends:

- ❖ To improve the organisational capacity of the primary sector so as to increase its competitiveness and strengthen its position in the agrifood chain, ensuring that unfair imbalances in pricing and in distribution of margins do not occur.
- ❖ To protect land for agricultural use (especially the most fertile) and improve it in as far as it is a strategic element to guarantee food for the population. Return wastelands that have most productive quality to agricultural activity.
- ❖ To provide the rural environment with the necessary services to pursue professional projects and enjoy an adequate standard of living, facilitating to new producers access to the land and supporting the incorporation of women into running agricultural holdings and farms.
- ❖ To boost training, knowledge transfer and skills amongst agricultural professionals.
- ❖ To promote the output of products with added value and synergies with other activities such as tourism and gastronomy that will permit profitability in agricultural activity and so keep the agricultural working population in the region.

2) Progress towards more sustainable production methods

To make this possible, the CADS recommends:

- ❖ To drive towards the most efficient use of energy and the consumption of renewable energy in the agrifood sector.
- ❖ To promote agricultural practices that improve soil fertility, that are more efficient in the use of fertilisers and that reduce the use of pesticides and herbicides, especially those that are most toxic to humans and animals (such a pollinators).

- ❖ To preserve a landscape mosaic that encourages agrosystem functionality and the preservation of ecosystem services, many of which are also necessary for the production of foods.
- ❖ To conserve Catalonia's phytogenetic resources, through the identification and classification of local varieties and their conservation, use and access by farmers.
- ❖ To support the sustainable management of fishing resources and promote the development of non-intensive aquaculture with low environmental impact.

3) Strengthen resilience to global change

To make this possible, the CADS recommends:

- ❖ To improve knowledge on the evolution of climate change and its impact on the agriculture and livestock farming and fishing sector, and drive specific and effective mitigation and adaptation strategies.
- ❖ To devise an integrated management of water resources and achieve sustainable forestry management in river basins to reduce losses through evapotranspiration.
- ❖ To increase efficiency in irrigation, encouraging crops with more added value and lower water consumption, plus the use of non-conventional water resources such as regenerated waters.
- ❖ To develop a plan to monitor the use of antimicrobials and a national plan on antimicrobial resistance to reduce use of drugs and rethink the animal production system to minimise risk of illness.
- ❖ To create reference laboratories assigned the mission to identify emerging plant and animal pests and diseases, as well as invasive species that could put food production in Catalonia at risk.

4) Encourage healthier diets consistent with the traditional Mediterranean diet of Catalonia

To make this possible, the CADS recommends:

- ❖ To promote the culinary culture and gastronomic heritage of Catalonia, based on the Mediterranean diet, heightening consumption of vegetables, pulses and fruits and moderating consumption of meat.
- ❖ To promote food education amongst children, young people and adults and ensure that advertising and labelling of foods is accurate and verifiable and does not lead the consumer to choose foods for the wrong reasons.
- ❖ To promote food purchasing habits that are less intensive in the use of energy and other natural resources, and facilitate the reconciliation of work and family life so that family members can shop and cook and have at least one meal together a day.
- ❖ To study the application of fiscal measures that tax least healthy products to reduce their consumption.
- ❖ To encourage public procurement to supply public catering facilities and canteens serving healthy food to generate good habits, and collaborate in the structuring of a system of production, transformation and distribution of foods that contributes to this.

5) Reduce food waste to have more food available for everyone, avoiding unnecessary use of resources and reducing waste generation

To make this possible, the CADS recommends:

- ❖ To have reliable measures in place on the amount of waste produced at each stage in the food chain, in accordance with a definition and calculation methodology that has been scientifically tested.
- ❖ To disseminate amongst the public information on food waste and its impacts, especially amongst the economic and social actors with higher responsibility in current wastage levels and amongst younger generations.
- ❖ To encourage food recovery through the promotion of social integration enterprises that guarantee a redistribution circuit for surplus foods and create decent jobs.
- ❖ To encourage companies that have food surpluses to transfer these foods to other users when apt for human consumption.
- ❖ To incentivise shops to sell, at reduced prices, quality food products that are suitable for human consumption but about to be withdrawn from the market owing to the imminent sell-by date.

6) Ensure that everyone can access food in sufficient quantity and quality

To make this possible, the CADS recommends:

- ❖ To encourage cooking habits and good practices in food preservation so that the entire population can have a balanced diet at a moderate and affordable cost.
- ❖ To gradually substitute distribution of in-kind foods to people on social benefits for measures that will permit their full participation as consumers in a standardised food system and an improvement in welfare benefits.

7) Establish an integrated food strategy

For everything set out in the report, the CADS recommends:

- ❖ To define and calculate the exact rate of food self-sufficiency in Catalonia.
- ❖ To press forward with the drafting and approval of the National Agreement for Food Policy, an instrument already announced by the Government of Catalonia to attain a productive, sustainable, resilient, healthy and responsible food system universally accessible. The agreement must contain an overall vision, strategic goals and priority action lines on the future of food shared by the different players in the Catalan food system.
- ❖ To develop the National Agreement for Food Policy using a strategy cross-cutting between ministries and sectors, with well-defined and measurable goals and lines of action.
- ❖ Within the food strategy framework, to draw up a contingency plan to address one-off food emergencies and a plan to diversify the variety of products intended for export to increase the resilience of the system in the face of potential production problems, changes in consumption patterns or geopolitical issues in destination countries.

- ❖ To bolster the work of the Catalan Food Council⁶⁵ as a driving and dynamic force behind the agreement and the strategy it develops.

8) Encourage research and innovation practices within the sector

To make this possible, the CADS recommends:

- ❖ To boost research into production techniques that most respect the environment, and promote a coordinated system of research in this field that leads research and experimentation and is a benchmark in technical and policy-making decisions.
- ❖ To promote research and innovation in precision agriculture and livestock breeding and information technologies to ensure optimum resource management, and also tools for knowledge transfer and advice to the production sector to improve efficiency in the management of inputs (water, energy, fertilisers).
- ❖ To drive innovation to introduce new products onto the market in accordance with consumer changing preferences (new packaging formats, ready-made meals, fourth range, functional foods, etc.) incorporating sustainability criteria.
- ❖ With the food strategy at the core, it is suggested that agricultural and food research agencies define a research framework that will permit progress in all the proposed areas to find solutions for Catalonia and become pioneers in innovation (technology, economic and social) that may be useful and catching for many other regions of the world in need to face similar challenges.

⁶⁵ The Catalan Food Council was created on 13 September 2017, as a forum for analysis, debate and proposals on matters related to agrifood policies in Catalonia, and as an agrifood observatory. In accordance with its governing regulations, it must develop proposals designed to: (1) continue promoting food quality and security; (2) promote Catalan food products, including those with differentiated quality, those locally produced and organic products; (3) facilitate harmony, transparency and positive synergies throughout the entire food chain; (4) enhance sustainability, social responsibility and the fight against food waste, and (5) promote the Mediterranean diet and encourage healthy food habits across the population.

6. REFERENCES

- ACA = CATALAN WATER AGENCY (2014). *Pla de gestió del districte de conca fluvial de Catalunya 2009-2015. Annex XI. Estimació i prognosi de la demanda d'aigua*. Barcelona: ACA. Online: <<http://aca.gencat.cat/ca/plans-i-programes/pla-de-gestio/1er-cicle-de-planificacio-2009-2015/>> [DOA: 16 January 2018].
- (2017). *Pla de gestió del districte de conca fluvial de Catalunya 2016-2021*. Barcelona: ACA. Online: <<http://aca.gencat.cat/ca/plans-i-programes/pla-de-gestio/2on-cicle-de-planificacio-2016-2021/>> [DOA: 20 February 2018].
- ALEXANDRATOS, N.; BRUINSMA, J. (2012). *World agriculture towards 2030/2050: The 2012 revision*. ESA Working Paper No. 12-03. Rome: FAO. Online: <<http://www.fao.org/docrep/016/ap106e/ap106e.pdf>> [DOA: 11 January 2018].
- ARC = WASTE AGENCY OF CATALONIA; UAB = UNIVERSITAT AUTÒNOMA DE BARCELONA (2011). *Diagnosi del malbaratament alimentari a Catalunya*. Barcelona: ARC; UAB. Online: <http://residus.gencat.cat/web/.content/home/ambits_dactuacio/prevencio/malbaratament_alimentari/publicacions_especifiques/resum_executiu.pdf> [DOA: 16 January 2018].
- ASPCAT = CATALAN PUBLIC HEALTH AGENCY (2013). *Guia de pràctiques correctes d'higiene per a l'aprofitament segur del menjar en els sectors de la restauració i comerç minorista*. Barcelona: ASPCAT. Online: <http://acsagencat.cat/web/.content/Documents/eines_i_recursos/Guia-aprofitament-menjar-restauracio-comerc-minorista.pdf> [DOA: 18 January 2018].
- (2016a). *Informe de les zoonosis transmeses pels aliments i de la resistència antimicrobiana a Catalunya 2011-2013*. Barcelona: ASPCAT. Online: <http://acsagencat.cat/web/.content/Documents/eines_i_recursos/informe_barometre_seg_ali_cat.pdf> [DOA: 17 January 2018].
- (2016b). *Memòria anual sobre la situació de la seguretat alimentària a Catalunya, 2014*. Barcelona: ASPCAT. Online: <http://acsagencat.cat/web/.content/Publicacio/eines_i_recursos/Publicacions/Memories_de_la_situacio_de_la_seguretat_alimentaria/2014/memoria_2014/Memoria-anual-sobre-la-situacio-de-la-seguretat-alimentaria_2014.pdf> [DOA: 18 January 2018].
- (2016c). *Investigació de residus en aliments d'origen animal. Informe de resultats de 2014*. Barcelona: ASPCAT. Online: <https://scientiasalut.gencat.cat/bitstream/handle/11351/2743/investigacio_residus_aliments_animals_informe_resultats_2014.pdf?sequence=1> [DOA: 18 January 2018].
- BABOT, D. et al. (2015). *Informe anual del sector porcí 2015*. Lleida: Edicions de la Universitat de Lleida. Online: <http://agricultura.gencat.cat/web/.content/de_departament/de02_>

estadistiques_observatoris/08_observatoris_sectorials/04_observatori_porci/informes_anuals/fitxers_estatics/CAT_Informe-sector-porci-2015_20160814.pdf [DOA: 15 January 2018].

BASTIEN, D. (2011). «El pastoreo mejora el contenido en ácidos grasos poliinsaturados omega 3 de la carne en el ganado vacuno». *Albéitar, Portal Veterinaria* [Zaragoza: Grupo Asís Biomedia]. Online: <<http://albeitar.portalveterinaria.com/noticia/9137/articulos-nutricion-archivo/el-pastoreo-mejora-el-contenido-en-acidos-grasos-poliinsaturados-omega-3-de-la-carne-en-el-ganado-vacuno.html>> [DOA: 15 January 2018].

BERMEJO, S.; CRESPO, T. (2017). *Fam oculta a Catalunya, un obstacle en la igualtat d'oportunitats*. Barcelona: Entitats Catalanes d'Acció Social: Universitat Politècnica de Catalunya. Online: <http://acciosocial.org/wp-content/uploads/2017/05/FamOcultaCat_informe_ECAS-UPC_2017.pdf> [DOA: 17 January 2018].

BOSCH, J. et al. (2013). *Present i futur de l'alimentació a Catalunya. Estudi prospectiu*. Lleida: Fundació del Món Rural. Online: <http://www.fmr.cat/sites/default/files/adjunts-fons/estudi_alimentacio_complet_130315_bo.pdf> [DOA: 15 January 2018].

BOUVARD, V. et al. (2015). «Carcinogenicity of consumption of red and processed meat». *The Lancet Oncology* [Amsterdam: Elsevier], vol. 16, issue. 16. doi: 10.1016/S1470-2045(15)00444-1 [DOA: 18 January 2018].

CALBÓ, J. et al. (2016). «Projeccions climàtiques i escenaris de futur». MARTÍN VIDÉ, J. (coord.). *Tercer informe sobre el canvi climàtic a Catalunya*. Barcelona: Government of Catalonia and the Institute for Catalan Studies (IEC). Online: <<http://cads.gencat.cat/web/content/Documents/Publicacions/tercer-informe-sobre-canvi-climatic-catalunya/1part/5-Projeccions-climatiques-i-escenaris-de-futur.pdf>> [DOA: 15 January 2018].

CATALAN OMBUDSMAN (2013). *Informe sobre la malnutrició infantil a Catalunya. Agost 2013*. Barcelona: Catalan Ombudsman. Online: <<http://www.sindic.cat/site/unitFiles/3506/Informe%20malnutricio%20infantil%20catala.pdf>> [DOA: 18 January 2018].

DALEY, C. A. et al. (2010). «A review of fatty acid profiles and antioxidant content in grass-fed and grain-fed beef». *Nutrition Journal* [London: BMC], vol. 9:10. doi: 10.1186/1475-2891-9-10 [DOA: 15 January 2018].

DE VRIES, G. et al. (2014). *Towards a Food Policy*. The Hague: The Netherlands Scientific Council for Government Policy. Online: <<https://english.wrr.nl/publications/reports/2016/12/13/towards-a-food-policy>> [DOA: 17 January 2018].

UK DEPARTMENT OF HEALTH et al. (2016). *Guide to creating a front of pack (FoP) nutrition label for pre-packed products sold through retail outlets*. London: UK Department of Health. Online: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/566251/FoP_Nutrition_labelling_UK_guidance.pdf> [DOA: 2 March 2018]

DINSA, G. D. et al. «Obesity and socioeconomic status in developing countries: a systematic review». *Obesity Reviews* (2000-) [[S. I.]: Wiley], 13 (11), p. 1067-1079. Online: <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3798095>> [DOA: 11 January 2018].

ECDC = EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL et al. (2015). «ECDC/EFSA/EMA first joint report on the integrated analysis of the consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from humans and foodproducing animals». *EFSA*

Journal [Stockholm: ECDC; Parma: EFSA; London: EMA], vol. 13, issue. 1. 114 p. doi: 10.2903/j.efsa.2015.4006 [DOA: 15 January 2018].

EEA = EUROPEAN ENVIRONMENT AGENCY (2017). *Food in a green light. A systems approach to sustainable food*. Luxembourg: Publications Office of the European Union. doi: 10.2800/884986 [DOA: 15 January 2018].

FAO = FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS (2011). *Global food losses and food waste: Extent, causes and prevention*. Rome: FAO. Online: <<http://www.fao.org/docrep/014/mb060e/mb060e00.pdf>> [DOA: 11 January 2018].

— (2015). *Food self-sufficiency and international trade: a false dichotomy?: The State of Agricultural Commodity Markets 2015-2016*. Rome: FAO. Online: <<http://www.fao.org/3/a-i5222e.pdf>> [DOA: 15 January 2018].

— (2016). *The State of World Fisheries and Aquaculture 2016. Contributing to Food Security and Nutrition for All*. Rome: FAO. Online: <<http://www.fao.org/3/a-i5555e.pdf>> [DOA: 15 January 2018].

FAO = FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS *et al.* (2013). *The State of Food Insecurity in the World 2013. The multiple dimensions of food security*. Rome: FAO. Online: <<http://www.fao.org/docrep/018/i3434e/i3434e.pdf>> [DOA: 15 January 2018].

FAO = FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS *et al.* (2017). *The state of food security and nutrition in the world 2017. Building resilience for peace and food security*. Rome: FAO. Online: <<http://www.fao.org/3/a-i7695e.pdf>> [DOA: 11 January 2018].

FOOD BANK FOUNDATION (2016). *Memòria 2016 del Banc dels Aliments de Barcelona*. Barcelona: Food Bank Foundation. Online: <<https://www.bancdelsaliments.org/ca/gestio-transparent/>> [DOA: 18 January 2018].

GARCIA, O. *et al.* (2016). *Enquesta de salut de Catalunya 2015*. Barcelona: Government of Catalonia. Online: <http://salutweb.gencat.cat/ca/el_departament/estadistiques_sanitaries/enqueses/esca/resultats_enquesta_salut_catalunya/> [DOA: 18 January 2018].

GOVERNMENT OF CATALONIA. MINISTRY FOR FOREIGN ACTION, INSTITUTIONAL RELATIONS AND TRANSPARENCY. ADVISORY COUNCIL FOR SUSTAINABLE DEVELOPMENT (CADS) (2015). *Informe 3/2015, sobre el Pla de gestió del districte de conca fluvial de Catalunya i el seu programa de mesures*. Barcelona: Government of Catalonia. Online: <http://cads.gencat.cat/web/.content/Documents/Informes/Informe-3_2015-sobre-el-Pla-de-gestio-del-districte-de-conca-fluvial-de-Catalunya-i-el-seu-Programa-de-mesures.pdf> [DOA: 16 January 2018].

GOVERNMENT OF CATALONIA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES AND FOOD (DARP) (2012). *Pla de regadius de Catalunya 2008-2020 (text refós)*. Barcelona: Government of Catalonia. Online: <http://agricultura.gencat.cat/ca/ambits/desenvolupament-rural/infraestructures-agrarries/dar_regadius/dar_pla_regadius_2008_2020/> [DOA: 16 January 2018].

GOVERNMENT OF CATALONIA. MINISTRY OF AGRICULTURE, LIVESTOCK, FISHERIES, FOOD AND ENVIRONMENT. OBSERVATORI DEL PORCI (2011). *Anàlisi econòmica del procés d'aprovisionament i producció de pinso en el sector porcí*. Barcelona: Government of Catalonia. Online: <http://agricultura.gencat.cat/web/.content/de_departament/de02_estadistiques_observatoris/08_observatoris_sectorials/04_observatori_porci/estudis/fitxers-binaris/informe_web.pdf> [DOA: 15 January 2018].

GOVERNMENT OF CATALONIA. MINISTRY OF BUSINESS AND KNOWLEDGE (DEMC) (2016). *Informe anual sobre la indústria a Catalunya 2015*. Barcelona: Government of Catalonia. Online: <http://empresa.gencat.cat/ca/treb_ambits_actuacio/emo_industria/observatori/informe_anual/> [DOA: 16 January 2018].

GOVERNMENT OF CATALONIA. MINISTRY OF TERRITORY AND SUSTAINABILITY (DTES) (2016). *Data of the environment in Catalonia 2015*. Barcelona: Government of Catalonia. Online: <http://www.gencat.cat/mediamb/publicacions/Memories/Dades_Medi_Ambient/dadesMA_2015_ang.pdf> [DOA: 16 January 2018].

GOVERNMENT OF CATALONIA. MINISTRY OF TERRITORY AND SUSTAINABILITY (DTES) (2012). *Catalan strategy for adapting to climate change 2013-2020*. Barcelona: Government of Catalonia (Catalan Office of the Climatic Change). Online: <http://canviclimate.gencat.cat/en/politiques/politiques_catalanes/ladaptacio_al_canvi_climatic/escacc/> [DOA: 16 January 2018].

HLPE = HIGH LEVEL PANEL OF EXPERTS ON FOOD SECURITY AND NUTRITION (2016). *Sustainable agricultural development for food security and nutrition: what roles for livestock?: A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security*. Rome: FAO. Online: <<http://www.fao.org/3/a-i5795e.pdf>> [DOA: 11 January 2018].

HUBBARD, N. (2015). «Towards a resilient food production system». JOINT RESEARCH CENTRE. *The challenge of resilience in a globalised world: Report by the Joint Research Centre, the European Commission's in-house science service*. Luxembourg: Publications Office of the European Union. Online: <https://ec.europa.eu/jrc/sites/jrcsh/files/jrc-resilience-in-a-globalised-world_en.pdf> [DOA: 15 January 2018].

ICAEN = CATALAN ENERGY INSTITUTE (2016). *Informe de seguiment del Pla de l'Energia i Canvi Climàtic de Catalunya 2012-2020*. Barcelona: Government of Catalonia. Online: <http://icaen.gencat.cat/web/.content/30_Plans_programes/31_PlaEnergiaCanviClimatic_PECAC/arxius/20170112_SeguimentPECAC_Juny2016.pdf> [DOA: 16 January 2018].

IPBES = INTERGOVERNMENTAL SCIENCE-POLICY PLATFORM ON BIODIVERSITY AND ECOSYSTEM SERVICES (2016). *Summary for policymakers of the assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on pollinators, pollination and food production*. Bonn: IPBES. Online: <<https://www.ipbes.net/assessment-reports/pollinators>> [DOA: 15 January 2018].

IPCC = INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, United Kingdom; New York: Cambridge University Press. Online: <<http://www.ipcc.ch/report/ar5/wg2>> [DOA: 11 January 2018].

LECHÓN, Y. et al. (2005). *Análisis del ciclo de vida de combustibles alternativos para el transporte*. Madrid: Ministerio de Medio Ambiente. Online: <http://rdgroups.ciemat.es/documents/10907/12207/Ciclovida3_p7.pdf/5f907633-317c-47b5-9899-4eb839a154af> [DOA: 17 January 2018].

LLASAT, M. C. et al. (2016). «Riscos d'origen climàtic». MARTÍN VIDÉ, J. (coord.) (2016). *Tercer informe sobre el canvi climàtic a Catalunya*. Barcelona: Government of Catalonia and the Institute for Catalan Studies (IEC). Online: <<http://cads.gencat.cat/web/.content/Documents/Publicacions/>>

[tercer-informe-sobre-canvi-climatic-catalunya/2part/06-Riscos-dorigen-climatic.pdf](#) [DOA: 15 January 2018].

MALINGREAU, J. P. et al. (2012). *Joint Research Center Science and Policy Reports: NPK: Will there be enough plant nutrients to feed a world of 9 billion in 2050?* Luxembourg: Publications Office of the European Union. Online: <http://publications.jrc.ec.europa.eu/repository/bitstream/JRC70936/npk%20final%20report%20_%20publication%20be%20pdf.pdf> [DOA: 15 January 2018].

MARTÍN VIDÉ, J. (coord.) (2016). *Tercer Informe sobre el canvi climàtic a Catalunya*. Barcelona: Government of Catalonia and the Institute for Catalan Studies (IEC). Online: <<http://cads.gencat.cat/ca/detalls/detallarticle/Tercer-informe-sobre-el-canvi-climatic-a-Catalunya-00003>> [DOA: 15 January 2018].

MAS-PLA, J. et al. «Recursos hidrològics». MARTÍN VIDÉ, J. (coord.) (2016). *Tercer informe sobre el canvi climàtic a Catalunya*. Barcelona: Government of Catalonia and the Institute for Catalan Studies (IEC). Online: <<http://cads.gencat.cat/web/.content/Documents/Publicacions/tercer-informe-sobre-canvi-climatic-catalunya/2part/07-Recursos-hidrologics.pdf>> [DOA: 15 January 2018].

MESTRE, M. et al.; PUIG, I. (coord.) (2017). *Possibilitats normatives i fiscals per prevenir el malbaratament alimentari de Catalunya*. Barcelona: Fundació ENT.

MINISTERIO DE SANIDAD, SERVICIOS SOCIALES E IGUALDAD (2015). *Plan Nacional de Resistencia a Antibióticos. Plan estratégico y de acción para reducir el riesgo de selección y diseminación de la resistencia a los antibióticos* Madrid: Ministerio de Salud, Servicios Sociales e Igualdad. 2nd. ed. Online: <<https://www.aemps.gob.es/publicaciones/publica/plan-estrategico-antibioticos/v2/docs/plan-estrategico-antimicrobianos-AEMPS.pdf>> [DOA: 16 January 2018].

MINISTRY OF HEATLH OF CHILE. *Manual de Etiquetado Nutricional de Alimentos*. Santiago de Chile: Ministry of Health of Chile. Online: <<http://www.indap.gob.cl/docs/default-source/default-document-library/manual-de-etiquetado-minsal-vf.pdf?sfvrsn=0>> [DOA: 2 March 2018].

MONFORTI-FERRARIO, F. et al. (2015). *Joint Research Centre Science and Policy Report: Energy use in the EU food sector: State of play and opportunities for improvement*. Luxembourg: Publications Office of the European Union. doi: 10.2790/158316 [DOA: 23 March 2018].

OBSERVATORI DE VULNERABILITAT DE LA CREU ROJA A CATALUNYA (2015). *L'accés de la infància a l'alimentació saludable*. Barcelona: Observatori de vulnerabilitat de la Creu Roja a Catalunya. Online: <<http://www.creuroja.org/AP/cm/5236P242L2/L-acces-de-la-infancia-a-l-alimentacio-saludable---8e-estudi.aspx>> [DOA: 18 January 2018].

WHO = WORLD HEALTH ORGANIZATION (2015). *Global action plan on antimicrobial resistance*. Geneva: WHO. Online: <http://www.wpro.who.int/entity/drug_resistance/resources/global_action_plan_eng.pdf> [DOA: 16 January 2018].

PELEJERO, C. et al. (2016). «Ecosistemes marins i costaners». MARTÍN VIDÉ, J. (coord.). *Tercer informe sobre el canvi climàtic a Catalunya*. Barcelona: Government of Catalonia and the Institute for Catalan Studies (IEC). Online: <<http://cads.gencat.cat/web/.content/Documents/Publicacions/tercer-informe-sobre-canvi-climatic-catalunya/2part/11-Ecosistemes-marins-i-costaners.pdf>> [DOA: 15 January 2018].

PEÑUELAS, J. et al. (2013). «Human-induced nitrogen-phosphorus imbalances alter natural and managed ecosystems across the globe». *Nature communications* [Basingstoke: Macmillan], issue. 4:2934. doi: 10.1038/ncomms3934 [DOA: 23 March 2018].

PIMENTEL, D.; PIMENTEL, M. (2003). «Sustainability of meat-based and plant-based diets and the environment». *The American Journal of Clinical Nutrition* [American Society for Nutrition: Rockville, Maryland], vol. 78, issue 3, p. 660S-663S. Online: <<http://ajcn.nutrition.org/content/78/3/660S.full.pdf>> [DOA: 17 January 2018].

PLANA, M. J.; DE LECUONA, I. (coord.) (2017). *Informació alimentària: qüestions ètiques, jurídiques i polítiques*. Barcelona: Edicions de la Universitat de Barcelona: Observatori de Bioètica i Dret. Online: <<http://www.publicacions.ub.edu/refs/observatoriBioEticaDret/documents/08601.pdf>> [DOA: 18 January 2018].

UNEP = UNITED NATIONS ENVIRONMENT PROGRAMME (2010). *UNEP Emerging Issues: Global Honey Bee Colony Disorder and Other Threats to Insect Pollinators*. Nairobi: UNEP. Online: <<https://wedocs.unep.org/rest/bitstreams/14378/retrieve>> [DOA: 15 January 2018].

RAO, M. et al. (2013). «Do healthier foods and diet patterns cost more than less healthy options? A systematic review and meta-analysis». *BMJ Open* [London: BMJ Publishing Group], vol. 3, issue 12. doi: 10.1136/bmjopen-2013-004277 [DOA: 23 March 2018].

SANTÉ PUBLIQUE FRANCE (2018). *Règlement d'usage du logo «NUTRI-SCORE»*. Version 14 of 19-02-2018, approved by Santé publique France. Saint-Maurice: Santé publique France. Online: <<https://www.santepubliquefrance.fr/Sante-publique-France/Nutri-Score>> [DOA: 2 March 2018]

STEFFEN, W. et al. (2015). «Planetary boundaries: Guiding human development on a changing planet». *Science* [Washington DC: American Association for the Advancement of Science], issue 347, article 1259855. doi: 10.1126/science.1259855 [DOA: 23 March 2018].

STENMARCK, Å. et al. (2016). *Estimates of European food waste levels*. Stockholm: FUSIONS. Online: <<https://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf>> [DOA: 11 January 2018].

UNDESA = UNITED NATIONS DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS. POPULATION DIVISION (2017). *World Population Prospects: The 2017 Revision, Key Findings and Advance Tables*. Working Paper ESA/P/WP/248. New York: UN. Online: <https://esa.un.org/unpd/wpp/Publications/Files/WPP2017_KeyFindings.pdf> [DOA: 11 January 2018].

7. PARTNERS

In drawing up *Feeding on Future*, the CADS consulted various experts on the issues analysed in the report, to whom the members of the Council wish to extend their sincere gratitude for their invaluable contributions. Their proposals and comments have helped enrich this report, the content of which is the sole responsibility of the CADS.

Below is a list of all those consulted:

- Josep Maria Alcañiz, Researcher at the Ecological and Forestry Applications Research Centre (CREAF).
- Jacint Arnau, Head of the Food Technology Programme at the Institute of Agrifood Research and Technology (IRTA).
- Àlex Bach, Head of the Ruminant Production Programme at the IRTA.
- Joan Bonany, Director of the Sweet Fruit Sub-programme at the IRTA.
- Jordi Bosch, Researcher at the CREAF.
- Joaquim Brufau, Director of the Mas de Bover Centre, IRTA.
- María Casado, Director of the Universitat de Barcelona's (UB) Observatory on Bioethics and Law.
- Joan Casals, Executive Director of the Miquel Agustí Foundation.
- Jordi Comas-Angelet, Professor at the Barcelona School of Agricultural Engineering - UPC-Barcelona Tech.
- Mercè Darnell, Head of Programmes and Services at Càritas Diocesana in Barcelona.
- Joan Girona, Head of the Programme for the Efficient Use of Water at the IRTA.
- Abel Mariné, Emeritus Professor in the Department of Nutrition and Bromatology in the Faculty of Pharmacy at the UB.
- Antoni Massanés, Director of the Alícia Foundation.
- Maria Mestre, Environmental Consultant at the ENT Foundation.
- Josefina Plaixats, Professor in the Department of Animal and Food Science at the Universitat Autònoma de Barcelona (UAB).
- Maria José Plana, Co-coordinator on the “Bioethics, Law and Food” line of research, at the UB Observatory on Bioethics and Law.
- Francesc Prenafeta, Head of the Integrated Management of Organic Waste Programme at the IRTA.

- Jordi Puig, Doctor in Environmental Sciences.
- Francesc Reguant, Deputy President of the Commission of Agrifood Economy at the Association of Economists of Catalonia.
- Marc Riera, Executive Director of the Món Rural Foundation.
- Marta Guadalupe Rivera, Researcher and Chair in Agroecology and Food Systems at the Universitat de Vic - Universitat Central de Catalunya.
- Robert Savé, Coordinator of Viticulture and Enology at the IRTA.
- Maria Teresa Sebastià, Professor at the Agricultural Engineering School at the University of Lleida.
- Joan Tibau, Director of the IRTA Centre in Monells.

