The Future of Food: Environment, Health and Economy

FUNDAÇÃO
CALOUSTE GULBENKIAN

The Future of Food: Environment, Health and Economy

Authors
Arlindo Cunha, Armando Sevinate Pinto, Augusto Manuel Correia, Benoît Miribel, Carlos Cardoso, Carlos Sousa Reis, Charles Godfray, David Baldock, Filomena Duarte, Francisco Avillez, Henrique Barros, Isabel do Carmo, Isabel Ribeiro, Jesús Contreras, José Lima Santos, José Luís Domingo, Luísa Neto, Maria Hermínia Cabral, Maria Leonor Nunes, Pedro Graça, Tim Lang

Coordinators
José Lima Santos
Isabel do Carmo
Pedro Graça
Isabel Ribeiro

Revision
Carina Ribeiro, Sean Linney, Geoffrey Chan

Design
Silva Designers

Translation
João Vanzeller, nota bene, Rui Cabral

Edition
Fundação Calouste Gulbenkian
April 2013

ISBN
978-972-31-1509-3

Legal deposit
357980/13

Contents

Foreword

Isabel Mota
Trustee of the Calouste Gulbenkian Foundation

We are now at a time in our history when we urgently need to reflect upon and act in relation to our global food system. The needs of a world population, which is predicted to reach nine billion people in 2050, have to be met with essential resources that are becoming increasingly scarce.

Climate change, fluctuating prices, major changes in culture and eating habits (particularly in developing countries), the lack of essential resources, such as water, energy and fertile soil, and threats to environmental conservation are challenges for an increasingly globalised world, whose sustainability should be safeguarded for current and future generations.

Within the context of the current economic and social crisis, we should view these constraints as an opportunity to encourage creativity and innovation, matching both technological resources and policies, in order to deal with the issues and make healthy and sustainable food for all a reality on a global scale.

Against this very particular backdrop, the Gulbenkian Human Development and Development Aid programmes combined their efforts, in partnership with the *Público* newspaper, to organize a season of seminars on "The Future of Food: Environment, Health, Economy", bringing together some of the world's most well-respected contemporary thinkers to promote a more thorough reflection and debate on this crucial issue, while seeking answers for the problems and proposing ways forward. These texts are the result of the seminars held at the Foundation between 9th March and 13th December, 2012.

Very special thanks go to the team – José Lima Santos (coordinator), Isabel do Carmo, Pedro Graça and Isabel Ribeiro – for their commitment and enthusiasm in devising and overseeing the series of seminars and the publication of this book.

Introduction:

Food with a future: healthy, sustainable and accessible for all

José Lima Santos
Isabel do Carmo
Pedro Graça
Isabel Ribeiro

Food is an issue that affects each and every one of us. We all eat and are therefore dependent on access to healthy and nutritious food. Consequently, food access and quality are key issues in human development. A society cannot be considered as developed if these issues are not mostly resolved. In addition to this, access to food and its quality (or lack of) has far-reaching implications for public health, the welfare of people and human capital, thus affecting society's very capacity for development.

Also, food is the main reason for productive activities, such as farming and fishing, which profoundly modify terrestrial, aquatic and marine ecosystems around us. The ecological footprint and sustainability of our model of food production, manufacturing, transport, distribution and consumption are key issues in the debate on food.

Social inequality greatly conditions the access of many to quality food, both in developing and so-called developed countries. As a result, this is also an issue that should not be excluded in any serious debate on the future of food.

As such, food with a future requires that everyone has access to a *healthy* and ecologically *sustainable* diet.

In a world experiencing fast demographic growth, where diets are rapidly changing and essential resources like water, energy and fertile soil are becoming scarcer, and against a background of increasingly visible climate change, nowadays, the future of food poses huge challenges for science, technology and public policy in a wide range of areas and for all of us as citizens and consumers.

Meeting these challenges involves an unprecedented capacity to innovate. We need to produce more with fewer natural resources, in order to feed a population that is forecast to reach 9 billion people in the middle of this century, whilst keeping the ecological footprint of our food within the boundaries of sustainability. Current levels of food waste need to be reduced and dietary behaviour and choices require change. Efforts are also needed to offer everyone access to a nutritious and healthy diet.

All of these issues are highlighted even more prominently in this current climate of crisis, in which it is essential to safeguard the basic needs of the most vulnerable and take the fullest advantage of the food system's potential to create employment and added value.

These challenges were the foundation for a cycle of seven conferences about "The Future of Food", which were held at the Calouste Gulbenkian Foundation in Lisbon between 9th March and 13th December, 2012. Over this period, a debate about the future of food came to fruition based on the talks given by various specialists who accepted the invitation to share their knowledge and views on the issues at stake. The debate was broad and inclusive, and led to a rich, interdisciplinary dialogue, which the problems regarding food have long been in need of, and where existing partial visions came together to produce new views and perspectives.

This book seeks to mirror the rich and interdisciplinary nature of this debate; to achieve this, we asked the various speakers to write an article based on what they had said at the conferences, included as a chapter. In each of the chapters, there is an analysis of possible choices and options, and, in some cases, recommendations. In addition to the speakers, the chairs of the different sessions also contributed a generally smaller text, which provides new perspectives or questions established perceptions. This book is aimed at reflecting the diversity of views and positions of the wide-ranging interdisciplinary debate that was held, rather than achieving some sort of convergence, and even less so, a consensus of opinion. Each chapter solely reflects the perspective of the author who wrote it. Together, the different chapters of

the book produce a kaleidoscope of diverse narratives and positions, which reveals the spectrum of the alternative opinions and options on offer.

The future of food is far from being consensual. In fact, the opposite is true. There is a wide range of possible futures in which policy choices have to be made as regards the particular food model that should be selected and promoted. There are different futures for food. This book is a modest contribution that informs these choices of possible futures by presenting and discussing the wide variety of alternative options and views available.

Despite the diversity of analyses, views, opinions and proposals contained in the different chapters of the book and the clear intention not to attempt a harmonization or convergence of these views, the editors – all members of the conference cycle coordination team – have risked setting out key ideas/themes that emerged from the event. This set of key ideas is intended only to provide a platform from which different views can be compared, whilst affirming their diversity. We felt that the construction of this platform of key ideas, in which any opinion is the sole responsibility of the editors, was important to give the book a sense of interdisciplinary dialogue (and not cacophony).

The first of these ideas is the following: the solutions for the future of food should simultaneously ensure people's health and well-being, environmental sustainability, and equity of access to food for all, while enhancing economic development prospects via added value and job creation. As such, any improvement proposals, particularly those at the public-policy level, should be assessed based on their impact on these diverse goal domains, according to the best scientific knowledge available. For this to occur, an approach focussed on food issues and involving a broad range of different knowledge areas is required.

In a number of countries, this approach has been developed in the form of interdisciplinary committees for food involving various stakeholders (including consumers, agriculture, industry and environment and development NGOs, among others) and experts in different areas. These committees support policy decisions that affect food. This integrated policy approach to food is not a consistent practice in Portugal yet, although there are several integrated projects already in existence. It is important to move from integrated projects to an integrated policy, which requires broad consensus to maintain a consistent strategy in the medium/long term.

The second idea is that the future of food will not involve a return to the past, which is neither possible nor desirable. Often, the past is an idealisation of ways of living to which we would not truly wish to return.

Globalisation, changes in lifestyle and the technological dynamic have led to new problems, which need new solutions. Future solutions have to be reinvented within a global, regional and local context by following a realistic approach grounded in modern science and technology. However, culture, tradition and ways of producing and eating food of the past and present are resources whose reinterpretation can help us devise future solutions. Examples of this are the dietary patterns that are characteristic of different geographical areas and certain traditional agricultural systems, which sought to produce locally in particularly difficult soils, using varieties of plants and production methods adapted to the local situation. This contrasts with modern efforts to change the agricultural environment in order to introduce more productive plants that are also more demanding and dependent on cheap energy. Many of these dietary patterns and locally-adapted traditional production systems still provide us with sources of cultural practices, as well as locally-adapted varieties and genes, which can be used as "parts" of future technologies when reinterpreted by modern science; a fruitful dialogue between scientific and local forms of knowledge, where the former contributes to reinterpreting the latter, may assist us in reinventing solutions for the future.

The third idea involves recognizing that the difficulty of the challenges ahead implies not rejecting *a priori* any possible courses of action. What is needed is an exploration of what is complementary, rather than employing sterile dichotomies, such as those which oppose new biotechnologies, which seek to act at the level of the individual parts of the production system (genes), to agro-ecology or organic farming, which look at the agricultural production system as a whole (agro-ecosystem).

When war is being waged, you do not lay down your arms. Given the need to feed another two billion people in a world undergoing climate change with increasingly inadequate natural resources, it will be more intelligent to use all the options at our disposal in a coordinated manner, while assessing each technological solution in a way that is transparent and open to public scrutiny, based on available scientific evidence and the precautionary principle. In this context, reconciling the need to increase production and productivity with a sustainable ecological footprint for the planet presupposes producing more with fewer resources and adopting a new technological model, which some have called "sustainable intensification". We also need to recognise that technology alone will not be enough. We will still need to rethink consumption patterns, combat food waste and adopt more suitable public policies in the different areas.

The fourth idea is that there are two main focuses of public intervention in the area of environmental sustainability of agricultural production: technological innovation and incentives for the production of public goods.

The technology resulting from research and the better understanding of how agro-ecosystems work is easily disseminated and, therefore, hard to patent. As such, state intervention is justified in developing and producing this type of technology, at the risk of the private sector not "producing" it. In addition to this, the market fails to remunerate public goods delivered by agriculture. For example, a farmer who chooses to use a production technology with a lighter ecological footprint (reducing greenhouse gas emissions, for example) is not necessarily remunerated by the market, although everyone benefits from this decision and nobody can be excluded from the resulting gains (less atmospheric warming, fewer risks of extreme weather). As nobody would be willing to pay for a service from which they cannot be excluded, state intervention is justifiable and necessary so that these public goods or services are produced. State intervention (via agricultural policy, environmental regulation or research and technological development policy) is crucial, in order for us to move beyond the impasse the current technological model of agricultural production finds itself in.

The fifth idea is that the future of food is dictated by consumer decisions, which, multiplied by seven billion, become the most powerful force for change. Consumers' food choices will be one of the most decisive factors for climate change, having an impact on water and energy consumption, as well as the use of land. The energy, water and land needs for the production, transportation, consumption and storage of different types of food, as well as the waste they produce, are all very different. Consumer food choices also affect public health, people's welfare and their ability to contribute to development. To this end, it seems very clear that changing behaviour and consumption decisions is key to guaranteeing food that is healthy, environmentally sustainable and generates greater potential for development.

The sixth idea is that the informed and responsible consumer alone is not sufficient for healthier, more sustainable and equitable food. The relationships between food, health, agriculture, fisheries and the environment are complex and, therefore, difficult to convey. As such, although it is desirable that consumers have the right facts in order to make informed choices, this is not enough. We make thousands of food decisions every

day (more instinctive than rational) and our choice is not as free as one might suppose. Despite what we might think, when we make a choice while looking at a supermarket shelf, the placement of a product on a particular shelf, with a particular type of lighting and setting is the result of a complex process developed by various economic agents (producers, distributors, marketers) in order to influence us. The issues that we would have to analyse simultaneously to consciously choose are varied and complex: food and health, food and agriculture (production method), food and environment (food's ecological footprint), food, culture and ethics, and food and the economy.

It would mean every consumer having a considerable amount of information, which often involves complex issues such as: should we eat fish every day? Is the fish contaminated? Is there enough fish for everyone? In short, consumer information is important, but it should not be the only way of influencing consumer decisions, because when information is complex, it can be more easily manipulated. Changing food choices implies an integrated approach with a wide range of intervention in schools, education, advertising, health-professional advice, labelling and public procurement, as well as the (un)availability of certain foods in schools and canteens, in order to improve the population's diet and produce more sustainable food patterns. Intervention regarding the availability of certain foods has proved effective in changing consumption. This already happens at various levels, from the regulation of the food available in schools to limiting the amount of salt in bread (where Portugal has been pioneering in its legislation), as well as taxing certain items, like soft drinks. The debate about the boundaries of state intervention in this area is an open one. Here, it is essential to reconcile safeguarding health and the environment with consumers' freedom to make their own food choices.

The seventh idea is the importance of social inequality when approaching issues of food. In particular, social inequalities mean being more cautious about particular generic food recommendations, such as "eat less meat", when there are certain sections of the population with insufficient or deficient protein intake. This is important not only in developing countries but also in developed countries. For example, at least one fifth of the Portuguese population lacks food security with different levels of dietary deficiency, in terms of nutritional quality and protein-calorie intake. These specific nutritional deficiencies cause fragility and make individuals more susceptible to certain diseases, particularly infectious diseases, such as pneumonia in the cold season. Another example is obesity, which

affects low-income social classes more. In Portugal, obesity is around five times lower in the highest occupational class than in the lowest.

The eighth and final idea is that food systems are influenced by the economy but also influence the economic development of the country. It is important not to forget that a strong economy depends on a healthy population. Inadequate and deficient food consumption leads to more fragile public health, worsening the vicious circle of poverty-malnutrition-illness-absenteeism, with obvious economic costs. Equal food access also involves robust welfare measures and active employment and poverty reduction policies. In addition to this, food systems also contribute significantly to added value and employment in economic sectors other than agriculture and agribusiness, such as tourism and the restaurant industry. Associated with memories and lifestyles, dietary patterns are an expression of cultural identity and contribute to the differentiation of countries on a global scale.

In order to maintain the initially-planned focus on exploring the range of issues associated with the future of food, this book is divided into seven parts, one for each of the seven conferences.

The first part is dedicated to production, consumption and food markets and their relationships at the global level. It begins with a chapter by Charles Godfray about "The challenge of feeding nine billion people by 2050", which introduces and discusses new challenges for the future of food, which largely motivated the cycle of conferences upon which this book is based. The second chapter, which was written by Arlindo Cunha, deals with the globalisation of food markets, discussing how the Common Agricultural Policy (CAP) has been changed within the global framework of successive multilateral negotiations in the World Trade Organization (WTO).

The second part, which includes four chapters, is focused on the crucial link between food and health. In the first of these chapters, Isabel do Carmo initially employs a historical perspective to review how views and issues related to food and health have changed over time, later concentrating on the importance of social inequality in addressing the problems of food. In the second chapter, Tim Lang discusses the possibility of a diet that is both healthy and sustainable. In the third chapter, Henrique Barros introduces an epidemiologist's perspective, discussing certain issues associated with the theme of food and health in light of this. In the fourth and final chapter of this part, Pedro Graça uses an integrated approach to discuss food practices in Portugal, based on normative

aspects (dietary requirements), food culture (what we want to eat), and eating habits (what we eat).

The third part of the book is dedicated to the important links between food and human development. In the first chapter of this section, Maria Hermínia Cabral and Augusto Manuel Correia discuss multiple interactions between development and food, focussing attention on the importance of agriculture, the productivity of small farmers and the role of women as core issues on the development agenda.

In the second chapter, Benoît Miribel proposes the adoption of a new world food security paradigm as the basis for ensuring individual and collective development.

The fourth part links food and economics and includes three chapters. In the first, Armando Sevinate Pinto addresses certain economic issues related to food production and consumption. In the second chapter, Francisco Avillez offers us a reflection on the myths and realities of food self-sufficiency, clarifying key concepts before questioning the desirability or even the possibility of pursuing food self-sufficiency in the current context of global food markets. In the third chapter, Filomena Duarte assesses to what extent the dietary changes that are happening within the current economic crisis constitute a return to the past.

The fifth part of the book is devoted to the relationship between food and fisheries, beginning with a chapter by Carlos Sousa Reis that introduces the main issues. In the second chapter of this part, José Luís Domingo discusses the main benefits and risks of fish consumption, proposing a new methodology that simultaneously considers the presence of both nutrients and pollutants for producing recommendations on the types/amounts of fish to include in diets. In the third and final chapter of this part, Carlos Cardoso and Maria Leonor Nunes discuss the importance of the consumption of fish products in Portugal, based on the results of a survey of consumer habits in relation to fishery products.

The sixth part of the book, which boasts two chapters, deals with the relationship between agriculture and the environment. In the first chapter, José Lima Santos identifies and discusses the main issues and challenges regarding agriculture and the environment that have arisen from the widespread implementation of the chemical-mechanical model in agriculture. Also discussed are the main solutions that have been pondered regarding future technological models and public policies for agriculture, environment and food, as well as for scientific and technological research. In the second part of this chapter, entitled "A sustainable agriculture for

Europe," David Baldock identifies the major agricultural and environmental issues at the European level, examining the various solutions that have been used in Community policies under successive reforms of the Common Agricultural Policy.

The seventh part of this book includes cultural and ethical-legal issues regarding food in three chapters. In the first, Pedro Graça discusses the "Mediterranean diet" in terms of health, culinary creativity and environmental protection, relating this with the right to a healthy diet. In the second chapter, Jesus Contreras discusses, from an anthropological perspective, to what extent the Mediterranean diet actually stems from traditional practice common to various areas in the Mediterranean, or whether it is the result of projecting modern ideas via a reinterpretation of the past that makes necessity a virtue. In the third and final chapter of this part, Luísa Neto discusses the possible areas and limits for state intervention in food policy as regards facilitating access to food, ensuring food security, safeguarding healthy dietary alternatives, or even a questionable imposition of eating habits by law.

Finally, we would like to thank the Calouste Gulbenkian Foundation for their very stimulating invitation to participate in the organisation of the cycle of conferences on the Future of Food.

Global production, consumption and food markets

The challenge of feeding nine billion people by 2050

Charles Godfray

I would like to begin by thanking the Gulbenkian Foundation very much for inviting me along this evening. I am a scientist and I think it is fabulous to have a foundation that is so active in both the sciences and the arts. I spent the afternoon wandering around the wonderful art collection here and also the garden, and I wish we did more linking across the two domains. I am also very grateful to the three very interesting introductions. I am slightly worried about the introduction by the President of the Foundation who, essentially, in five very elegant minutes, said everything that I'm going to say this afternoon and what is more, he said it in Portuguese! I am very sorry but I am completely monolingual.

I am going to be talking about some of the challenges of feeding the world by the middle of the century, when we expect there to be about nine to ten billion people and I am going to be building on a project that has been mentioned a couple of times[1], which was led out of the United Kingdom Government's Office of Science. It was a project that was meant to look across the different departments, the different ministries in the UK, and bring in outside experts to try and look at some of the issues facing all governments going forward over the next 40 or 50 years.

I am painfully aware, looking around the room, that there is huge expertise on many different aspects of agriculture and in the next 40 minutes, I am going to try and talk about some of the big issues that affect the whole of the food system. I know there will be people here that will

1 Foresight: The Future of Food and Farming: Challenges and choices for global stability: Final report available at: www.fao.org/docs/eims/upload/288629/future-of-food-and-farming-report.pdf

be real experts on some of the things that I will only spend a very small amount of time talking about. Please excuse me for spending so little time on your topic, but I want to try and look at some of the big picture issues.

I am going to spend the first 15 minutes or so talking about some of the problems that we are going to see, or that we are going to face, over the next 10, 20, 30, 40 years and then I want to look at three categories of issues that we have to deal with. I am going to spend the most time on the first, which is the issue of how we can balance supply and demand in the food system without there being really major problems: large increases in food prices, the danger of hunger, etc. I will be arguing that everything we do in the food system needs to be done considering (1) environmental sustainability and (2) the needs of the very poor, the one billion people, give or take, who go to bed each night hungry. And I will say a little bit about that at the end, but I will not have time to give those two topics the length of time they obviously deserve.

So, let us look at what might be some of the growing pressures on the food system. Of course, as we all know, one of the main pressures that we are going to see is the increase in global population. Almost certainly, we are going to have to feed somewhere in the order of 9 or 10 billion people by the middle of the century. I say almost certainly but there is considerable uncertainty about these estimates: it might be better and it could, if things go wrong, be considerably worse. But not only are we going to have to feed more people but these people are, on average, going to be richer, which is a good thing, but if you are richer you will be demanding a more varied diet and a diet that contains many food types, which has a greater impact on the environment.

In **figure 1**, I have plotted meat consumption for different countries. This is data from the Food and Agricultural Organization of the UN[2]. I should pause to say that there is a great range of meat types with different effects on the environment and I am being a bit simplistic just looking at one.

In the developed nations, meat consumption is roughly constant. In fact, in Europe, meat consumption is going down very slightly. But look at China, meat consumption is rising radically. Increasing demand in China is being driven by rapid industrialisation and people becoming richer and aspiring to a more western diet. But India has a similar economic trajectory to China, perhaps a little bit behind, eating far less meat, so it's not

2 FAO (2009). *The state of food and agriculture: livestock in the balance*. Rome: FAO. Available at www.fao.org/docrep/012/i0680e/i0680e.pdf

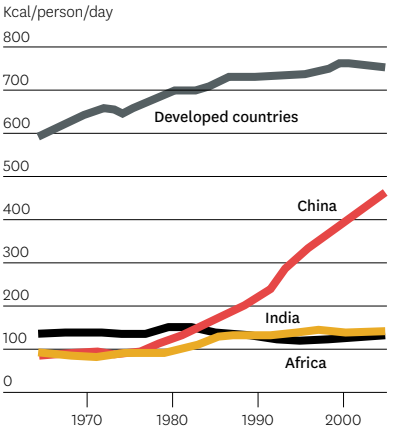


Figure 1. Meat consumption between 1970 and 2006.
Source: FAO, 2009

Figure 2. FAO food price index between 1990 and 2012.
Source: FAOSTAT, 2012

ineluctable that increased wealth leads to a more western diet. For interesting economic, social and cultural reasons, diets are not changing in India as they are in China... and finally in Africa, a large part of which is still very poor, meat consumption is still very low. So, clearly we are going to see a dramatic increase in demand in the future and we are going to see it at a time when there are threats to supply.

I am not going to spend a long time going through the list of problems we are likely to face, because I suspect that all of you are aware of most of them, but we will see, as the population gets bigger, increased competition for land, increased competition for water, for energy and for other inputs, perhaps some limiting of fertilizers. And all of these challenges will have to be faced at the time when we experience an existential threat to the human race through climate change. Although the major effects of climate change, the effects that are now unavoidable, are probably going to be experienced in the second half of the century, we are likely, before that, to see increasing evidence of climate change in the increased frequency of extreme events. Portugal is currently having a very dry winter, as we are in parts of the UK, and there is some suggestion that the reason for this is that the jet stream is today running further north than it used to because the ice in the arctic ocean is melting. Now, we do not know that for certain yet but I suspect, as the years go by, there will be more and more instances of where climate change is shown to be responsible for negative effects. Work that we commissioned as part of the Foresight report shows the

number of agricultural grain-producing areas that may get substantially warmer. Although this may be beneficial in some regions near the current northern limits of crop growth, overall, it is likely to be negative.

We are going to see an increase in demand and we are going to see threats to supply at the same time. And we still live in a world where nearly a billion people go to bed hungry each night, most of them in Africa, Asia and in the Pacific. If you look at the numbers of people hungry beginning in 1970, it has remained roughly constant in absolute numbers, with a recent increase associated with the food price spire. If you look at it in terms of percentage, because the population is going up, the percentage of the world's people going hungry was going down. In fact, we were, until a few years ago, on track to meet the Millennium Development Goals, which were to have reduced hunger to 8% by 2015. I will say a bit more about this later; however, it is largely because of the recent volatility in food prices that we are almost certainly not going to make it.

Now, I suspect that no one here believes that the reason why we have hungry people is because we do not produce enough food. It is a myth that the problem with hunger is that the world cannot produce enough food. The problem with people going hungry is that, sometimes, they do not have physical access to food. If you live in Somalia, you do not have physical access to food. But, overwhelmingly, the problem is that you are too poor to afford food or to afford the means of growing it yourself. Less frequently, hunger is associated with social access to food. So, hunger is intimately involved with issues of development.

I said that about a billion people go to bed each night calorie hungry; however, another billion people go to bed having insufficient nutrients of one type or another. They suffer some form of malnutrition and I understand, later on in this series, you will examine this problem in more detail.

Another issue that I am going to talk about is that around a further billion people are overweight, of which a third are clinically obese. We are having situations where countries, which have done very well in reducing the diseases of malnutrition, hunger and macronutrient deficiencies, are now beginning to suffer the diseases of the rich world: coronary diseases, diabetes, etc. These are really important questions and I am not going to be talking much more about them because of time, not because they are unimportant.

Finally, the food system is not sustainable. You hear the word sustainable rather bandied around these days and sometimes it is used almost for effect. But the food system at the moment is *literally* not sustainable, in

the sense that the food we produce at the moment, we would not be able to produce in 20 or 30 years' time if we tried to do it in the same way. To give a very concrete example: one of the successes of addressing hunger in India has been areas in the northwest of the country, in the Punjab and Rajasthan, which have become really efficient bread baskets, growing lots of wheat. However, they rely almost exclusively on aquifers, on water that is pumped out of the ground. Today, they are having to drill wells ever lower to reach water and that source of water will disappear completely in 15 years. We are thus going to see a large, very productive agricultural region ceasing to be productive. And there are places all around the world where they have the same problems, including in the rich world, for example large parts of central North America, in the United States. In addition, there are major issues with the state of the world's soil. Twenty four percent of vegetated land suffers from some form of soil degradation. Agricultural intensification is a major source of greenhouse gases: 30% of the total, with about 15% coming directly from agriculture, because of the way we keep cows, the way we produce rice, the way we deal with manure, for example. However, another 15% comes indirectly from converting land or, in particular, forest to make new agricultural areas and it really is critical to think about these indirect effects. Agriculture is also a major source of nitrates and other pollutants. Large areas of the Caribbean Sea are just completely dead because of the nitrogen that flows down the Mississippi. And finally, and this is not something that I am going to be talking about much, nearly all the capture fisheries that we use are over-exploited. It is something that I know Portugal is extremely concerned about. Issues of fisheries management are very important.

And so, we have all these threats and what we may be seeing already is the beginnings of them working through to affect the food system at the moment. **Figure 2** shows the FAO food price index, which was initiated in 1990 remained, for the first 20 years or so of its existence, relatively low until there was a major food spike in 2008, and another one in 2010. Now, at least in the rich world, food is still historically cheaper. We, in Europe, spend, I think, an average of about 14% of our income on food; in the States, it is under 10%. No civilization has ever spent that little on food since money was invented. You can make an argument for us in the West that perhaps it would not matter if food prices actually went up a bit. There is some truth in that, but we do live now in a globalised world and what happens to global food prices has effects throughout the globe, including poorer countries. I think it would be foolish for anyone to

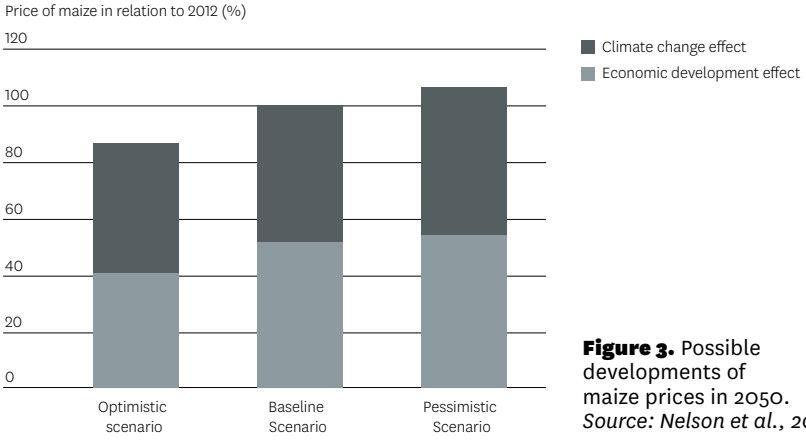


Figure 3. Possible developments of maize prices in 2050. *Source: Nelson et al., 2010*

say that the reason why we are seeing the Arab spring over the last year and a half has solely been because of food prices; however, I think that food prices were clearly one of several causes of the convulsions in North Africa and now in the Middle East. We are living in a very different world, compared to even 20 years ago. Then, many people in the poorest parts of the world lived in rural communities, where they did suffer starvation, although they had some means of buffering themselves, for example, by going out and foraging for what are called famine foods, the type of food that you wouldn't normally eat, unless you were really hungry. And if you failed to do this, and if you very sadly died, you died invisibly, with relatively few political consequences.

Now, increasingly, over 50% of the world's population lives in cities where the urban poor get hungry and there is very little they can do to buffer themselves; they cannot dig up roots or things like that. Hunger is immediately seen in political action, such as civil unrest on the streets. We are thus in a curious position now, where food is probably too cheap (except for the poor) and yet the consequences of food prices going up are political and economic instability. That is a brief canter through some of the threats and challenges facing the global food system. What I want to do now is to explore some of the issues about balancing future demand and supply sustainably. Of course, the first thing to ask is how all these factors combine to affect food prices. I have talked about higher demand-side pressures from consumption and population growth and on the supply side, competition for water and energy. Within the Foresight Project, we commissioned some modelling from a group at the International Food

Policy Research Institute in Washington, led by Jerry Nelson, who are probably some of the best people modelling in this area[3].

Figure 3 shows an example of one of the model outputs produced. For those who are economists, it is a partial equilibrium model coupled to a climate change model, also including a representation of global hydrology. The figure shows that for different assumptions about how yield growth in one particular crop – maize – might change over the next 20 to 30 years, what the percentage price increases in this crop might be by 2050. With business as usual and no climate change, there will be price rises in the order of 40- 45%, which will be serious; however, people will be richer and this will somewhat counterbalance this. But if you include climate change, which has a significant effect on yields, the model predicts price rises of the order of 100%. Now, having presented these results, I would strongly encourage you not to believe them, at least the detailed productions. Yet, with a number of other model-related approaches, all point towards problems of this magnitude. What I conclude from the totality of the economic modelling in this area is that there is a real risk of substantial price rises if radical action to reform the food system is not taken

A number of groups who have done models of this type, including the Food and Agricultural Organization of the UN, have come up with the argument that we need to produce a certain amount of extra food. The FAO said that the world needs to produce 70% more food. A couple of other groups have said 100%. We, in the UK Foresight report, did not want to put a specific figure on it because we believe that action is needed throughout the food system. Yes, we do have to produce more food; increasing supply is important but it is not just a question of increasing agricultural production, as I think the President of the Foundation explained very well. Not only do we need to think about supply but we need to consider demand. We need to examine what we eat and maybe change our diets. We need to think about waste and we need to have difficult discussions about how we improve the governance and efficiency of the food system. We need to get involved in the details of Common Agricultural Policy (CAP) negotiations to make this happen. CAP is so important for us in Europe; it is not perhaps the most fashionable thing to study, but it is incredibly important.

And whatever we do, how we produce more food, what food we decide to eat, how we reform the CAP, how we decide the Doha Round of trade negotiations or whatever will replace the Doha Round, there must be

3 Available at: www.ifpri.org/sites/default/files/publications/ib66.pdf

decisions viewed through twin prisms: what does it do for environmental sustainability? Climate change, yes, but other aspects as well. And how does it address the needs of the poorest?

Of course, if we were having this discussion 50 years ago or 100 years ago, then a viable strategy would be to bring substantial new land into agriculture. Today, there isn't that much spare land available, but if you actually look at the consequences of bringing that land into agriculture, especially cutting down rain forests, or draining wetlands, the consequences for greenhouse gas emissions, for putting carbon dioxide into the air, are very severe. The best way to get carbon dioxide into the atmosphere is to cut down tropical rainforest and it has very detrimental effects on biodiversity. Therefore, bringing more land into agriculture is not part of the solution of feeding the world today. That is not to say that restoration of agricultural land, restoration of the approximately 24% of agricultural land, which is now severely degraded, is not really critical.

If you accept the argument that increasing yields must be a part of the solution and that there is no new land, then you have to produce more food from the same amount of land with less environmental impact. You have to increase the efficiency with which you use water, nitrogen and other inputs and you have to reduce negative environmental effects, such as greenhouse gas emissions. Others call this sustainable intensification. Some people hate this term; they think that intensification means farming in a particular way: big business agriculture. That is not what we mean by sustainable intensification; it is using any means you can to produce more food in an environmentally friendly way, using the best of organic farming, the best of high-tech modern farming or whatever techniques are available. Increasing the supply of food means producing more using existing knowledge (closing the yield gap) and innovating to increase productivity.

If the arguments are right, that demand will go up, then this will lead to price signals, this will lead to food prices going up. We will see some of the yield gap closing in response to higher demand. That is how the market economy should work and I do not believe we should go back to an old-fashioned target for production. Instead, we should look at the barriers for our farmers to respond to price signals. Where is there a deficit in the skills that people have to produce things, to produce more food? We perhaps need to rethink our model of extension, the advice we give to food producers. I am not advocating that we go back to the old form of extension we had 20 years ago, or 30 or 40 years ago. But instead to think about

a modern form of revitalised extension, using part public money, where we are asking food producers to provide public goods, such as reducing greenhouse gas emissions, but then part private money, here we are actually helping food producers make higher returns.

Many of the same issues apply equally in developing countries, although with different challenges of exactly how you fund. In developing countries, there are particular issues linking areas of food production to markets, investing in the roads and in the ports, doing what Brazil has done so extraordinarily well over the last 20 years.

Now, there are some people, especially people who do not like the idea of modern scientific agriculture, who say that closing the yield gap is all we need to do. If one makes some heroic assumptions about the speed at which we are likely to bring down the yield gap and moderate demand, then this can just about be made to add up. But, I think that is a very dangerous course, if you look at the challenges ahead. We have to invest in new knowledge, not only to increase yields, but also to maintain the yields that we have at the moment. Agriculture is not like other industries in that farmers have to forever fight with pests, with diseases, with pathogens, with weeds, with things that are evolving the whole time. Agricultural research cannot stand still. It must forever be fighting back about these biotic challenges. It worries me that over the last 40 years, when food has been so cheap, there has been very little impetus for governments to invest in agricultural research, and we have actually reduced the level of investment. In the UK, it has been impossible for major research universities to find enough research funding in these areas to keep that going.

There is a great need for more research, but it needs to be refocused research, now more than just yields. In the old days, a livestock or crop would try to breed a fatter cow or wheat with more grains in its head. Nowadays, it is more complicated. Yes, we need more yield but we need varieties that are more sustainable, more efficient, that make better use of water. For example, my colleagues at Oxford are breeding for redesigned root systems that are much more efficient at taking up water. And we also need to refocus some of our research not on maize, rice and wheat, but on sorghum, cassava, etc., the crops that poorer people in the driest parts of Africa need. There is exciting recent work, particularly funded by the Gates Foundation, which is pursuing these goals.

So, what type of agricultural research should we invest in? My view is that, if you look dispassionately at the threats the world is likely to experience to the food system in the next 40 years, it is just foolish to throw

away any particular strategy. So, I think that one should invest in biotech including GM, but treating GM as just one of a number of techniques that will be valuable in some cases but not in others. I think that is wrong to exclude it but I think it is equally wrong to oversell what GM is going to do: it is not, by itself, going to feed Africa, but it might help in certain cases. I think we do need to invest in highly technical parts of agronomic research, but we equally need to invest in some of the neglected subjects. I suspect they are slightly less neglected in Portugal than in the UK and America, for example: agronomy, agro-ecology, soils. There are only about four working soil scientists left in the whole of the UK. I think there are also barriers to getting the research into the field and we need to understand much more of the social and economic context of innovation. In the research community, we tend to go and tend to do our research and then sort of say "Hey, you farmers! Take this and go and run with it". It is really important to work with recipients from the beginning, especially in less developed countries. We also need to get right the relationship between the different funders of the generation of new knowledge. What is the right role for the public sector? What is the right role for the private sector? Increasingly, a third sector, with groups such as the Bill and Melinda Gates Foundations and others as well, are becoming highly influential.

Let me say a little bit about demand. As the President of the Calouste Gulbenkian Foundation said, it is literally impossible for the world to have a western diet. We could not produce enough meat to satisfy this demand. There are some straightforward research questions here, two of which I will highlight. First, we do not yet know enough about the environmental footprint of different food types. I have been rather unfair, just talking about meat and the environmental harm of meat. Certain ways of producing meat, especially chicken and pigs, are extremely efficient. Two months ago, I was in Kenya, with the Samburu people, in the north. They only eat meat and milk products. They cannot grow anything there, so we have to be very careful about demonising one type of food. We also need to understand better what makes people eat different types of food, following up research on how people respond to food that has different health consequences.

But I think the real issue is how we as consumers are able to take more informed decisions. Better labelling is certainly part of it but not everything: better education and better food literacy is needed. But I am not someone who believes that consumer behaviour alone is going to give rise to sufficient changes of the right magnitude in the type of food that we eat.

One of the most important things we need is informed debate: discourse in civil society of a sufficient level that politicians are legitimised to act, to take the decisions that, at the moment, are too hard for them to make: to legislate, to tax certain types of food, maybe even to ask the private sector to restrict what they put on their supermarket shelves. I think one can draw a parallel with smoking. We have known, as a matter of fact, that smoking kills us for 50, possibly 60 years. There has been really no doubt about that in the scientific world. And yet, it has taken 30 or 40 years for a civil society discourse on smoking to have got to a level that governments have been able to act. Probably, the most extraordinary thing that has happened in my adult life, something I would never have predicted when I was 20, is that you cannot smoke in a restaurant in Paris! And I think we need to have as sophisticated and as difficult discussions about some of the issues around what we eat.

We also waste a lot of food. About 30% of all food that is produced is never consumed; a lot of it in low income countries is wasted on the farm and in the transport system. In high income countries, we waste it at home, in restaurants, and in the food service sector. There are things that can be done to address all of this, but I think we have to be quite sophisticated here. Some people say that there is not a food problem; we just need to stop wasting 30% of what we produce. But you need to take a hard economic look at this. The hard economics will tell you some good news. One of the reasons that we waste so much food at the moment is food is so cheap. As food gets more expensive, then we will stop wasting at least some of it. During the Second World War, 2% of food was wasted in Europe. Prices will never get high enough again (I hope) to drive waste that low. Further reductions will require that people have the food literacy and skills to know what to do. I suspect that our mothers and grandmothers will be appalled about how little we know about food compared to their generations. Some waste actually makes sense economically and even environmentally. So, I think it is foolish to think that it is just an easy big winner there, but nevertheless there are clear gains from being more efficient in food.

And then we have this really important challenge of improving governance. Trade is critical for food. Food self-sufficiency in a globalised world is nonsense, and we are not going to turn back globalisation. I think that the real challenge, as Nobel Prize Winning Economist Joseph Stiglitz put in his important book, “Globalization and its Discontents”, is how we get globalisation working in favour of food security. A well-functioning global food system allows different countries protection against

production shocks. What we know from climate change is that greater geographical areas are going to be affected. More and more, we are going to see events like the wheat crop in Australia drop or major disruptions to maize productions in North America, requiring the development of a functioning global food system that allows different areas to compensate for each other.

And trade that also allows the world to exploit a comparative advantage; for example, the wonderful opportunities that exist for producing grain in the old Soviet Union countries and in Brazil. But this is a complicated topic involving difficult discussions about protectionism, tariffs, the rights of poor countries and how to develop liberalised trade rules. There has been some good news recently. If you compare the 2008 and the 2010 food price spikes, the lessons of harmful protectionism in 2008 were learnt and fewer were imposed in 2010.

Another important issue is volatility. Volatility is a bad thing, as it causes market inefficiency and is likely to increase in the future. A lot of people have thought that the movement of investment capital from American mortgages and other assets into commodities might be one of the reasons we have seen a lot of volatility recently. My reading of the evidence is that speculation was a major factor behind recent food price spikes. Looking to the future, it will be important to monitor modern commodity trading and it is particularly critical to increase market transparencies. People have called for a global system of grain reserve but I worry very much that it will become a target for speculators. There will always be some volatility and we need innovative ways of thinking about how we can provide appropriate insurance for individual producers, especially in poor countries, but also sovereign insurance for poor countries. I think if the ingenuity that the banks have put into developing ever more credit default swaps and other derivatives had gone into producing financial tools that would actually help poorer countries cope with volatility, we would be in a much better place,.

I shall touch on two further important issues. The first issue is ending hunger. I think that one of the problems with agriculture, food and the poor over the last 30 years is that there has been an ideological belief that investing in low income countries' agriculture is not a good way of helping them. I think that this is changing. There is a growing recognition of the benefits of agriculture, how it produces food, bolsters rural economies, and often gets money into the pockets of women, who produce 70% of the food in Africa. But there have been decades of underinvestment. We must rebuild

the infrastructure and we must increase the political importance of agriculture. I have spoken to senior civil servants in African countries who say that there is no prestige in working in agriculture departments. They want to work in finance, the foreign office or in health; agriculture is right at the bottom. That must change. Smallholder farmers are absolutely critical to increase food production. Yet, I think that there is a real danger in romanticising smallholder farming to the exclusion of all others. Smallholders must be a critical component of the solution. But there is probably a place also for larger scale farming, at least in some areas. And we must do better at scaling up best practices. Africa is full of model villages, where things work well, but we are bad at scaling up and at monitoring evaluation.

Finally, a few words on sustainable foods and on sustainable food systems. Consider first, climate change. We need to be better able to assess the vulnerability of different communities. We know that we are going to get a two-degree increase in temperature. No one I know in the physics community, working on climate change, thinks it is going to be under four degrees. That is pretty frightening. We shall need a lot of adaptation, using both existing knowledge and new knowledge. We also have to look for the potential for agriculture to help mitigate climate change. We need increased efficiency, so that agriculture produces fewer greenhouse gases, especially methane and nitrous oxide. A lot of greenhouse gases can be reduced by better animal husbandry, by more efficient use of fertilisers, including manure. We can use waste more efficiently. We must also have a very much more sensible biofuels policy. The way we are implementing biofuels in the States and in Europe is plain crazy.

And finally, let me just say a word about biodiversity. We need a multifunctional landscape that produces food but supports biodiversity as well. I think there are really hard issues of scale. We need a multifunctional landscape but should we try to optimize biodiversity everywhere or should some areas concentrate on food and others (for example, the wonderful cork-growing and pig-rearing systems that you get in the east of this country in the Alentejo) concentrate on biodiversity? These are really hard questions, which I do not think either the environmental community or the agricultural community have really gotten to grips with yet. Is it hard because we do not all share the same values when it comes to biodiversity? Many people do not care about biodiversity. How can we get a consensus? There are issues of governance, there are issues of the rights and vulnerabilities of the poor, and as I said, there is a need for more sophisticated discourse.

This is a unique time in history. I am a population biologist and I am more optimistic now, aged 53, than when I was 25. Twenty eight years ago, you could not make an intellectual argument that global populations were to peak naturally. We now know that demographic transition will happen, that if we do things right, there will be an end to global population growth. We can, for the first time, really consider that Malthus was wrong. Humankind now dominates the global system, water, carbon, nitrogen; anything you think about is dominated by human actions. But since the end of the cold war, there has been very much a global consensus on ending poverty. The food system is going through radical change, a phase change. We are moving from a time where, at least in a rich world, the problem was producing too much food to a time where high demand is the issue. The food system and food thinking need radical and profound change along some of the lines I have talked about this evening.

My final message is the following: if we fail on food, we fail on everything. What are you most interested in? The poorest in developing countries? If we fail on food, we cannot help them. Are you interested in biodiversity? If we fail on food, forget biodiversity. Are you interested in climate change? We are not going to get any attention on climate change and on reducing greenhouse gases if we fail on food. Food is absolutely critical to what will happen over the next 40 years.

The CAP and the globalisation of agri-food markets

Arlindo Cunha

I am going to talk about the way the European Union dealt with the issue of food when it was founded, how it deals with it today and how, in the meantime, it has managed to adapt to globalisation; in other words, how it managed to move from an internal policy that was generically protectionist and which distorted international competition, to one based on a multilateral and disciplined view of the agri-food business. To do so, I will focus on the origins of the Common Agricultural Policy (CAP), how it has developed over time, the globalisation model of the agri-food markets that came out of the WTO's Uruguay Round and the perspective for development in the near future.

The historical model of the CAP: aiming for food security

We live in a Europe that currently has no food security problem, in the sense that its markets are regularly supplied. Our bellies are full and, on top of this, food is relatively cheap. However, it was not always like this and it will probably not be like this in the future, taking into account the latest international forecasts, which indicate a 70% increase in the demand for food by 2050 (MAMAOT, 2010). In reality, when it was founded in 1957, the then named European Economic Community (EEC) had a serious food problem, and it was precisely to solve this problem that it created a policy at a common level – the CAP. The political importance afforded to this issue can be seen in the emphasis and development that the Treaty of Rome gave the CAP, which, for many years, was virtually the only child of the European Union's common policies.

Consequently, part of this Common Agricultural Policy boasted a rationale of food security. Europe had survived a devastating war and, in

addition to being left poor, it lacked a basic food supply. As such, production had to be stimulated in order to ensure a regular and secure supply of food. So, the Common Agricultural Policy was created and based on a model that nowadays would not be acceptable under normal conditions; however, at that time, it was not just understandable but also justified. The core elements of the first 30 years of the CAP were a system of high guaranteed prices to encourage farmers to produce more, and an import threshold price and variable levies system. This system of variable tariffs (normally designated as levies) ensured that any imported product under this protectionist regime could only be sold on the internal market above the minimum entry price and intervention price. As a result, we had a Common Agricultural Policy that was constructed in such a way that whatever came from outside could only be sold on the European market at a relatively high price and never below the internal intervention price. Such a system corresponded to what is usually called the community preference system. The way it operated meant that market operators had no economic incentive whatsoever to import, due to the system of levies (unless in situations of scarcity), and the generous system of internal intervention prices encouraged community producers to produce more and more. Years later, when the European Union began producing a surplus of certain products, community preference began to work in the opposite direction. However, as internal prices were very high in relation to those of the world market, the only way of exporting was to use a system of export subsidies.

An important question to ask is how it was possible for the European Union to create such a protectionist agricultural policy. The answer is very straightforward: because, at that time, agriculture was not part of what we now call globalisation. Despite the GATT (General Agreement on Tariffs and Trade) having existed since 1947 as a multilateral trade agreement, agriculture operated under different rules[1] to those in the world of multilateral trade.

Within this context, each country had the right to define and implement an agricultural policy that suited it best without being subject to international constraints. It should also be noted that there was a great deal of understanding given to the European Union because it had endured World War II and had a serious food problem to solve. Because of this, there was a great deal of tolerance in relation to Europe establishing a protectionist agricultural policy that encouraged domestic production.

1 Known as the agricultural exceptionalism clause.

Due to the systems of intervention prices and minimum entry prices, this initial CAP model was designed in such a way that farmers could ensure a satisfactory level of income by selling their products in an internal market at prices that were considered minimally remunerative.

The Common Agricultural Policy was essentially a policy of prices and markets and, at the same time, something that operated to protect farmers' income.

It is also important to stress that, at the time, there was a major dichotomy between the income of the agricultural population, which accounted for over 20% of the active population, and the remainder of the population working in the other economic sectors; which meant that protecting agriculture and encouraging production meant increasing income for farmers and, consequently, creating a policy of social cohesion in the process.

As we know, the CAP was a huge success, given that, with an internal system of state purchase and import protection, there was no great economic risk for farmers' production decisions because they were always protected by the system of public purchase at reasonable prices. The CAP was so successful that, in less than a decade, Europe moved from a net importer to a relatively important exporter at a world level, particularly in the areas of cereals, beef, dairy products and sugar – which are essentially the most important commodities in human and animal diets.

The consequences of the Uruguay Round: "settling the score" with the CAP

With the continued policy of subsidising exports, the EU was creating adversaries in the international market, using and abusing dumping practices, to the point where subsidies for exports were absorbing almost half the agricultural budget. What is curious is that the United States (which was already a major agri-food power at the time) was one of the countries that insisted that agriculture should be left out of the GATT in 1947 (Josling, 1996). Such a position was not innocent, given that the country had a very dense agricultural policy with generous subsidies, and they did not want any international constraints made on their internal farm support decisions. When the USA finally realised that the European Union was doing the same two decades later and were starting to make inroads in international markets, they initiated an international campaign against the CAP and the agricultural policies of relatively protectionist countries, like Eastern European countries, Japan, Korea, Switzerland and Norway. It was through the lobbying of the international coalition for the deregulation of

agri-food trade (embodied in the Cairns group[2] and supported by the United States), almost 30 years after the CAP began operating, that agriculture was finally subject to the rules and discipline of multilateral trade – which was achieved within the framework of the Uruguay Round of the GATT (which then became known as the World Trade Organization – WTO).

In general terms, the agricultural chapter of the Uruguay Round (via the 2004 Marrakesh Agreement) obliged those countries which signed it to abide by the following objectives for six years, between 1995 and 2000[3] (WTO, 1999):

- A 20% reduction in internal support (13% for developing countries over 10 years);
- The reduction of import protection (improving market access) by 36%;
- A reduction of export subsidies (36% in value and a minimum of 21% in volume). For developing countries (DC), these figures were 24% and 14%, respectively, over 10 years;
- The end of levies, with all custom's protection ensured by means of ad valorem tariffs;
- Negotiation of basic rules (which the experience of these years has demonstrated to be rather poorly defined and insufficient) in three main areas: i) sanitary and phytosanitary measures (SPS Agreement); ii) geographical denominations, trade-related copyright and intellectual property (TRIPS agreement); and iii) product labelling rules (TBT agreement);
- The establishment of a safeguard clause, which allows temporary protection from the internal market if there is a major drop in world prices or an unusual increase in imports of a particular product;
- The establishment of a peace clause, which is a kind of non-aggression pact through which the countries involved make a commitment not to question the agricultural policies of their partners (provid-

2 Coalition of thirteen agricultural export countries: Argentina, Australia, Brazil, Canada, Chile, Colombia, the Philippines, Fiji, Indonesia, Malaysia, New Zealand, Thailand and Uruguay. The United States of America was not part of the group, but it was strategically similar in its approach.

3 All of the percentage objectives to be achieved were based on the reference period of 1986-88. The different types of support for agriculture make up what is called the AMS (Aggregate Measure of Support), which currently corresponds to 38% of the total income of farmers in OECD countries. These subsidies were put into three categories or boxes: the green box includes measures that are not considered to distort competition, such as agro-environmental measures, subsidies for vocational training or compensation for less favoured areas; the amber box has the subsidies that are considered to be those that most distort international trade, such as high intervention prices or export subsidies; the blue box has the compensatory assistance for the reduction of intervention prices used in the 1992 CAP reform and the old American deficiency payments.
The subsidy reductions mentioned refer only to those in the amber box, which account for over half of European agricultural subsidies, but just less than 20% in the United States, which is a factor that clearly distorts competition to the detriment of the European Union.

ing that they are part of the Marrakesh Agreement) until the end of 2003, thus leaving a three-year period after the end of the agreement to make allowances for any delays in on-going negotiations.

Essentially, there was a reduction of internal subsidies, which were more distortions of competition, protectionism was reduced, access to the market was improved and a schedule for the reduction in export subsidies was established. Regarding this last point, since the 2005 Hong Kong ministerial conference, all parties agreed that every type of export subsidies would be banned from the next round of the WTO (2005).

As such, it is worth noting that it is the Uruguay Round of 1994 that makes agriculture becoming part of globalisation, and with this, the end of the total autonomy of WTO member states to define their own policies; in other words, the end of agricultural exceptionalism.

The process of CAP reforms: competitiveness, cross-compliance, food safety

External pressure from the EU's trade competitors in agri-food was one of the main, if not the main, reason for the major reform of the CAP in 1992, having been the sine qua non condition for allowing the WTO's Round of Uruguay negotiations to move forward (Cunha & Swinbank, 2011).

The 1992 reform was just the first in a continuous process, which included the reforms of 1999 (Agenda 2000), 2003 and 2008 (CAP Health Check). The reforms were essentially based on a rationale of lowering internal prices, weakening guarantee mechanisms and reducing import protection, with compensation for reduced prices via direct payments. In other words, prices now reflected the realities of the market and farmers' incomes are ensured by means of direct payments.

As a result of these reforms, the EU controlled the problem of surpluses **(Figure 1)** and drastically reduced intervention prices (from 1991 to 2008) in particularly sheltered sectors, attaining 85% for hard wheat, 84% for rice, 80% for soft wheat, 77% for sugar, 73% for beef, 68% for butter and 61% for powdered skimmed milk (European Commission, 2009a). Such drastic reductions introduced a more competitive market rationale to the CAP.

More important than the price reductions was the significance of the reforms. Before 1992, 70% of the CAP budget was for price support measures, including export refunds and only 10% for direct subsidies, including support for rural development.

After the reforms, the CAP now spends 20% less on the first type of measure and over 80% on the second type **(Figure 2)**.

From the consumer's point of view, and in terms of external impact, the difference is huge. With support via artificially high intervention prices, consumers were penalised with the products they bought on the market. And because high prices encouraged increases in production and the creation of high levels of surpluses, the budget was also called to subsidise exports, as European produce would not be competitive on the international market due to high prices in the EU, as has been previously mentioned.

Before the reforms, export refunds accounted for an average of approximately 25% of the value of exported products, which was a very powerful political stimulus for the creation of artificial competitiveness, leading to the distortion of competition in relation to those who operate in international markets with the EU. After the CAP reforms, refunds account for no more than 9% of export value. Before the reforms, they accounted for around half of the CAP budget, while the current figure is 5%.

After the 2003 reform, direct subsidies became decoupled from production, which meant that producers received an annual amount, regardless of what they chose to produce, as long as they abided by the rules of cross-compliance. It is worth highlighting that this decoupling was once again due to pressure exerted by the WTO (Cunha and Swinbank, 2009), in order to save the planned reduction of direct payments within the context of the Doha Round, as, not being non-production based assistance, they were subject to considerable cuts according to the proposals made during those negotiations (WTO, 2003b).

Finally, we should stress three other important changes that were introduced via successive reforms to the CAP: first, the substantial consolidation of tools geared towards the development of rural areas, including support for modernising agricultural structure, the environment and animal welfare; second, achieving stable expenditure, with the CAP absorbing less and less of the community budget; and third, a seamless compatibility with the rules of globalisation, achieving good trade relations with external competitors and exporting to the world market, practically with no need to use export refunds.

Post-2013 CAP: improving the agricultural policy model with equity and cohesion

We are currently discussing the new CAP reform. It essentially aims to consolidate the agricultural policy resulting from the reform process, with two main concerns: demonstrating the reason for the budgetary

costs of the CAP to European citizens and breaking away from the historical model of how support is distributed, introducing equity among farmers, producers and regions.

The rationale of direct subsidies for agriculture is important, in order for citizens to understand why the European Union spends close to 55 billion euros a year on its agriculture and farmers.

First, Europe chose to have strong agriculture throughout the continent, not only for economic reasons but also for reasons of territorial, environmental and social balance. This demonstrates an understanding and appreciation of agriculture as a public good, which has to be supported via a common policy and budget, as the market cannot guarantee such a thing[4]. Second, the European Union opted to be part of globalisation when it accepted the rules of the agricultural agreement of the Uruguay Round. Consequently, as it cannot guarantee its farmers a decent standard of living through market protection, as it did before CAP reforms, it does so now through direct subsidies unrelated to production. Third, because the European option of producing foods to satisfy its needs through regular supply also means that farmers have to abide by a huge list of cross-compliance standards that are considered to be fundamental values of our society by Europe's political leaders. These standards imply additional production costs, which have a negative effect on the competitiveness of European agriculture within a global context. As the World Trade Organization does not yet have rules that oblige competitors from non-EU countries to comply with similar standards, the only way of ensuring fair competition and the survival of European agriculture is to compensate producers via compatible CAP measures and mechanisms, such as direct subsidies or rural development measures.

The issue of equity in the distribution of assistance is also important for the public's perception of the CAP, which has two major contradictions: i) the current direct subsidies for farmers (which represent 78% of the budget for the first strand of the CAP) are attributed according to the historical productivity that existed at the time when they were created, compensating for the reductions in intervention prices made in successive reforms since 1992. The 2003 reform decoupled the majority of that support from production but it maintained the basis (and criteria) of how it was determined and distributed; ii) only those farmers whose production intervention prices were reduced at the time of the reforms were entitled to such assistance **(Figure 3)**.

4 In economic terms, an example of market failure.

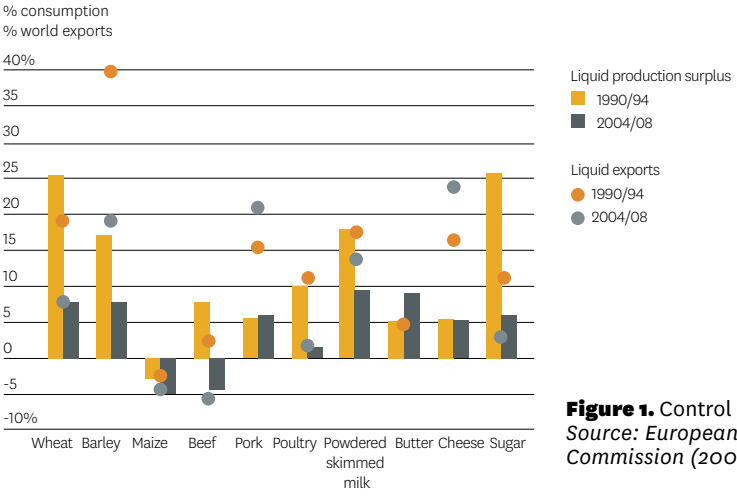


Figure 1. Control of surplus. *Source: European Commission (2009a)*

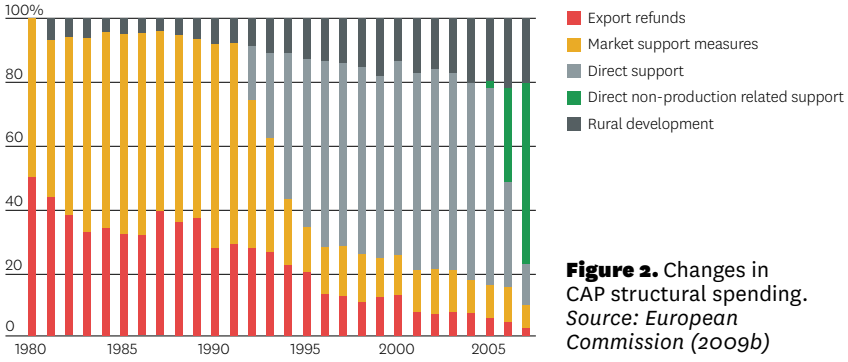


Figure 2. Changes in CAP structural spending. *Source: European Commission (2009b)*

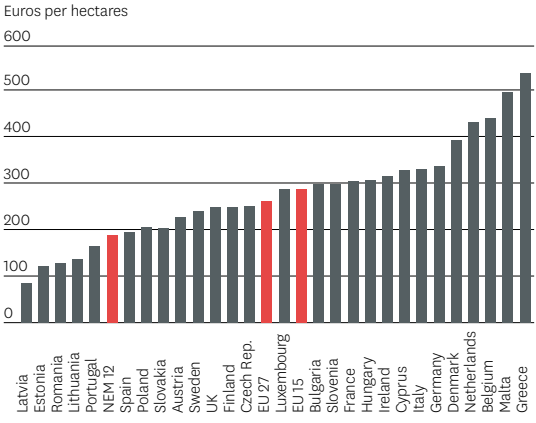


Figure 3. Direct support by member-state in 2008. *Source: European Parliament (2010)*

Three conclusions are immediately clear in terms of justifying the need to reform the CAP in the post-2013 period: I) we are not helping all farmers, but only a few and, among these, the level of support is very uneven, both within countries and particularly between countries; II) we are paying more to those who need it less, as the most competitive farmers (due to greater production and larger holdings) are the ones who receive the most; and III) we are providing support based on criteria that contradicts the abovementioned positive externalities.

In other words, we have an issue of dual personality in the current CAP: one to defend the agricultural budget before public opinion (the personality with the political discourse of multi-functionality and public goods and the positive externalities of agriculture); and another, diametrically opposed, to distribute assistance to countries, territories and farmers.

Does this globalisation have a future?

The globalisation of the world economy has been clearly reflected in agriculture. Figure 4 shows that the main exporter of agri-food products is the United States, followed by the European Union, Brazil (which, surprisingly, exported almost the same amount as Europe exported 10 years ago) and China, which was virtually unknown in these markets a decade ago.

In terms of imports, the European Union is a clear first, followed by the United States, China and Japan. It is worth noting that China is still a major importer of agri-food goods, much more than it is an exporter, which is the opposite of its situation regarding manufactured goods. In contrast, Brazil is very much an exporter and imports relatively little, in global terms **(Figure 4)**.

A bigger question in this context is if this globalisation model has a future. As we know, in terms of the agri-food sector, the result of the Uruguay Round agreement was a model that was more geared towards quantitative issues rather than qualitative ones; one more focussed on the objective of promoting the increase in commercial exchange than a multi-functional view of agriculture – a concept that involves giving greater priority to issues, such as preserving agricultural activity throughout the territory, cross-compliance, food safety, regular and secure supply, or even animal welfare.

For the last twelve years, we have been negotiating a new World Trade Organization agreement (the Doha Round), which is demonstrative of the problems involved and how few are in a rush or keen to continue in the

same vein as the Uruguay Round. There are three pressing issues for the future: the balance between the different elements of the deal; the type and degree of support for the poorest countries; and the model of globalisation itself.

The first is that globalisation has to move towards a better balance between economic or quantitative aspects and qualitative ones; in other words, those related to rules regarding certain standards, whether they be environmental, social, related to public health or animal welfare. It, therefore, becomes important to consolidate and simplify the qualitative and regulating mechanisms, without which there will be neither fair competition nor harmonious and sustainable development.

The second is that a considerably different approach is needed for the poorest countries. If the evidence of the last few years of globalisation shows anything, it is that the biggest winners are not the poorest countries; indeed, quite the opposite. In terms of the agri-food sector, more than ever before, the next WTO Round needs to come up with a radical solution for these countries. It was because of this issue that the European Union proposed the Everything but Arms initiative to its WTO partners, in which the richest countries in the world and some should accept all agri-food exports from the 50 poorest countries, with the exception of arms and ammunition, free of all types of tariffs and quotas. Sadly, until now, only the European Union is implementing this initiative.

In Figure 5, we can see the percentages of agri-food imports of the richest countries from the poorest.

We see that in 2008-2010, the European Union imported 60 billion euros worth of goods, with 71% of its imports coming from developing countries.

In contrast, the next five richest countries, New Zealand, Australia, Canada, Japan and the United States, on average, only bought 40% of their imports from this group of countries. Another important measure of these countries would be the creation of a Food Security Box or Development Box, which would go some way to preserving the internal market of the poorest countries so as to foster their domestic production and not be inundated with imports at low prices; in other words, using the argument of affording emergent industries protection during a transitory period from the markets of these countries, considering that they are not in a position to compete with major agri-food powers **(Figure 5)**.

The third important issue for the future, which, in this context, I will just mention, is that, faced with the very unequal world we live in, would it not be better to approach globalisation in terms of regional blocks?

Personally, I agree with this approach because no development process seems sustainable in the long term if it is not based on greater cooperation between neighbouring countries and territories.

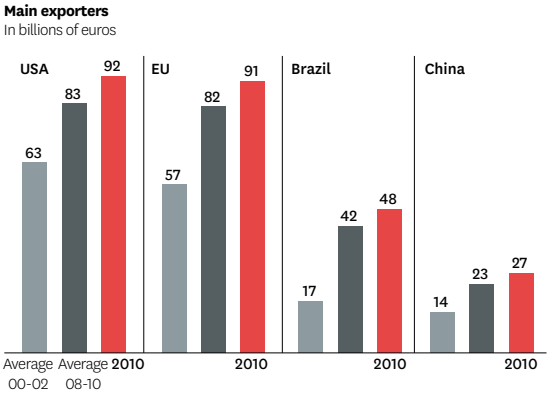
Final points

Until recently, we thought that feeding the world's population was a problem already solved. However, it is not. Of the positive impacts of globalisation, one of the greatest is the improvement in the living standards of many people, particularly those in Asia and South America, whose diets have improved considerably. However, nowadays, there is a good chance that demand for food will outstrip supply. With this forecast of relative food scarcity, it seems important that the approach to globalisation should be more focussed on regulation and a multi-functional view of agriculture, which involves, inter alia, a concern for regular and secure supplies.

Indeed, the food crisis of 2007-2009 was a lesson; faced with a serious lack of certain commodities, some of the countries that were the most enthusiastic about deregulating agri-food trade, like Argentina and Brazil (as well as India), were the first to place restrictions on their agricultural exports. In other words, we learn that countries need the right to a certain degree of self-sufficiency in terms of food production and that they cannot be overly-dependent on imports to supply their markets.

It is within this context that the current debate and later negotiation of the CAP for the 2014 to 2020 period should incorporate a profound reflection upon what we want from agriculture and this policy: a type of multi-functional agriculture more geared towards a balanced rural world without disproportionate concern for international markets? Or, alternatively, should we focus our concerns on international markets and aim to resolve the predicted world food shortage? It is a debate with no consensual response, due to the interests of the various countries involved, and, as we know, there is no such thing as a free lunch in this area. The two options do not have to be mutually exclusive, although it is vitally important to decide where the emphasis is placed and to arrive at a strategic option.

Today, the European Union boasts agriculture, based on high-level technology, that is highly competitive in various sectors and exports a considerable amount of what it produces. The EU has a very high standard of living, a high cost of living and it has imposed particular rules on its producers, particularly demanding rules in terms of the environment and animal welfare which, as previously mentioned, have a significant effect on production costs.



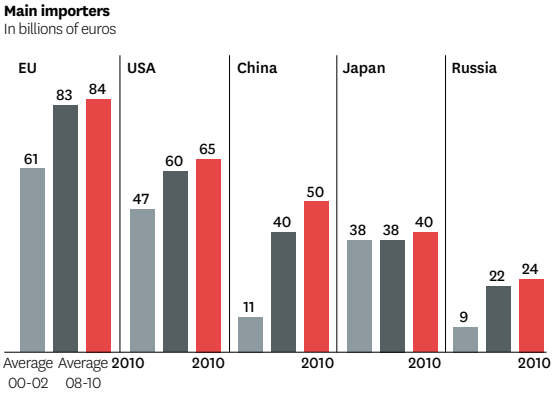


Figure 4. Main exporters and importers of agri-food products. *Source: European Commission (2011)*

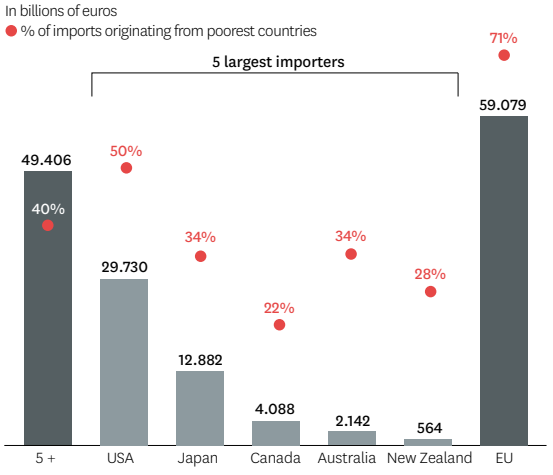


Figure 5. Agri-food imports in the richest countries from the poorest countries. *Source: European Commission (2011)*

As it opted for globalisation within the WTO framework at the same time, it has to find compatible solutions in order to preserve its agriculture, meaning that it has let its agricultural policy evolve so as to be compatible with these multilateral trade rules. However, these rules are not immutable, nor do they seem to be the most suitable and sustainable in the long term. Within such a context, the EU has every right to preserve its agriculture, its territories, and its strategic food reserves, as any other country has the same right. Obviously, if it does all this while maintaining competitiveness, it will also make a contribution to reducing the predicted world food shortage.

Bibliography

/ European Commission, 2011. *Monitoring Agritrade Policy*, no. 01-11
/ European Commission, 2009a. *Agricultural Policy Perspectives*. Brief no.1.
/ European Commission, 2009b. *Why do we Need a Common Agricultural Policy?* Working Document DGAgri.
/ Cunha, A., Swinbank, A., 2011. *An Inside View of the CAP Reform Process: Explaining the MacSharry, Agenda 2000, and Fischler Reforms*. United Kingdom: Oxford University Press.
/ Cunha, A., Swinbank, A., 2009. "Exploring the Determinants of CAP Reform: A Delphi Survey of Key Decision-Makers", *Journal of Common Market Studies*, 47(2): 235-61.
/ Josling, T. E.; Tangermann, Stefan; and Warley, T.K., 1996. *Agriculture in the GATT*. London: Macmillan Press.
/ MAMAOT – Ministério da Agricultura, Mar, Ambiente e Ordenamento do Território, 2010. *A agricultura portuguesa e o futuro da PAC pós-2013*. Document drawn up by the Expert Group created by Order 7164/2010 from the Ministry of Agriculture, Rural Development and Fisheries.
/ European Parliament, 2010. *The Future of the CAP after 2013*. Working Document, Committee on Agriculture and Rural Development.
/ WTO, 1999. *The Legal Texts – The Results of the Uruguay Round of the Multilateral Trade Negotiations*, Cambridge.
/ WTO, 2001. *Doha Ministerial Declaration*, Doha.
/ WTO, 2006. *World Trade Report – Exploring the Links between Trade and the WTO*.
/ WTO, 2005. *Hong Kong Ministerial Declaration*, Hong Kong.
/ WTO, 2008. *Revised Draft Modalities for Agriculture*. TN/AG/W/4/Rev.1.

Food and health

Human diet: health, environment and equality

Isabel do Carmo

The human diet currently poses new kinds of problems, since the needs are different, as is the knowledge. In what are now called developed or industrialised countries, the issues a century ago concerned "hygienism", calorie sufficiency and even the sufficiency of certain nutrients that had been discovered to be essential. How everything has changed in a century and even between current generations!

We are vaccinated, we take antibiotics for gastro-intestinal infections, cities have basic sanitation, we have learnt to regularly wash our hands and we drink highly pasteurised milk. We live twice as long and also dream of longer, better-quality lives. Hence, we eat for twice as many years, which means consuming at least twice the amount of food, if satiation is rational... And as the development of the means of production keeps pace with needs (while also creating new ones), the agro-industry has expanded massively in the production and distribution of foodstuffs.

As all of this has occurred in a deeply unequal world, but one open to communication and trade, we have to free ourselves from the individualistic and limited concept of our own food in order to embrace a more complex way of thinking.

As such, when we talk about our food, we are talking about:

- Food that not only allows us to survive, but also increases our chances of well-being and good health, contributing to reducing risk factors of early death and morbidity;
- Foods whose production does not involve ecological risks, harming nature, resources and, consequently, human beings themselves;
- A form of production and distribution that is not carried out at the expense of hunger or scarcity for many while providing abundance for others.

Is it possible to combine and achieve these three aspects? As this is not a mathematical equation but rather a human one, it seems it is up to us to solve it. However, it is not just a matter of will. It is an intricate economic, political and social issue. It is also a scientific issue, which begs reflection.

Calorie consumption in the developed world and beyond

The agro-food industry boom in the developed world and the apparent problem human homeostasis has establishing levels of satiation, has led to growing calorie consumption in European countries and North America. Often, average calorie consumption far exceeds that which is calculated to be what men and women actually need, particularly in countries where most work is done with the assistance of machines and people predominantly use transport.

In contrast, when we look at how calorie consumption has developed in Latin America and Asia, we can see that, on average, the populations in those parts of the world have evolved since the 1960s until now and no longer go hungry. They have exceeded what are considered to be average needs. Although inequalities continue to exist, the below-average consumption of one part of the population is compensated by the above-average consumption of another. In fact, there are major differences between rural and urban Brazil, between Beijing and parts of rural China, between North and South Asia. However, even considering the decreases in calorie consumption, it is clear that a part of the world's population no longer goes hungry, which coincides with some of these countries (Latin America) freeing themselves from dictatorships.

The same cannot be said for Africa. Even considering the abundance of certain population niches in Africa, average calorie consumption on this continent remains below the level of needs, which means there are great swathes of people going hungry (FAO, 2012).

This is the state of the world at a time of globalisation and free trade **(Figure 1)**.

For those of us who live in the area of calorie excess, the problem is where that excess energy goes.

Generally it accumulates in the form of fatty tissue on the human body. According to various epidemiological studies, this excessive fatty tissue is potentially harmful to people's health and increases the likelihood of early disease or death.

Therefore, the question is why human beings do not possess a homeostasis system that provides signs of satiation, much like the hunger pangs

we get in moments of need. It is a mystery that begs some attempt at a response.

Attempts have been made to explain this insatiable behaviour using two approaches that may be complementary. On one hand, there is the evolutionist perspective, which would explain the survival of the species via mechanisms that take advantage of calories and create reserves, which allow people to endure periods of scarcity, alternating with periods of abundance (Zimmet *et al.*, 1990). On the other, it has been shown that dietary behaviour is generally automatic and located in areas of the central nervous system, which is free of permanent cognitive control and stimulated by the proximity and characteristics of food (Cohen, 2008a). In other words, the first hominidae and human beings were selected within their genetic system as good exploiters, maintaining automatic mechanisms that encouraged the impulse of consuming whatever is closest and highest in calories. The agro-food industry has taken advantage of our innate desire (Cohen and Farley, 2008b). A sedentary lifestyle is also a risk factor.

Food and social class

In developed countries, when one talks of food consumption and health consequences, we tend to talk about averages, which ignores distribution by social class, generation and region within each country.

In Portugal, we have not had a national food survey since the 1980s. The EPIPORTO study offers us a pattern of consumption in the Porto region (Lopes, 2006); the Study on the Prevalence of Obesity in Portugal was accompanied by a questionnaire on frequency of consumption, which provided us with some results regarding excess weight (Camolas, 2008) and some local studies, which were also mainly on the aspect of obesity, have given us other information.

However, what are we saying when we talk about what the Portuguese eat? The most accurate figures come from the Instituto Nacional de Estatística (Statistics Portugal), which demonstrate the quantity of food available for consumption, taking into account imports and exports (INE, 2012a). These are important indicators, particularly because they give us an idea of how things have developed, although none of these studies provide us with results based on social class. Once again, we are talking of averages. However, there are alarming distribution figures – a 3.7% drop in sales figures in the first quarter of 2012, the most significant in 15 years (Cardoso, 2012). Therefore, it is risky and socially dangerous if, when

looking at the figures, we come to the conclusion that "we are eating too much meat", for example.

Who exactly are we talking to? To a non-existent average person? Are we talking to social groups of major meat consumers or to those who go to the butchers to ask for "scraps", which were previously reserved for dogs (Pinto, 2012)?

An indicator of social differences in developed countries is the distribution of obesity. In all of the countries where the relationship between obesity and social class was studied, it is most prevalent in lower income groups. This was the conclusion in studies from Finland, Sweden, the UK, Germany, Canada and the USA.

In Portugal, the national Study on the Prevalence of Obesity between 2003 and 2005 provided clear results in this respect.

Professions and education were considered as indicators of social class. When we observe the distribution according to education, we see that the level of obesity is around four times less prevalent in the most qualified than in the least qualified **(Figure 2)**.

If we analyse the prevalence of risk due to a large waistline according to levels of education, we see that the lower level contains around double the number of people at high risk (Do Carmo *et al.*, 2008). These results indirectly demonstrate that food choices vary and can represent different availability **(Figure 3)**.

Crisis, hunger and needs

The current financial, economic and social crisis may highlight another issue. According to the Family Spending Survey undertaken by INE (Statistics Portugal) in 2009 and published in 2012 (INE, 2012a), there were around a million and a half Portuguese people with a per capita income of 550 euros or less, with some receiving well below that amount. In the same survey, it was calculated that average spending on food was 13.3%. These data indicated that people had an average of 2.43 euros to spend on food per day. It is believed that from 2009 until now, the situation has become much worse. According to the latest figures (Santos, 2012), there are 3 million Portuguese people living on 16 euros or less a day, with those living on less than 14 euros a day (2 million people) being considered indigent. As there are around 1 million unemployed people within families where pensions or wages have kept them from slipping into poverty or indigence (but still place them in a situation of need), it is no exaggeration to think that a large section of the population is experiencing quantitative and qualitative food

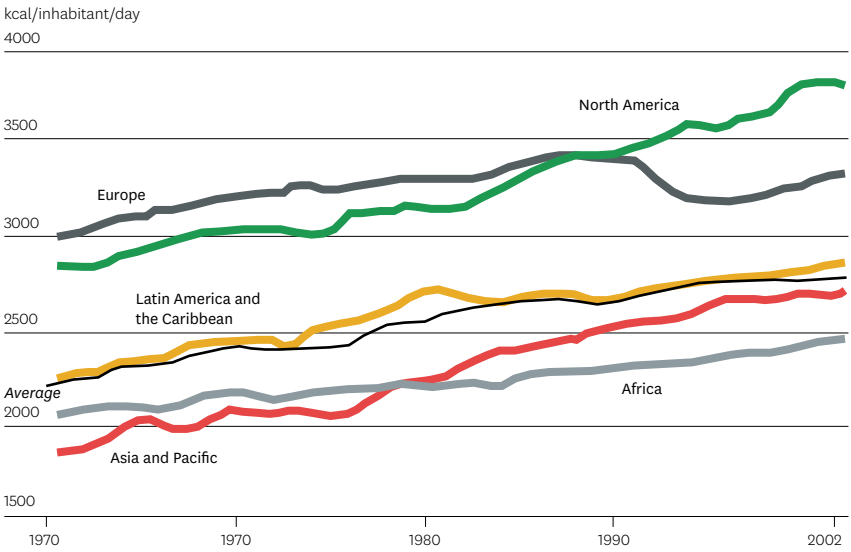


Figure 1. Changes in per capita calorie consumption (1961-2009).
Source: FAO internet data base (FAOSTAT)

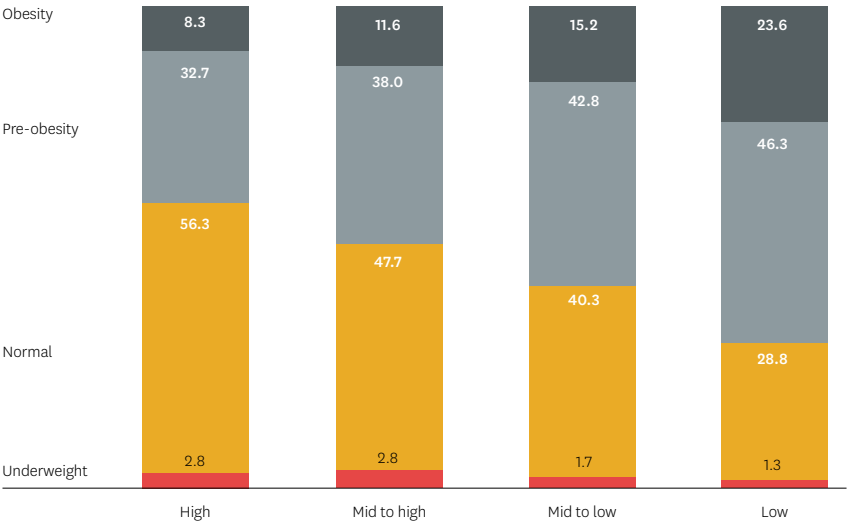


Figure 2. Prevalence of obesity and social class according to academic qualifications.
Source: Carmo et al., *2006*

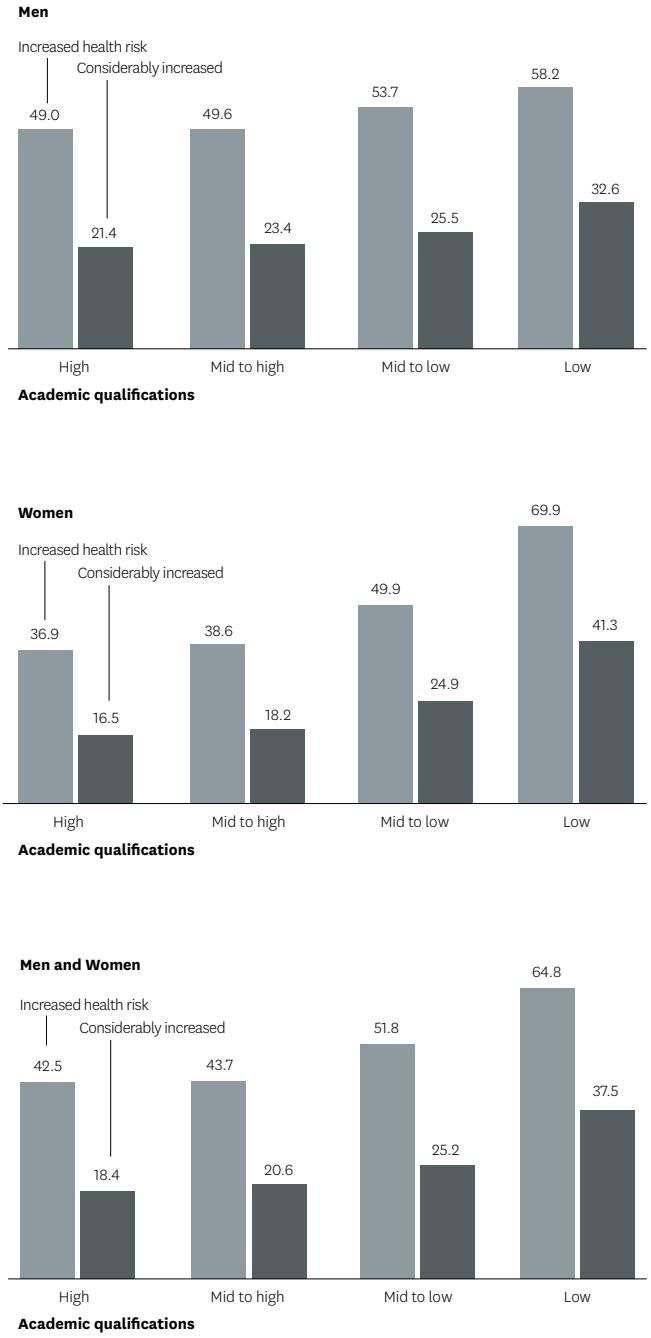


Figure 3. Prevalence of large waistline risk according to academic qualifications. *Source: Do Carmo* et al., *2008*

shortages at the moment. They are experiencing food insecurity or, in other words, "limited or uncertain availability of nutritionally suitable and safe food or limited ability to acquire appropriate food in socially acceptable ways" (Mahan, 2010).

We could risk saying that at least two million people go hungry, which means they consume less than they need. Hunger is a situation in which the energy consumed (generally counted in kilocalories) is inferior to that which is used. Let us suppose that a man burns 2,500 kilocalories a day; if he only consumes 1,200 kilocalories, he goes hungry.

This hunger may be voluntary, like on a slimming diet, using up reserves of fat, which is beneficial for health while continuing to eat food rich in protein, like dairy products, and vitamins and minerals, such as fruit and vegetables. It may be pathological, like anorexia nervosa. It may also be absolutely voluntary and used as a protest, like in the case of a hunger strike. In this case, where consumption is reduced to zero, water is taken but death occurs in a short space of time. Bobby Sands survived in Irish prisons for 70 days under these conditions. The current hunger in African countries south of the Sahara, in Southern Asia and a few years ago in South America is generally a situation of serious and drawn out calorie shortages, leading to a slow, painful and tragic death; an extreme degree of food insecurity in the community.

It was this degree of hunger that affected German-occupied Holland during World War II, Leningrad during the siege and Athens in the same period, like in the concentration camps. There are various degrees of hunger.

Returning to the previous example, if a man who works and burns around 2,500 kilocalories a day eats 1,200, he goes hungry; he feels hungry, he suffers the consequences of hunger but survives for years. The same man, if he only has access to 300 kilocalories a day, will survive but will eventually die of hunger. In Portugal and Spain, people died of hunger until the 1960s. In Spain, there are descriptions of situations at that time in Andalucía where population groups became gatherers again (Turmo, 1998).

These details about hunger are important because there is an open debate about the issue and the State needs to take on the role of guarantor of the survival of populations and we all have to know what we are actually talking about.

In situations of hunger, those most vulnerable are children, the aged and the sick. However, the entire population is affected. These children are more aggressive; they have more problems concentrating and their

growth will be affected (school meals are not enough). Pregnant women will have problems regarding foetal growth and the aged will be more fragile, more prone to depression and pseudo-dementia.

It is believed that a considerable section of the population has problems accessing sufficient calories, leading to food insecurity, which the Banco Alimentar (Food Bank), parishes, local councils, charities and other associations have tried to alleviate. However, these attempts are far from enough to meet needs.

Sandwich families

However, another significant section of the population makes dietary choices that provide sufficient or excess calories but cause other specific problems.

These choices lead to a shortage of proteins and micronutrients, such as iron, calcium, zinc, iodine, vitamin B12 and folic acid. This population can be considered part of what are called sandwich families (Costa-Pinto, 2010) in the study "Retratos de um Portugal em mudança" – Portraits of a Changing Portugal (Guerra, 2010), as reflected in the words of two people interviewed during field work: "Our situation is that of a squashed sandwich (...) It is a sandwich but then it's very squashed (...) We are on the edge of survival. Because I think that this is not being on the threshold of poverty, it's a threshold of survival. It's enough to live but"... (Vera); "You don't stop eating: you have a better lunch and then a worse dinner. You don't have one thing, you have another" (Filipa).

Some developed countries, like Sweden, Holland and the United Kingdom, have studied this problem, concluding that there are specific needs and malnutrition in countries with calorie sufficiency and a lower social inequality rate than ours (Ljungquist, 2009, 2010). European bodies have raised this issue for Europe (European Commission, 2010). We do not know what is happening in Portugal, but one has to suppose that this situation affects a significant part of the population. A single study on iodine revealed alarming figures regarding pregnant women (Limbert, 2012). It was because of these specific needs that the Gulbenkian Foundation organised the "Comer bem é mais barato" (Eating Well is Cheaper) programme, which sought to encourage people with lower incomes to make better choices.

However, this situation should lead to scientific studies and analysis that would form the basis of a national plan of action. It is true that specific shortages, although not like those in the Sub-Sahara, can exist alongside obesity,

Table 1. Food consumption frequency for children between 1-7 years old on São Miguel Island, 1985 (%). *Source: Homem de Gouveia, 1985*

Food	Never	Very rarely	Occasionally	Adequately
Eggs	34.7	30.7	32.28	2.32
Meat	21.2	49.8	22	7
Fish	7	34	46	11
Fruit	42.91	24.32	25.98	6.20
Milk	5.5	16.15	42.5	35.35

Table 2. Weight and height of children on São Miguel Island, 1985 (%). *Source: Homem de Gouveia, 1985*

	Weight%		Height%	
	Normal	**Insufficient**	**Normal**	**Insufficient**
6-60 months	49	51	48	82
6-8 months	56	44	46	55

making people fragile and more vulnerable, particularly to infections. Cold weather, flu epidemics and community-acquired pneumonia can affect a more vulnerable population, increasing the need for doctor's appointments, emergency care, hospital admissions and increasing death rates.

The price paid by countries that escape hunger

The WHO believes that the populations that no longer endure hunger have come to a "dead end", having gone straight to a situation of obesity. On one hand, they are selected as good exploiters, as they are mostly made up of people who genetically overcame hunger. On the other hand, calorie storage is done, at least in the early stages, via fat-rich foods.

Excess fat gained in this way tends to be stored in the intra-abdominal area, which expands the waistline. This increases cardiovascular risks, even when excess weight is below the level considered to be dangerous for populations in developed countries, which can be seen in risk studies for a region like China (Li, 2002). We are, therefore, looking at a forecast of obesity and type 2 diabetes and associated health risks affecting a large section of the world population by 2050.

One could say that it's better to be obese and diabetic than hungry and dying of starvation. However, a third alternative is possible, but one that can only be discussed when there is a global food policy for the world.

Nostalgia and reviving old cultural know-how

This issue is relevant because often the beneficial research and revival of old habits and practices is accompanied by a nostalgic discourse about "the good old days" with regard to food.

The rather unscientific nature of this nostalgia is the result of a number of factors. Often, those responsible for it refer solely to the time when they were young, which tends to imply good memories. In general, this nostalgia involves no aspect of social class whatsoever and focusses on individual cases and examples, as if they were the standard diet for the country. Neither the meal described in *A Cidade e as Serras*, by Eça de Queirós, nor the Infanta D. Maria's cookbook tells us what the Portuguese population ate in the 19th or 15th century.

We need historical research with a systematic analysis of food consumption for various eras and the different social classes and one which gives us an idea of daily life and development, without recourse to individual cases. However, we know from records that there were major periods of hunger and monotonous diets, as well as the fact that people still died of starvation in Portugal in the 1960s. There is an interesting example from a study undertaken in the Azores in 1985 (Homem de Gouveia, 1985), which gives us information on the consumption of certain foods by children between the ages of 1 and 7 **(Table 1).**

Remarkably, we see that in 1985, 21.2% of children never ate meat and 42.9% never ate fruit!

It seems logical that data regarding weight and height indicated significant malnutrition with half or more of the child population demonstrating stunted growth and low weight levels **(Table 2)**.

Among these children, those that were 7 years old are now 34. Perhaps it is easy to understand their behaviour when, in subsequent years, they had access to this food and an abundance of calories. We also understand their attitude towards their own children. Perhaps this data (in addition to the concentration of insular genetics) is important to understanding why the Azores is one of the places in the country with the highest incidence of child obesity. Fortunately, the huge effort that has been made on the archipelago has avoided a fundamentalist and doctrinal approach in relation to populations that have only recently been lifted out of almost widespread poverty, which is still a threat for some. What has happened in the Azores is similar to other parts of the country.

In relation to any particular health benefits, often mentioned acritically and with no scientific analysis in expressions like "in the old days, we

were tough" or "in the old days, people were healthy", there is a clear lack of logic when we consider that a century ago, people's life expectancy was half of what it is today.

What happened in the recent or distant past was not particularly desirable. Poverty, hunger and a monotonous diet were widespread in the country.

However, in response to shortages, populations and women, in particular, developed special standards and food preparation. These traditional or old ways should be the subject of research and revival, as they are part of human knowledge that was handed down over the generations, involving the culture of regions and populations. In addition to this, knowledge of these dietary standards may be a useful contribution to current recommendations that are compatible with health and the economic situation.

Studies on diet-related risk factors

Some follow-up studies with large samples relate lifestyle to the risk of death and disease. Such is the case of the Framingham Study, which was initiated in 1948 (Meigs *et al.*, 2003); the American Cancer Society Study, initiated in 1959 (Williamson *et al.*, 1995), the Gothenburg Study, which began in 1963 (Jood *et al.*, 2004); of the follow-up study of those enrolled at Harvard, which took place between 1962 and 1988 (Lee *et al.*, 1993); the Bogalusa Study, which took place between 1973 and 1991 (Berenson *et al.*, 2005); the BEDA Study, in Sweden, initiated in 1979 (Rosengren *et al.*, 2003); and the Finnish study for Diabetes Prevention (Lindstrom, 2006). The well-known Nurses' Health Study, which began in 1976 with 121,700 females, included a semi-quantitative food questionnaire created by Willet, already validated for Portugal, which has been used in various Portuguese studies (Willet *et al.*, 1995).

With regard to the specific prevention of type 2 diabetes, the Diabetes Prevention Program Study (DPPRG, 2002) established a dietary pattern that is considered healthy, having obtained a 58% reduction in new cases of diabetes in the intervened group compared to the non-intervened group after 3.2 years. These recommendations are on the same lines as those established by the American Diabetes Association (ADA, 2013).

The connection between dietary standards and the prevention of hypertension has been studied in the implementation of Dietary Approaches to Stop Hypertension (DASH) (Sacks *et al.*, 2005). In relation to the role of fat and types of fat, the early works of the Keys group is important (Keys

et al., 1956, 1957), having focussed attention on the negative effects of the consumption of saturated fat in terms of levels of plasma cholesterol and atherogenesis.

The protective effect of monounsaturated fats, as well as the fat found in olive oil, has been highlighted (Astrup *et al.*, 2011; Howard *et al.*, 2010). Polyunsaturated fatty acids of the n-3 long chain (omega-3) significantly reduce cardiovascular risks, particularly the eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) in horse mackerel, chub mackerel, sarda and sardines (Bandarra and Nunes, 2012).

The various credible studies that demonstrate the effectiveness of a particular dietary pattern have led the World Health Organization to establish recommendations published in the reports (WHO, 2008; WHO, 2003; WHO, 2002).

Conclusions

- The issue of food should be handled by the different sectors in a co-ordinated way: production, distribution, nutrition, health.
- Food is related to individual health, as well as ecology and the world economy.
- Social inequality clearly influences the difference of access to the quantity and quality of food.
- One can calculate that at least two million Portuguese are in a situation of food insecurity.
- Calorie quantity, which may even be excessive, is possibly associated with a serious lack of certain nutrients.
- The lack of specific nutrients causes fragility and a vulnerability to certain problems, particularly infectious diseases.
- Dietary recommendations cannot be generalised without taking social class into account.
- Obesity in developed countries has a greater effect on children and adults in low-income and low-education groups.
- We should consume food produced as close to our place of residence as possible and shop at traditional markets. We should check the origin of products in supermarkets and traditional markets.
- The main recommendations of the studies undertaken on the prevention of early death and disease with conclusions from the World Health Organization are the following:
  - Overall fat consumption should be below 30% of total calories;
  - Preference for vegetable fat, like olive oil;

– Consumption of long chain omega-3-rich fish, low in mercury (horse mackerel, mackerel, sarda and sardine);
– Consumption of skimmed dairy products (adults) or semi-skimmed (children). A glass of skimmed milk is the equivalent of 2 yoghurts in protein and calcium;
– Consumption of fibre in wholemeal cereals, vegetables, fruit;
– Beans and pulses rich in fibre, minerals and vegetable protein;
– A reduction in salt consumption (maximum of 5g/day, which is the equivalent of 2.3g of sodium);

Bibliography

/ American Diabetes Association. Standards of medical care in diabetes, 2013. Diabetes Care, 2013, 36, Suppl 1:S1166. doi: 10.2337/dc13-S011.
/ Astrup, A., *et al.*, 2011. The role of reducing intakes of saturated fat in the prevention of cardiovascular disease: where does the evidence stand in 2010? American Journal of Clinical Nutrition, May 2010, 684-688.
/ Bandarra, N.M. e Nunes, M.L., 2012. Benefícios associados ao consumo de peixe azul. In Saúde Pública, 5th October.
/ Berenson, G.S., 2005. Obesity, a critical issue in preventing cardiology: the Bogalusa Heart Study. Prev Cardiol 8(4), 234-241.
/ Camolas, J., Carmo I., Santos O. Vieira, 2008. *Escolhas alimentares na população adulta portuguesa in Obesidade em Portugal e no Mundo*, ed Carmo, I *et al.*, ed Faculdade de Medicina de Lisboa.
/ Cardoso, F.P., 2012. Austeridade empurra famílias para novo fundo: lá nem a comida se safa. In Público, 27th June.
/ Carmo, I., Dos Santos, O., Camolas, J., Vieira, J., Carreira, M., Medina, L., Reis, L., Galvão-Teles, A., 2006. Prevalence of obesity in Portugal. *Obesity Reviews*, 7, 233-237.
/ Cohen, D.A., Farley T.A., 2008. Eating as an automatic behavior. Preventing chronic disease. *Public Health Research, Practice and Policy* 5(1).
/ Cohen, D.A., 2008. Neurophysiological pathways to obesity: below awareness and beyond individual control. Diabetes, 57, 1768-1773.
/ European Commission, 2010. *Combating poverty and social exclusion – A statistical portrait of the European Union*. Luxembourg: Publications Office of the European Union.
/ Costa-Pinto, *et al.*, 2010. Famílias sanduíche em Portugal in Guerra I. (coordination) *À Tona de água II. Retratos de um Portugal em mudança*, Lisbon: TESE/Tinta da China/ Calouste Gulbenkian Foundation.
/ Diabetes Prevention Program Research Group, 2002. Reduction in the incidence of type 2 diabetes with lifestyle intervention or metformin. In The New England Journal of Medicine (online edition). Feb 7, 346(6): pp.393-403.
/ Do Carmo, I., Dos Santos, O., Camolas, J., Vieira, J., Carreira, M., Medina, L., Reis, L., Myatt, J., Galvão-Teles, A., 2008. Overweight and obesity in Portugal: national prevalence in 2003-2005. *Obesity Review*, 9, 11-19.
/ FAO Statistical Yearbook, 2012. World Food and Agriculture. Rome: FAO.
/ Guerra, I., Costa Pinto, T., Almeida, S. Gonçalves, A., Martins, M. (coordination), 2010. *Á tona de água II. Retratos de um Portugal em mudança*, Lisbon: TESE/ Tinta da China/Calouste Gulbenkian Foundation.
/ Homem de Gouveia, *et al.*, 1985. Tentativa de avaliação do estado de nutrição da criança da ilha de S. Miguel (Azores). Atlântica Médica, 38.
/ Howard, B., *et al.*, 2010. Low-fat dietary pattern and lipoprotein risk factors: The Women's Health Initiative Dietary Modification Trial. *American Journal of Clinical Nutrition*, 91, 860-874.
/ Instituto Nacional de Estatística, 2012a. Inquérito às Despesas das Famílias, Lisbon: Instituto Nacional de Estatística, I.P.
/ Instituto Nacional de Estatística, 2012b. Balança Alimentar Portuguesa, Lisbon: Instituto Nacional de Estatística, I.P.
/ Jood, K., Jern, C., Wilhelmsen, L., Rosengren, A., 2004. Body mass index in mid-life is associated with a first stroke in men: a prospective population study over 28 years. Stroke, 35(12), 2764-2769.
/ Keys, A., Anderson, J.,M., Biorck, G.,Brock, J., Fidana, F., Keys, M., 1956. Physical Activity and the Diet in Populations Differing in Serum Cholesterol. In J Clin Invest, 35(10), pp. 1173-1181.
/ Keys, A., & Grande, F., 1957. Role of dietary fat in human nutrition. III. Diet and the epidemiology of coronary heart disease. In *American Journal of Public Health*, 47(12), pp. 1520-1530.
/ Lee, I-M., Manson, J.E., Hennekens, C.H., Paffenbarger, R., 1993. Body weight and mortality. A 27-year follow-up of middle-aged men. In Journal of American Medical Association; 270, pp. 2823-2828.

/ Li, G., Chen, X., Jang, Y., Wang, J., Xing, X., Yang, W., Hu, Y., 2002. Obesity, coronary heart disease risk factors and diabetes in Chinese: an approach to the criteria of obesity in the Chinese population, in Obesity Review, 3, pp.167-172.
/ Limbert, E., 2012. Editorial, Current Opinion in Endocrinology, Diabetes, Obesity, Clinical Nutrition and Metabolic. Care, Portuguese edition, 4(5), 321.
/ Lindstrom J, Illanne-Parikka P, Peltonen, 2006. Sustained reduction in the incidence of type 2 diabetes by lifestyle intervention – a follow-up of the Finish Diabetes Prevention Study. *Lancet*, 368, 1673-1679.
/ Ljungqvist, O., e de Man, F. 2009. Undernutrition – A major health problem in Europe. Nutr Hosp. 24, 368-370.
/ Ljungqvist, O., *et al.*, 2010. The European fight against malnutrition. Clin Nutri., 29(2), 149-150.
/ Lopes, C., Oliveira, A., Santos, A.C., Ramos, E., Gaio, A.R., Severo, M., Barros, H., 2006. Consumo alimentar no Porto. Porto: Faculdade de Medicina da Universidade do Porto. Disponível em: www.consumoalimentar.med.up.pt
/ Mahan, L., e Escott-Strump, S., 2010. *Krause – Alimentos, Nutrição e Dietoterapia*, 12ª ed, Rio de Janeiro: Elsevier.
/ Meigs J.B., Wilson P.W.F., Nathan D.M., D'Agiostino R.B., Williams K., Haffner S.M. 2003. Prevalence and characteristics of the Metabolic Syndrome in the San Antonio Heart and Framingham Offspring studies. In Diabetes, 52, pp.2160-2167.
/ Pinto, J.A., 2012. Pobreza, ideologia e austeridade. In *Público*, 19th April.
/ Rosengren A., Wilhelmsen I., Lappes G., Johanssons (2003). Bodymass index coronary heart disease and stroke in Swedish woman. A prospective 19-year follow-up in the BEDA Study.In European Journal of Cardiovasular Prevention and Rehabilitation, 10(6), pp. 443-450.
/ Sacks F., Svetkey L., Vollmer W., Appel L., Bray G., Harsha D., *et al.*, 2001. Effects on Blood Pressure of Reduced Dietary Sodium and the Dietary Approaches to Stop Hypertension (DASH) Diet. In The New England Journal of Medicine; 344(1), pp.3-10.
/ Santos, N., 2012, Cem por cento, Economia, *Expresso*, 17th November
/ Turmo I.,1998. L'alimentation des espagnols. Dupoint de vue de l'antropologie de l'Espagne, terre de contraste. In Ecologie et Politique, 23, pp. 39-50.
/ Willet W.C., Manson J.E., Stampfer M.J., Colditz G.A., Rosner B., Speizer F.E., Hennekens C.H 1995. Weight, weight change, and coronary heart disease in women. Risk within the "normal" weight range. In JAMA, 273(6), pp. 461-465.
/ WHO, 2002. Protein and Amino Acid Requirements in Nutrition. Geneva.
/ WHO, 2003. Diet, Nutrition and the Prevention of Chronic Diseases. Geneva WHO, 2008. Interim Summary of Conclusions and Dietary Recommendations on total Fat & Fatty Acids from the Joint FAO/ WHO Expert Consultation on Fats and Fatty Acids in Human Nutrition. Geneva.
/ Williamson, D., Pamuk, E., Thun, M., Flanders, D., Byers, T., Heath, C., 1995. Prospective Study of International weight loss and morbility in never-smoking overweight US White Women aged 40-64 years. In American Journal of Epidemiology; 141, pp. 1128-1141.
/ Zimmet, P., Dowse, G., Tinch, C., Sergean, T.S., King, H., 1990. The epidemiology and natural story of NIDDM – Lessons from the South Pacific. In Diabetes Metabolism Review, 6(2), 91-124.

Sustainable food for sustainable diets? The challenge of ecological public health

Tim Lang

Introduction

Europe is an area of the world which has a rich food legacy. Collectively, our food cultures offer remarkable diversity and splendid foods. The starvation of previous centuries appears to have been banished. People live longer lives. Supermarkets are full of food. We have brought foods from all over the world. We have abundant food! Europeans *en masse* have never been so well supplied with so much food. A positive picture can be painted. Yet, in this lecture, I want to suggest that all is not well with the food system, and humanity's relationship with its food.

The world of food faces huge challenges ahead: health, environment, social justice, economy, resources, people and skills. The challenge can be summarised as this: how to ensure that consumers everywhere – even in Europe – eat a diet which is sustainable and how to shift our food supply to become sustainable at the same time. This apparently simple goal – sustainable diets from a sustainable food system – is currently distant. Europe over-consumes. We waste. We consume as though there are two-three planets (the USA as though there are four planets).

The data on such issues has been mounting up for decades, yet the policy makers have been in denial. They want to leave it to market dynamics, which they think are working reasonably well. OK, the politicians argue about whether the state is too involved or not involved enough, but

broadly they are happy that the supermarkets are full of food. Many of them think that 'market dynamics' are working well, and that consumers control what is produced. This is sadly not true. The challenge of altering how we eat and how foods are produced, distributed and managed throughout their life cycle is immense. So the debate we are having in Europe about the direction ahead is very important.

What is the problem?

Globally, there are just under one billion people hungry and ill-fed, and 1.3 billion over-fed, with around 2 billion suffering various diet-related diseases of malconsumption. Food is a huge factor in the causes of premature death in rich and poor economies, but for different reasons. The medical case for changing diets has been building up for decades – arguably since Ancel Key's pioneering international Seven Countries study.[1] Despite pretty good knowledge of how to improve diets to prevent ill-health, the trends in the world are towards unhealthy diets – too high in fats, salt, sugars, too many processed foods, not enough fruit and vegetables and 'protective' foods.

Environmentally, the toll is immense. Rockström, Steffen and colleagues showed, in a much-cited paper in 2009, how planetary limits are being reached.[2] We are literally living beyond our means. Modern agriculture may have yielded vastly increasing outputs in the 20th century, but it has done so with immense environmental costs. The Stern review suggested modern agriculture accounts for about 14% of greenhouse gas emissions. How we use land is a key factor. Consumers' desire for meat and dairy has a huge impact. Meat and dairy account for 24% of European consumers' GHG impact, according to the EIPRO study in 2009. Global agriculture is thirsty. It uses 70% of all freshwater for human use.[3] Again, much of this is to do with livestock use. But there, the message for us in Europe is probably to reduce this anyway. But what of fish? Here, there is a clash. Nutritionists recommend we should eat fish (you do in Portugal!) but the evidence from fish stocks is looking very sober. The UN's Food and Agriculture Organization in its 2007 *State of Food and Agriculture* report was stating that 52% of stocks are 'fully exploited'.[4]

1 Keys A., ed. (1970) Coronary heart disease in seven countries. *Circulation* , 1970, (Suppl to vol.41) 1–211.

2 Rockström, J., *et al.*, Planetary boundaries: exploring the safe operating space for humanity. *Ecology and Society*, 2009. 14(2): p. 32 online www.ecologyandsociety.org/vol14/iss2/art32/

3 See G Rayner and T Lang (2012). Commentary in *World Nutrition*, 3, 4, April 2012 www.wphna.org

4 FAO (2007) *State of Food and Agriculture*. Rome: Food & Agriculture Organization www.fao.org/docrep/010/a1200e/a1200e00.htm

Behind these changes and food's deepening footprint on the planet and on our public health is a cultural transition. The late 20th century has changed what we eat, how we get it, where we buy it, how we travel to get the food (by car not walking), and the quantity and quality of our diets. The world's diets seem to go through what Professor Popkin at the University of North Carolina has called the Nutrition Transition.[5]

The economics of all this are fragile. For decades, the success of the 20th century's intensification of food production was that it brought prices down. There were hiccups or reversals in World Wars 1 and 2, and then again in the oil crisis of the early 1970s, but progress was assumed to come from ever cheaper food. All this changed following the 2007-08 price spike. Mainstream economists prophesised that business-as-usual (i.e. a return to cheaper food) would resume. It has not.[6] Now the mainstream analysis is that volatility and rising prices are the norm.

What is going on?

My colleagues and I at the Centre for Food Policy at City University London argue that we are seeing the gradual ending of what we call the Productionist Paradigm. This is the policy formula which has shaped or framed food thinking since the 1940s. The paradigm was deceptively simple: Science + Technology + Distribution × cut Waste × Output rise × Prices fall × Affordability rise = Health + Progress.[7] This represented the scientific consensus from the 1930s. More food can be produced with the help of science, technology and capital, and this will reduce prices, and as long as the food is distributed well, more people will be able to afford it (because it will be cheaper) and thus they will eat better and be healthier.

But now, the voluminous data on diet-related ill-health, and the data on food's environmental impact suggests that this policy formula has run out of value. It is too crude for the complexity we now observe in the world of food.

This is the situation where we now find ourselves in Europe. We have no high-level agreement yet on what are sustainable lifestyles, levels of food consumption or production. The policy measures on which most cultural change relies are 'soft': labels, education, moral appeals to consumers to 'do the right thing', information exchange. These are not working

5 See: www.cpc.unc.edu/projects/nutrans

6 See FAO food price index: www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/ and see FAO and OECD *Agricultural Outlook 2010–2019*.

7 T Lang & M Heasman (2004). *Food Wars*. London: Earthscan.

fast enough, or deeply enough. No wonder politicians are nervous of food policy. It is looking like a ticking time-bomb. For decades, they have relied on the Common Agricultural Policy at the European level and on food companies at the supply chain level, but now analysts know that probably what is needed is some pretty significant systems change.

And now here is some good news. As the evidence on food's big impact on health, environment and culture has been mounting up for the last twenty years or so, some initiatives have begun to try to address some of this. Not enough. Not systemically. But there are some tentative steps to deliver systems change: The EU's Sustainable Production and Consumption Industrial Policy Action Plan of 2008; The Roadmap to a Resource Efficient Europe of 2011; The Swedish joint Environmental Protection Agency and National Food Administration proposals for Environmentally Conscious Consumers in 2009; The Netherlands Government's policy steps to achieve Sustainable Food in 2009; The British Government's Food Matters report of 2008. These all show policy makers beginning to engage, tentatively, slowly, but importantly. Ironically and sadly, the 2007-08 price spike helped. Suddenly, the rich world became aware that its food security was not as secure as it thought. Its supply chains could be disrupted. Its food prices could bring consumers onto the streets in protest. Its fragilities had been exposed.

The tables below list some initiatives globally, in Europe and in some member states.

Meanwhile, within market dynamics, big companies too had woken up. Suddenly, they too realised that the environmental crisis ahead meant they might have to alter their business models. Some companies began to engage. Others continued to resist. But the issue began to move from the radical policy fringe to, well, if not the centre, at least towards legitimacy.

Where are we now?

I see a number of key policy hotspots. The first is meat and dairy. We have to reduce how we use animals. We need to reduce high levels of consumption. The second is waste. Whereas in the 1930s, waste was a problem near the farm, today it is rich western consumers who waste.[8] So we have a paradox: rich consumers need to re-learn from poor consumers some respect for food. The third core problem is inequality. Food has always

8 See the summary of this in UNEP (2012). *Avoiding Future Famines*. Nairobi: UN Environment Programme. www.unep.org/publications/ebooks/avoidingfamines/

Table 1. Summary of certain policy measures adopted globally, regionally and locally.

Level of action	Policy Measures	Limitations
Global	High Level Task Force (2008ff); Committee on World Food Security (CFS); Rio+20 (June 2012)	Tends to suffer from LDC focus (little about the rich and powerful DCs); marginalised by financial crisis
Regional / EU	CAP reform CAP2020; Sustainable Consumption & Production (SCP) programme	Not joined up with health; marginalised by Eurozone crisis; locked into intra-CAP dynamics
National / UK	Food Matters (2008); Food 2030; Food Business Plan 2011-15; Green Food Project (2011–12)	Emerging structural reviews not followed up or consolidated into action
Sub-national / Scotland, Wales	Scotland: SDAP review (2007) SNP Food & Drink Scotland. Wales: Rural + public purchasing	More holistic than England /UK but some sector 'myopia' (eg alcohol and sheep)
Local	Community food actions; Food Policy Councils;	Build networks but little influence on powerful corporate interests

Table 2. Sustainable food consumption and production – emerging government policy advice in Europe (North)

UK (2006)	Sustainable Development Commission (SDC) & National Consumer Council	Sustainable Consumption "I will if you will" – generic
Germany (1990s; 2008)	German Council for Sustainable Development	Sustainable Shopping Basket: includes food – lists labels and schemes
EU (2008)	Sustainable Consumption-Production & Sustainable Industrial Policy Action Plan	Voluntary initiatives – but little food focus
Netherlands (2009)	LNV Ministry – Policy outline for achieving Sustainable Food	Sustainable food production & consumer educ. campaigns
Sweden (2009)	National Food Administration (& Swedish EPA) – notification to EU (withdrawn 2011)	Defining ecologically sustainable food choices
UK (2009)	SDC, Council of Food Policy Advisors – Dept Environment Food Rural Affairs (Defra)	Recommend defining low impact (sustainable) healthy diet
Netherlands (2011)	Health Council for Ministry Economic Affairs, Agriculture & Innovation	Guidelines for a Healthy Diet: an Ecological Perspective

been a key indicator of social inequality. It still is today, both within and between countries. The fourth hotspot is the price mechanism. Who pays for food's damage to ecosystems? Currently, no one. How can food prices fully internalise the costs of environmental damage? Will consumers pay more for properly-costed food?

I think that these new debates mean that food is the most exciting, yet the most poorly engaged, part of public policy. We desperately need to get a grip on food policy. It is drifting. The Brundtland tradition of thinking about sustainability is too loose. Back in 1987, it proposed a triple focus: environment, economy and society.[9] My colleagues and I have proposed a more complex approach for what is suitable for food.[10] [11] This outlines six policy issues around which engagement and action needs to be focussed to create systems change: quality, social values, environment, health, economy, and governance.

The UN's FAO has recently produced the first formal working definition of sustainable diets.[12] It fits the schema I have proposed. It was produced at a scientific symposium reviewing the issues globally.[13]

What difference does this kind of thinking make to policy processes? In my view, a lot changes for the better. Firstly, it offers some heuristic for the way ahead. It's not enough to aim for low carbon food systems. They also need to be water efficient and favourable to diversity. Secondly, the notion of sustainable diets driving food production (rather than production-driven diets, which has been the case for the last half century) helps re-calibrate public health nutrition. Thirdly, it suggests new directions for institutional reform. If European societies genuinely want to move towards sustainable diets from sustainable food systems, then we need to ask: are our present institutions helping that transition quickly and smoothly enough? We need to be more ambitious.[14]

---

9 Report of the World Commission on Environment and Development: *Our Common Future* (the Brundtland Commission), 1987. www.un-documents.net/wced-ocf.htm

10 Sustainable Development Commission (2011). *Looking Back Looking Forward*. London: SDC. www.sd-commission.org.uk/publications.php?id=1187

11 T Lang & D Barling (2013). Nutrition and Sustainability: an emerging food policy discourse, *Proceedings of the Nutrition Society*, 72, 1, 1-12 doi: 10.1017/S002966511200290X. http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=8822971

12 FAO Final Document of the Sustainable Diets International Scientific Symposium, Rome November 3-5, 2010. www.fao.org/ag/humannutrition/23781-0e8d8dc364ee46865d5841c48976e9980.pdf

13 www.fao.org/docrep/016/i3004e/i3004e.pdf

14 See my proposal to have a Hot Springs 2 conference. Who today talks of Hot Springs 1943? Yet that conference held in the USA towards the end of World War 2, mapped the direction that the free world, and then the rest of the world, took. We need a Hot Springs 2 for the 21st century! See my paper to the OECD later in 2012: www.oecd.org/site/agrfcn/

Table 3. A value scheme for a sustainable food system
Source: UK Sustainable Development Commission, 2011, pp. 14.

Quality	**Social values**
Taste	Pleasure
Seasonality	Identity
Cosmetic	Animal welfare
Fresh (where appropriate)	Equality & justice
Authenticity	Trust
	Choice
	Skills (citizenship)
Environment	**Health**
Climate change	Safety
Energy use	Nutrition
Water	Equal access
Land use	Availability
Soil	Social status/affordability
Biodiversity	Information & education
Waste reduction	
Economy	**Governance**
Food security & resilience	Based on scientific and technological knowledge
Affordability (price)	Transparency
Efficiency	Democratic accountability
True competition & fair returns	Ethical values (fairness)
Jobs & decent working conditions	International aid & development
Fully internalised costs	

We need to rethink diet around ecological public health principles. We need to begin to revise our national and European dietary guidelines to incorporate the need to live within environmental limits. This raises the problem with which I began this lecture: the need to change consumption patterns. This is very delicate, I know. Everyone likes to think they eat what they like and they like what they eat. We all think we choose our diets. In fact, we choose them less than we think we do. We inherit, and are taught, tastes. The nutrition transition research also shows how rapidly tastes can change, and are changing globally.

Politicians are frightened of consumers. Consumers are their voters. But they – we – also have longer-term interests, as well as short-term desires. Indeed, we note already how the big food companies are quietly choice editing for consumers. They are altering ingredients, packaging,

water use, and more. Much of this is driven by the resource efficiency agenda, of course, and much by self-interest. Lowering footprints lowers costs in some cases. But everyone knows that the big changes that are actually needed if we are to put Europe's food system onto a sustainable basis will not be done silently, without consumers noticing. Dramatic shifts to more plant-based diets are good news for health and the environment. But if we want that, we'll have to invest in vast increases in rural skills and better land use. We'll have to make it more attractive to work on the land. We'll have to re-inject some respect for food into mass consumerist taste. The public and environmental health challenge posed by the current food system's unsustainability is ultimately a cultural challenge.

Are we prepared to push for that? I think we must. There is enough evidence for us to change policy.

What a pleasure and privilege it has been to do this lecture. Thank you for inviting me, Calouste Gulbenkian Foundation! And thank you, audience, for coming!

Food and health: an epidemiologist's issues

Henrique Barros

To contextualise my contribution to this project about the future of food, let me introduce myself.

I am a professor at the University of Porto's School of Medicine. I am a doctor and my profession is a relatively unknown one. I am an epidemiologist. However, in another life, I was a gastroenterologist, which must be why I have always had this relationship with, and been drawn to, food, and why I enjoyed coming to realise two essential things.

The first is why people choose certain foods and not others, and the second is, to put it simply, why some people manage to control their weight while others are incapable of doing so, which is why we have tried to study this issue throughout life. This has helped raise certain questions to which we seek answers; it also poses some challenges and has opened up interesting possibilities for the future.

The relationship between food and health is almost an intimate part of us as human beings, dating back to our most distant past and memory as people. It has fuelled so many, often unfounded, myths and ideas; however, what is most interesting to think about, now that we are at the beginning of the millennium, is that at a time when we have probably reached maximum life expectancy – when the greatest number of people are able to live in conditions never before experienced, in terms of quality of life and access to food – we live almost in dread of what might happen to us in relation to food. And this is because epidemiologists have tried to show and shape the information in such a way that it now seems almost inevitable that, for the first time, we are approaching a situation in which the generations to come will not live as long as ours.

We are probably at a new point of epidemiological transition in which, put in the simplest possible terms, our children will not live for as long

as our parents did. This really is an enormous challenge, because this decrease in life expectancy, this undoing of the trend, has been associated with the obesity epidemic.

Efforts have been made to resolve this with a very simple equation involving input and output. The input is what is ingested, while the output is what is expended on exercise. We are also offered some hope that all this can be resolved merely by adjusting one side of this hypothetical balance, or even both.

However, everything indicates that the issue is much more complex than that. It is not only the balance that is at stake, or the simple maths of energy input and output; there is much more: not only are there aspects of a psychosocial nature, but there are also environmental factors. When I say environment, I am not only talking about surroundings and context or the physical space around us. I mean the various dimensions of this environment: how we make our choices; how we are given the opportunities to choose; how we may or may not be free to interfere with these choices and help tip the scales.

It is interesting to consider the two phenomena that could act as a kind of backdrop: the relationship between the society we organise and the way in which we organise ourselves.

We had a 19th century that was very focused on hygiene, followed by a 20th century – especially the mid-20th century – in which a famous book was written called *The Hungry Future* (those more familiar with demography, particularly French demography, will remember it). It conveyed the idea that there was no way of feeding a population that was growing too rapidly. In the end, what we see today is that we are producing much more than we need and, in particular, consuming considerably more than we need. However, it is interesting to think about this hygiene theory because it works well for phenomena that are not immediately understandable, such as asthma. Why is it that cleaner societies are those with more asthma sufferers compared to more polluted societies? Or something else that is very interesting. Why is it that children delivered by caesarean section will be fatter than those born in a traditional delivery?

There are lots of other things in this equation that link food to health, knowing, as we do, that we live in a time when we are not only concerned about all aspects of food safety, but also about the right to what is considered to be a healthy diet, despite this not always being perfectly explained and defined. And there is also another aspect: one which all of us in democratic societies aim to maintain: our right to choose – what we often call free will – or our way of seeing and judging the world.

Useful and possible changes

I would like to offer a word of caution. It is extremely challenging and exciting to think about these issues. But what most people expect is rather prescriptive: "What should I do?" And the answer to this question is dangerous, because we know very little in order to make major changes. Our relationship with food has developed over centuries, millennia, to reach what might be called fine tuning. And we want to change this relationship in a very short time. Perhaps because in our heads we have this idea that the immense power of science can take us to unimaginable places – which is true, but since they are unimaginable, they may not be the best places to be. We can see that there has been a social standardisation of food: I want it because, for years, for generations, my family did not have access to it. And we have effected remarkable change in the space of 30, 40 or 50 years. In the past, the rich were fat and the poor were thin, and now it is the exact opposite. Our knowledge still does not fully explain/understand the reasons behind this change. And we need to understand it.

It is very dangerous to give the idea that we have solutions, because what recent history has shown us is that many of the solutions (regarding epidemiology or public health) do not work and this has brought extraordinary discredit to the idea of change, of useful change. Unlike changes in other areas, like those in which Tim Lang works or genetically modified foods (which may help to feed millions of starving people), changes in health must take human behaviour in relation to food choices into account.

I would like to mention something that happened in California. As you may know, it was one of the first places in the western world where the problem of the obesity epidemic was identified. And, at the time, it was said that the role of schools would be crucial in finding solutions and that education would be key – these are all ideas we have; however, they require better evidence. Something had to be done, and it was clear that it was better to eat oranges than to drink sweetened drinks; as such, many Californian schools decided to hire a supermarket shelf specialist, who rearranged the shelves and displays in some school canteens, moving certain products further away and putting the foods they thought the children should choose in a different (more visible) place. This changed the food pattern (choices) and even reduced the average weight of the children at the schools where this system was being implemented. This shows us that our idea of freedom of choice is something we need to work on, as well as demonstrating that with a few small gestures (rather than huge changes) we can achieve our objectives: to have a planet that lives and breathes better, where we can live better with people who live longer and more happily.

Eating in Portugal: needs, practices and choices

Pedro Graça

How can we balance current global food issues, which were described by Tim Lang, and more local situations? We will attempt to use global knowledge to formulate more critical thinking on a national level, while trying to find solutions that can be applied on a local level. In this text, we propose to discuss the problems and constraints we have at the national level in order to then construct a food strategy or propose a set of initiatives that, when fine-tuned, can aim to improve the food status of our population. This reflection forces us to think in a less direct way about the traditional relationship between nutrients and health and more about the relationships between eating and its determinants and consequences.

There are four simple questions to be asked. Four questions we will have to consider and try to answer to begin constructing strategic thinking regarding this issue. The first and core question is: what do we need to eat to be healthy? And then, as we advance, there are the other questions – what do we eat, what do we want to eat and, finally, what is the best way of achieving these objectives? These are questions that start at the macro level and move progressively towards the micro, while making us – the consumers who buy and consume in Portugal – increasingly responsible.

What do we need to eat to be healthy?

There is an answer to the first question in the reference table **(Table 1)**. These are dietary recommendations, or in this case, nutritional recommendations for the population. These RDAs (or in this case, RDIs) are recommended intakes of nutrients for the population and apply as much to the English as they do to the Portuguese or any western population. To some degree, this is the objective we want to achieve. We can say that this

Table 1. Recommended Nutrient Intake (daily average)
Source: Institute of Medicine, Food and Nutrition Board

Life Stage	Calcium (mg/d)	Carbohydrates (g/d)	Protein (g/kg/d)	Vit A (µg/d)	Vit C (mg/d)	Vit D (µg/d)	Vit E (mg/d)[b]	Thiamine (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Vit B_6 (mg/d)	Folate (µg/d)	Vit B_{12} (µg/d)	Copper (µg/d)	Iodine (µg/d)	Iron (mg/d)	Magnesium (mg/d)	Molybdenum (µg/d)	Phosphorous (mg/d)	Selenium (µg/d)	Zinc (mg/d)
Children																					
0-6 months																					
6-12 months			1.0													6.9					2.5
1-3 years old	500	100	0.87	210	13	10	5	0.4	0.4	5	0.4	120	0.7	260	65	3.0	65	13	380	17	2.5
4-8 years old	800	100	0.76	275	22	10	6	0.5	0.5	6	0.5	160	1.0	340	65	4.1	110	17	405	23	4.0
Male																					
9-13 years old	1100	100	0.76	445	39	10	9	0.7	0.8	9	0.8	250	1.5	540	73	5.9	200	26	1055	35	7.0
14-18 years old	1100	100	0.73	630	63	10	12	1.0	1.1	12	1.1	330	2.0	685	95	7.7	340	33	1055	45	8.5
19-30 years old	800	100	0.66	625	75	10	12	1.0	1.1	12	1.1	320	2.0	700	95	6	330	34	580	45	9.4
31-50 years old	800	100	0.66	625	75	10	12	1.0	1.1	12	1.1	320	2.0	700	95	6	350	34	580	45	9.4
51-70 years old	800	100	0.66	625	75	10	12	1.0	1.1	12	1.4	320	2.0	700	95	6	350	34	580	45	9.4
>70 years old	1000	100	0.66	625	75	10	12	1.0	1.1	12	1.4	320	2.0	700	95	6	350	34	580	45	9.4
Female																					
9-13 years old	1100	100	0.76	420	39	10	9	0.7	0.8	9	0.8	250	1.5	540	73	5.7	200	26	1055	35	7.0
14-18 years old	1100	100	0.71	485	56	10	12	0.9	0.9	11	1.0	330	2.0	685	95	7.9	300	33	1055	45	7.3
19-30 years old	800	100	0.66	500	60	10	12	0.9	0.9	11	1.1	320	2.0	700	95	8.1	255	34	580	45	6.8
31-50 years old	800	100	0.66	500	60	10	12	0.9	0.9	11	1.1	320	2.0	700	95	8.1	265	34	580	45	6.8
51-70 years old	1000	100	0.66	500	60	10	12	0.9	0.9	11	1.3	320	2.0	700	95	5	265	34	580	45	6.8
>70 years old	1000	100	0.66	500	60	10	12	0.9	0.9	11	1.3	320	2.0	700	95	5	265	34	580	45	6.8
Pregnancy																					
14-18 years old	1000	135	0.88	530	66	10	12	1.2	1.2	14	1.6	520	2.2	785	160	23	335	40	1055	49	10.5
19-30 years old	800	135	0.88	550	70	10	12	1.2	1.2	14	1.6	520	2.2	800	160	22	290	40	580	49	9.5
31-50 years old	800	135	0.88	550	70	10	12	1.2	1.2	14	1.6	520	2.2	800	160	22	300	40	580	49	9.5
Breastfeeding																					
14-18 years old	1000	160	1.05	885	96	10	16	1.2	1.3	13	1.7	450	2.4	985	209	7	300	35	1055	59	10.9
19-30 years old	800	160	1.05	900	100	10	16	1.2	1.3	13	1.7	450	2.4	1000	209	6.5	255	36	580	59	10.4
31-50 years old	800	160	1.05	900	100	10	16	1.2	1.3	13	1.7	450	2.4	1000	209	6.5	265	36	580	59	10.4

is the nutritional objective. Fortunately, nutritional science came a long way over the 20th century, which now allows us to map the nutritional needs of humans, wherever they are, and we want the Portuguese population to be able to achieve particular nutritional levels to be healthy. So, at this level, there is a guideline for all those who work in the field.

What do we eat?

The following question is more difficult to answer and involves knowing what we eat, while trying to understand if those recommendations are in line with what our average consumption is. And this is where Henrique Barros has focussed much of his efforts in recent years, particularly in epidemiology teams linked to Porto's Faculty of Medicine, as well as other bodies that have been working at the national level.

These efforts focus on the foods we consume (we do not eat nutrients, we eat food) and compare our intake with recommended nutritional needs, in terms of vitamins and minerals, for example, and verify to what extent the food we eat coincides with requirements according to gender and age. This equation may appear simple, but unfortunately, in our case, we have very little information about what we eat. This should be the basis of our work at the national level. We should know today, for this year, or the last two or three years, what we have consumed, in nutritional terms, and compare this with the last 5, 10, 15, 20 years.

Unfortunately, at the national level, the data we have from population surveys in the field only goes back to the 1980 National Food Survey, meaning that the information we have is insufficient to make effective and informed decisions. There are other tools and other ways of getting this precious information via more indirect methods, both nationally and locally, although this implies limited quality and representativeness. Currently, we have reliable information for some regions but not enough nationally, and fortunately, in the north of the country, some quality information on food intake is now available. However, this is not the case across the country, which makes comparisons impossible. In England and Holland, this kind of survey is undertaken quite regularly, which facilitates comparisons of the population's food consumption.

What we have is what INE (Statistics Portugal) gives us regarding the availability of food; however, availability, or what enters houses, after comparing what we import and export, is often not directly related to what we consume. Fat is a good case in point. A good example is oil. A litre of oil a week may be available but, depending on how it is used, the family may

consume all of it, if it is used to season food, or consume much less if it is used to fry food As the oil can be used in completely different ways, only an individual intake survey can give us that information accurately, in the same way it would give us information about average intake by region, age, gender, etc.

Luckily, we have some comparative data. For example, the work of Sara Rodrigues[1] **(Figure 1)** compared different ways of obtaining information about food consumption. This work showed that, in Portugal, there is no direct relationship between what we consume and what is available. For example, in the case of oil and other fats there is considerable disparity between availability and intake.

A greater quantity of better, high-quality information is needed to make decisions. Perhaps this is the first conclusion to draw: our information systems have to improve considerably to meet our needs in order to understand what we eat and if what we eat is different to what we ought to eat.

What do we want to eat?

After being aware of what we should consume (nutritionally-speaking) and what we actually eat, the third question is related to what we want to eat. And what we want to eat (Tim Lang has already given us some direction here) can be a food consumption guidance model that includes nutritional goals alongside all the other objectives here, ranging from the environmental to the cultural and social. When a model of what would be desirable in terms of diet is drawn up, citizens' individual autonomy to decide for themselves has to be taken into account. However, there should also be a degree of autonomy in our country and within the institutions that work in this area, in order to assist in making the political decisions to create models, while not forgetting that we need to respect citizens' freedom when making recommendations or laws that encourage models of consumption.

Returning to the issue of "what we want to eat", we can see that it is possible to intervene locally, regionally and nationally. Oddly, our food wheel (one of the national food guiding documents) **(Figure 2)** is one of the few in the world that has water in the centre. I think that this is a good example of where we can be innovative. I don't think that there is any food wheel or similar figure that puts water at the centre and places such a

1 Rodrigues SSP, Lopes, C., Naska, A., Trichopoulou, A., Almeida, MDV, 2007. Comparison of national food supply; household food availability and individual food consumption data in Portugal. J Public Health, 15(6), 447-455.

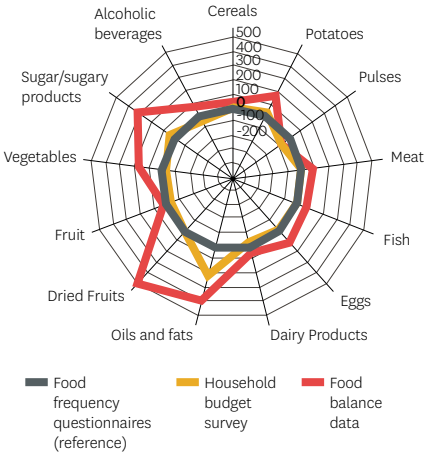


Figure 1. Three food consumption assessment models.
Source: Rodrigues, S., et al., *2007*

Figure 2. The new Portuguese food wheel.
Source: Institute of Consumer/FCNAUP

priority on it as we do in Portugal. If we look at the wheel, it has a number of typically Portuguese foods, which means that, in terms of conceptual advances in the area, we are not so badly off. The Portuguese wheel displays the Portuguese apple variety (bravo de Esmolfe), a Madeira banana and even a Portuguese cabbage (collard greens). Our sardine, which Tim Lang talks about, is there. Despite this wheel being a few years old, there was this idea of promoting foods that are sourced locally or nationally; foods that are particularly seasonal and that do not need to be transported great distances.

On the Portuguese wheel, we can see three groups that provide protein. Let us consider the amount of protein we need every day. In the case of an adult male, we need something like 56 g of protein per day or 0.8 g for every kilogram of body weight per day. Based on these figures, we may begin to decide where we want our protein to come from. Do we want it to come from pulses? And we have several types of pulses to choose from: beans, lentils, chickpeas ... Or do we want it to come from sardines, eggs, chicken, beef or dairy products? This is already a choice that has started to be given to those who make this recommendation and which can start being differentiated by citizens according to the various objectives and social, cultural or economic situations. So, there is some leeway for professionals who want to suggest different options, which must be also geared towards the needs and tastes of different groups of citizens.

The environment

In addition to nutritional issues, there are other perspectives to consider, such as environmental, economic, social and historical issues that can be discussed at the national level. Focussing on the Swedish situation, Annika Carlsson Kanyama analysed the impact of food on the environment, specifically in terms of energy use.[2] Because we do not have data for Portugal yet, we have to look at this kind of work. Kanyama analysed the Life Cycle Energy Input, which is the amount of energy that is used to get food to our table; from the very start of production to processing, manufacturing, transport and preparation. Using this method for various food groups, while estimating the precise location of the end consumer, it is possible to make various calculations. From these basic figures we can do some math and extrapolate for Portugal, albeit in a general and imprecise form. In this case, we indicate two meals, which could be two dinners: dinner A and dinner B. Each provides roughly the same amount of energy and both are similar, nutritionally-speaking. These dinners are apparently alike – one includes beef with rice, greenhouse tomatoes, wine and butter, while the other is comprised of chicken, pasta, fresh tomatoes, water and oil. Despite the similarities, if we use the energy expenditure tables provided by this type of study, we notice that dinner A requires three times more energy than dinner B, and that apparently similar choices, in terms of nutrition and even flavour, have very different consequences when it comes to energy expenditure (Table 2). Of course, these data have to be viewed in light of a series of calculations, although with considerable caution. We must be particularly careful when extrapolating for the Portuguese situation. This is just one example, but something we can begin to work with, when we consider there is already a great deal of information regarding foods that imply greater energy costs, especially animal-based processed foods and those that are transported over thousands of kilometres before they are consumed. This is not only about the possible environmental labelling of food, but also about how our daily food consumption has a major impact on the amount of energy used. Identical calculations can be done for water use and other indicators, and when these calculations are done for millions of consumers, the results are impressive.

2 Carlsson-Kanyama, A., Ekström, M., P., Shanahan, H., 2003. Food and life cycle energy inputs: consequences of diet and ways to increase efficiency. *Ecological Economics*, 44(2-3), 297-307.

The economy

Another important issue when discussing what consumption model we want is the economic situation in Europe and, in particular, Portugal and the southern European countries like Spain, Italy and Greece, the so-called Mediterranean countries with a Mediterranean diet. There is work, like that of French researcher Nicole Darmon[3], which has recently analysed the effect of citizens' economic situation upon their food choices. More specifically, for the French situation, it analyses food consumption variations according to individual or family income, using populations on a national scale, which makes this work particularly valuable. What has been consistently discovered in various population groups is that, generally, the cheapest dietary patterns and those chosen by people with fewer economic resources are systematically those that provide the most energy. In other words, what these bodies of work have demonstrated is the opposite of commonly-held beliefs. Energy was expensive and acquiring sufficient energy via food was a factor in the selection of the species. This has been our tradition for thousands of years, but recently, for technological and other reasons, it has become easier to acquire and consume cheap energy and that energy is then converted into fat and something that generates obesity and other health problems. In addition to this, this cheap energy is of generally lower quality **(Figure 3)**.

As such, there is now an inverse relationship that is emerging between quality food consumption and socio-economic status that makes us think about its effects. One of them is the link between obesity and socio-economic status and we can see this in the researcher's work. These data are also consistent with those of other European and western countries, where it has generally been found that there are clear increases in levels of obesity as family income diminishes. However, as there are many factors involved in obesity, this interpretation of the information has to be viewed with care.

What we are finding is poverty associated with health problems and associated with obesity, partially related to food quality and the energy contained in food that is cheap and also more popular with this population group. At a difficult time in Portugal, when we have populations experiencing serious economic hardship (clearly visible in 2009 – Figure 4 – and if we had data for 2011 or 2012, data would probably be even clearer), those at greatest risk are associated with income levels below

3 Drewnowski, A., Darmon, N., 2005. The economics of obesity: dietary energy density and energy cost. *American Journal of Clinical Nutrition*, 82(1), 2655-2735.

Foods	**kg**	**MJ** (energy provided)	**MJ** (energy necessary for its production)
Dinner A			
Beef	0.13	0.8	9.4
Rice	0.15	0.68	1.1
Tomato	0.07	0.06	4.6
Wine	0.3	0.98	4.2
Butter	0.014	0.44	0.56
Total	**0.66**	**2.96**	**19.86**
Dinner B			
Chicken	0.13	0.81	4.37
Pasta	0.175	0.61	1.08
Fresh tomato	0.07	0.06	0.37
Tap water	0.2	0	0
Olive oil	0.02	0.74	0.48
Total	**0.6**	**2.22**	**6.3**

Table 2. Two meals: food, energy provided and energy necessary for its production. *Source: Calculated from Carlsson-Kanyama, 2003*

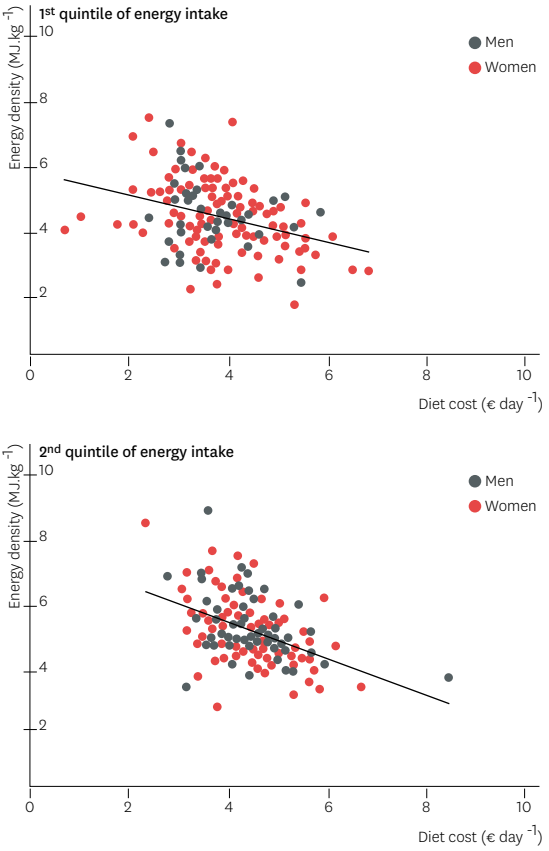


Figure 3. Relationship between energy density and diet cost. *Souce: Darmon, 2005*

414 euros a month. These are very low income levels and we can see that there are considerable sections of the population in this situation, such as the aged, large families or one-parent families. Clearly, these are the people we have to focus on and who need some kind of protection, as we believe them to be the most likely to suffer the consequences of poor diet if there is no form of prevention and care strategy.

The OECD table **(Figure 5)** establishes a link between the number of hours we work and obesity in the 21 OECD countries. What we see is that the more hours of work done per year, the greater the prevalence of obesity in populations. The countries where citizens work the most hours are generally the ones where there are greater levels of obesity. This is also a completely different paradigm, because people work more hours but expend less energy. These figures may indicate a number of different situations, such as the fact that work is now less physical. Very often the work of many is characterised by low physical effort and routine, with little effect on the level of energy expenditure. However, this is rather odd because it means that we clearly have to modify all previous paradigms regarding energy spent and energy consumed and all the things that we health professionals and others thought in the past, which this new information calls into question.

The historical question

Finally, to conclude the issue of what we want to eat, we have the historical question. Traditionally, there is the idea that countries in the south (Mediterranean countries) have a healthy diet. This was actually true; the model itself is healthy; now all we need to know is whether we are currently in a position to adhere to it on a daily basis. We present four examples of Mediterranean dishes (combined dishes), which involve know-how and a person's ability to do something, having the time and the capacity to buy fresh produce and that produce being available. In other words, it implies a set of conditions that are increasingly less common, despite the produce being available and us still having the know-how (although less and less so). The question is: how do we keep this protective dietary tradition alive? From some point in time, we may not be in a position to do so, due to a lack of knowledge, time or money and even a lack of desire to produce it, as the family does not recognise its importance **(Figure 6)**.

Tim Lang talks of a vegetarian diet or a diet with more vegetable-based food as something that safeguards the environment and something necessary, due to population growth and less available food. The

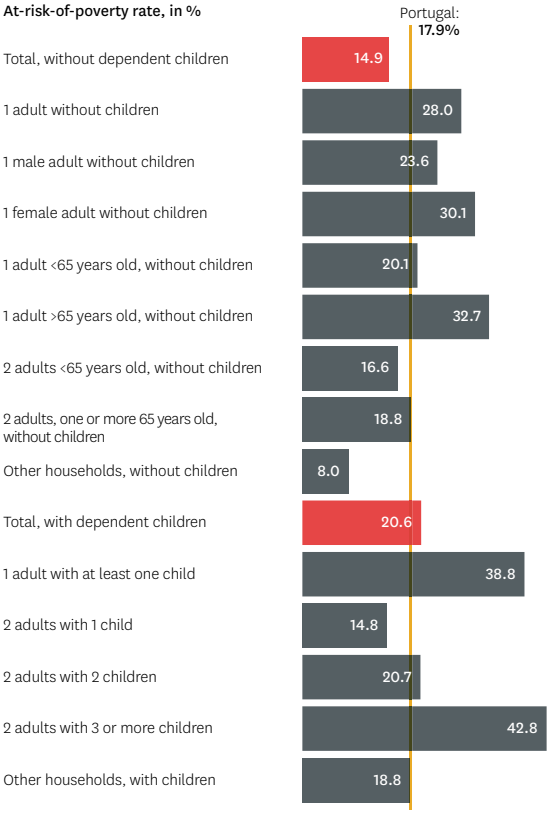


Figure 4. At-risk-of-poverty rate according to family profile, Portugal.
Source: EU-SILC 2009

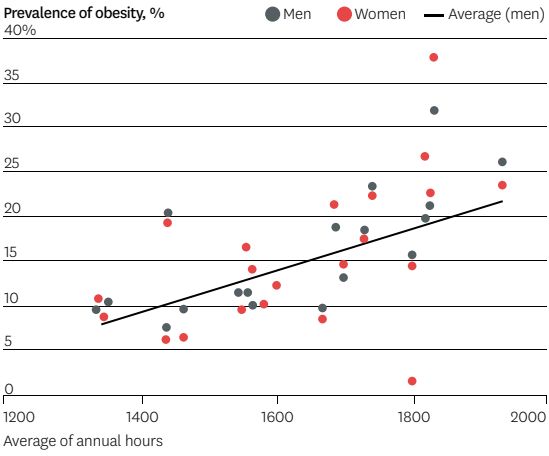


Figure 5. Relationship between obesity and average hours worked.
Source: OECD, 2009

Mediterranean-style diet is clearly vegetarian based and has always had things like different sausages and cod as meat substitutes; products with a lot of flavourings or salt (in the case of the sausages) that gave the illusion of meat when there was none, which was also the case with salted fish and its canned derivatives. This was a diet associated with frugality and uncertain food cycles that many of us want to forget nowadays. When we look at a *cozido à portuguesa* (traditional Portuguese dish) there is meat; it is no longer the pretence of meat that it probably was 50 or 60 years ago. This is a type of cooking that involves a vegetable base where meat appears to a greater or lesser extent, according to the family's current economic situation, the time of year and whether it is a more festive occasion or not. This dish also illustrates the way of sharing at the table, where the ingredients can be distributed differently to those eating, according to their taste and needs. So, here are different paradigms, and it is worth considering if we are in a position to maintain or even promote them nowadays.

The last question: what is the best way of achieving this goal? It depends on the food pattern, which may be a Mediterranean one. Recently, Portugal submitted its candidacy for the Mediterranean diet for the UNESCO list of Intangible Heritage. This means that we are at least committed to maintaining this type of dietary pattern, even if it is only from a cultural perspective, hoping that culture drives change. It is interesting to talk about this at a foundation that is very culture-focussed.

Integration

What is the best way of achieving this goal? There are a number of ways. We have presented a relatively recent OECD study in this session that says that one of the things that has the greatest effect on changing eating habits is advice or support from a health professional **(Figure 7)**. Obviously, this model would be very interesting if we had one health professional per citizen, given the extent of the dietary problems. Unfortunately, although not totally impracticable, I would say that this model is very difficult to implement. In the majority of cases, there has to be a mixed intervention involving direct action from a health professional and work on education, as well as changes in legislation. Based on a combination of these three things, there has to be a general intervention to change food consumption.

On a positive note, I would like to mention that there are now many professionals in this field in Portugal, which signals great progress. Over the last 20 years, we have seen enormous growth in the number of nutritionists, as well as other health professionals.

Figure 6. Four examples of Mediterranean dishes

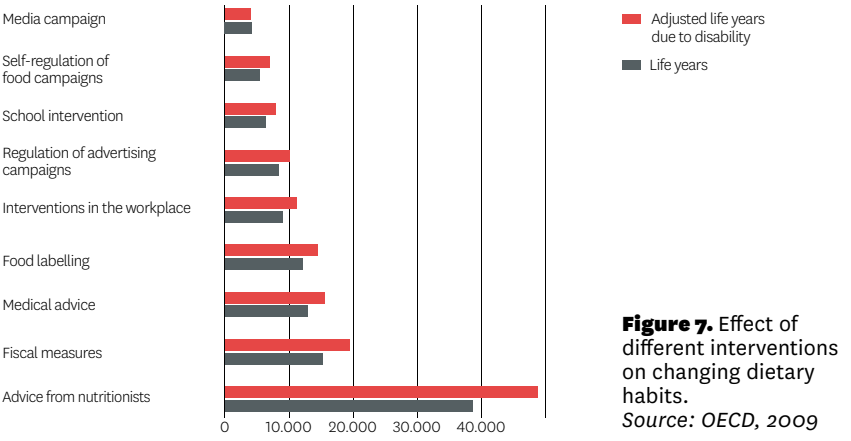


Figure 7. Effect of different interventions on changing dietary habits.
Source: OECD, 2009

I would also like to say that the OECD is of a similar opinion and has reached similar conclusions. When multiple interventions are combined and involve school, education, advertising, health professionals and nutritional information on labels that I was speaking about a little earlier, this is always more effective than isolated efforts.

This means that creating a food strategy involves integrating people and knowledge areas. In fact, the aim of this series of conferences is to integrate knowledge. Elizabeth Elsing, who worked for many years in this area and at the World Health Organization, defined a food policy as "a set of concerted efforts geared towards improving the nutritional status of populations". I believe this is what has to be done, along with what Tim Lang talks about: agricultural policy, educational policy, social policy, environmental policy and health policy; integrating all of these sector policies and attempting to intervene where it matters, which is the food consumption of populations.

This integrated model seems interesting and one that appears to be viable. We are taking our first steps. Unfortunately, it has never operated formally in Portugal. I think it has to be considered in this way, because time is running out. There are some interesting examples of cooperation between education and agriculture, like school fruit scheme, which sees fruit being given to thousands of children throughout the country. This project began very recently, but has demonstrated that it is possible to work in a coordinated way (in this case, between the Ministries of Agriculture, Education and Health), offering fruit to school-age children. However, it is not just any fruit. This is fruit that should mostly be certified as organic or grown using integrated production methods, using environmentally-friendly production methods and preferably by local producers. There are projects in Portugal involving the local authorities and government that are attempting to offer an integrated response to these questions. Although they are still few in number, we hope that more appear in the future and the concerted food strategy we spoke of is constructed.

In relation to the integration of sector policies, it is worth looking at other countries, like Norway, which offer good examples of what a food policy can be. After the Rome Conference in 1974, it was the Norwegians who began defining a food policy that aimed initially to protect agriculture. Later, they redefined this a number of times, via different plans that clearly involved integration of the different areas. The latest plan (2007-2011) involved 12 ministries, which demonstrated a commitment that began with the Ministry of Health and included the other ministries.

There has to be an integrated commitment from all sectors, because food and diet are not just a health or agriculture issue, but rather something that goes beyond mandates that requires major investment of time and resources. In Portugal, we have had 18 governments during the time in which these four integrated plans operated in Norway. Such a large number of people thinking, often in very different ways, does not help define a food policy, which clearly has to stretch beyond the political space and time of a mandate. It is something that can be designed for 10 or 15 years, involving joint reflection and integration, because it is a strategy that cannot be constructed from one moment to the next.

Various national health priority programmes have recently been published and are currently being discussed and developed. One of them could be the basis of a medium-term food strategy and is called the NNational Programme for the Promotion of Healthy Eating. This signals hope that we can do something in the future and that, increasingly, with other colleagues from other fields, we can begin building a national programme that is truly comprehensive and one that involves a variety of perspectives.

I would like to end with the words of someone who has been important in this field but who, unfortunately, is no longer with us. This comes from Dr. Emílio Peres and I think it reflects what we are talking about very well: "It is food that makes us big or small, imbeciles or intelligent, fragile or strong, apathetic or active, unsociable or able to live alongside others; it kills us early, still in the embryo of the mother's womb, or late, by chance, after a full life."

Food and development

From development to food and from food to development

Augusto Manuel Correia
Maria Hermínia Cabral

The relationship between development and food, although seemingly obvious, is not always linear. On the one hand, it is obvious, as it represents the desired causality between development and people's right to food; on the other hand, it is non-linear, as facts have shown us that the benefits of growth do not always reach the poorest, who, as a consequence, are the worst affected by the scourge of hunger.

Even though recent years have seen the highest rates of economic growth in the developing world, these countries still have the highest number of undernourished people, both in absolute and relative terms.

The latest available statistics indicate that there are 870 million undernourished people in the world, i.e. around 12.5% of the world population – 850 million of whom live in developing countries, particularly in Southern Asia and Sub-Saharan Africa (FAO, 2012).

However, there are also other imperfect relationships between hunger/malnutrition and (personal and collective) development, which, in macro terms, can be seen at the level of morbidity and mortality rates (in some diseases), as well as in schooling and school dropout rates – and also in the productivity rates of those countries. In 2000, the first Millennium Development Goal was set: to halve the percentage of people living below the poverty line and affected by hunger between 1990 and 2015. In terms of the international agenda for development, this not only made the correlation between these two phenomena explicit, but it also showed how core they are in terms of development indicators. Poverty is, without doubt, one of the main reasons preventing access to food. As such, in order to improve food security rates, first and foremost, poverty must be reduced.

For the poor populations, who live mostly in rural areas or in the shanty towns of megacities in developing countries, feeding themselves is a daily challenge, which, in extreme situations of sudden price spikes of basic foodstuffs, leads them to hold street protests – as was the case in 2007/2008 and 2010/2011. These protests are often the only time that the international community and governments focus their discourse on the importance of agriculture for development.

It should be noted that, today, several voices attribute the current situation of food insecurity in developing countries to the role that was assigned to the agricultural sector in development strategies between the 1950s and 1970s (functioning as a resource reservoir for the industrial sector or for the production of low-cost food) and to the disinvestment in agriculture by donors and international financial institutions in the decades that followed.

Recently, and particularly after the agricultural price crises in 2007/2008 and 2010/2011, there has been an increasing number of declarations and initiatives from the international community, advocating that agriculture should play a central role in the reduction of poverty and hunger in lower-income countries. Econometric studies have shown that "GDP growth originating in agriculture is, on average, at least twice as effective in benefiting the poorer half of a country's population as growth generated in non-agricultural sectors" (World Bank, 2008).

However, despite the high number of (chronically) undernourished people and the injustice that this reflects (the world's food production is sufficient to feed its entire population), significant progress has been made in recent decades: it has been estimated that the rate of malnutrition worldwide was halved between 1970 and 2010, and that from 1990 to 2010, it dropped by 33%[1]. Nevertheless, this improvement was neither environmentally neutral nor equitable, and should current consumption and production patterns continue, in the future, guaranteeing the entire world population sufficient food production or access to food will be unsustainable.

The challenges that lie ahead are enormous and highly complex. It is necessary to meet the needs of a world population that continues to grow – according to the United Nations' 2010 estimates, there will be over 9.5 billion people in 2050, with 8 billion in the poorest countries – and which, as its income increases, tends to favour food consumption that is less eco-friendly.

1 Source: www.fao.org/hunger/en

Climate change, which has a greater impact on developing countries, and the environmental degradation of many natural resources, along with the growing energy production needs that we have experienced, will accentuate the current competitive demand for land and water resources and the shifts from food production to non-food production.

Today, there is a new geopolitics of food, with the poorest countries leasing or selling their land to other developed and developing countries – ensuring food production and food security for the latter without knowing how this will affect the former.

As such, ensuring food for everyone is a difficult equation to solve, and one that requires bringing together many different variables – among which investment, innovation and technology will be crucial. However, make no mistake, there is no, nor will there be, a single formula. The implementation of policies suited to the contexts of each individual country will, without doubt, be one of the keys to much sought-after success.

The binomial "development-food" will, once again, involve placing agriculture at the centre of the international development agenda, with particular attention being given to increased productivity among small farmers and women, the main agents of change.

In addition, it is also important to ensure effective coherence among all the countries' different policies regarding the global objective of "food for all", and to promote integrated agriculture-nutrition-health approaches at a local and national level. These will be some of the many paths to be taken so that development will be nutritionally beneficial to developing countries.

If we agree on this, we shall have to abandon rhetoric and take action, once and for all! Will we manage? Let's hope we do.

Bibliography

/ Antil, A., 2011. Le Phénomene d''accaparement des terres': quelle grille de lecture pour l'Afrique? *Ramses 2011 – Un monde post-américain?* Thierry de Montbrial et Philippe M. Desfarges (dir.). Paris: IFRI.
/ Alexandratos, N. (ed.), 2010. *World Agriculture: Towards 2010: an FAO study*. Available at www.fao.org/docrep/V4200E/V4200E00.htm
/ FAO, WFP and IFAD, 2012. *The State of Food Insecurity in the World 2012. Economic growth is necessary but not sufficient to accelerate reduction of hunger and malnutrition*. Rome: FAO. Available at www.fao.org/docrep/016/i3027e/i3027e00.htm
/ Pirstrup-Andersen, P., Pandaya-Lorch, R. (eds.), 2001. *The unfinished agenda: perspectives on overcoming hunger, poverty and environmental degradation*. IFPRI.
/ World Bank, 2008. World Development Report: Agriculture for Development. Washington DC: World Bank.
/ For further information: www.fao.org/hunger/en; http://hdr.undp.org/en

A new paradigm for global food security, ensuring individual and collective development

Benoît Miribel

I am very honored to participate in the Gulbenkian Foundation's initiative regarding a key issue for the coming decade: our food security.
It is common knowledge that no human being can develop both physically and intellectually without having food in sufficient quantity and quality. According to the Food and Agriculture Organisation (FAO, 2012), there are currently over 850 million people who are vulnerable in terms of food. Can we talk about a developed civilisation whereas there are people who are not able to ensure their needs in terms of food? How come in the 21st century we are still not able to feed everyone? What kind of challenges shall we be confronted with, as far as food security is concerned ?

International experts are divided, as far as the response to this crucial need to manage human and animal resources is concerned, however, most agree on the following: if we do not redefine our current production and distribution model, the 9 billion people expected to inhabit the Earth in 2050 will have to face successive food crises, which will lead to social, economic and political tensions.

As the food riots that made headlines in 2008 clearly demonstrated it, food insecurity, once again, proved itself to be a disseminating factor of political insecurity. As a whole, rulers who forget that their people need bread in order to live, usually end up paying dearly for it. Last year's Arab revolutions, namely in Tunisia and Egypt, arose from the growing revolt of the people in relation to the prices of basic foodstuffs.

Hunger has always been prone to being used as a weapon to control populations, to weaken them and thus make them dependent, and even to annihilate them, as had happened in numerous conflicts!

At the Aquila Summit in 2009, the G20 members included the issue of food security on their agenda, with a 22 billion dollar contribution from the various countries for the next five years.

Was this the result of the emotion caused by the spectacle of hundreds of thousands of people going hungry, or an international spirit of solidarity, or the awareness that " the food bomb" may one day be as dangerous as an atomic bomb? In any case, this pledge by the G20 in 2009 has so far been only partially respected, despite pressure from international NGOs, so that the political declarations made in this field may not be forgotten, once the media coverage is over.

Food security is the cornerstone of human development, as well as of our health and our environment. The awareness that our resources are limited and that there will be more and more of us on this planet is, justifiably, a factor of tension and concern. Could this great challenge that faces humanity be an opportunity for us to reconsider the current bases of food production and management at a worldwide level? How best could we be able to create the conditions for the access to food for all ?

The issue

There is a direct correlation between individual development and collective development, i.e. one about economic and social development to benefit the community.The latest FAO report points out that economic growth contributes to the fight against malnutrition (FAO, 2012). Sustained agricultural growth, in particular, often has an impact on the poorest, as most people affected by poverty and hunger live largely off agriculture, in rural areas. However, growth alone does not contribute as such, towards improved nutrition for all. For this to happen, it is also necessary that growth policies and programs promote food diversification, access to drinking water, public sanitation and health services, as well as to consumer education in nutrition and child care.

Action contre la Faim (ACF) considers nutrition security to be a priority, as it allows us to bring together "food security with a suitable sanitary environment, adequate health services, appropriate nutritional care and practices to ensure a healthy life for all the members of the family. " (Shekar, 2009).

Every year, the United Nations, through the United Nations Development Programme (UNDP, 2012), draws up a "human development" index,

which makes it possible to address the concept of the development of people, using criteria going beyond the merely economic sphere, as it was the case for decades. On an international scale, there is a significant correlation between the ranking of countries with a low human development index and those having a reduced capacity for food self-sufficiency.

In this era of globalization, our world remains nonetheless effectively divided between the developed countries on one hand and the developing countries on the other one, despite the appearance over the past decade of a new category of "emerging countries", in which a large number of people suffering from malnutrition are to be found (India and China). In the 2010 FAO and WFP (World Food Programme) report, the emphasis was put on one category in particular: that of countries experiencing "protracted crises", which includes 22 countries seriously impacted in terms of food insecurity. Natural disasters and political crises recurrently weaken around 20 countries worldwide, which have in common the fact that approximately 40% of their population is vulnerable in terms of food.

The media are mentioning millions of dollars donated every year for decades by the international aid to countries experiencing food difficulties. Most of our fellow citizens do not understand why international development aid has not yet been able to contain the problem of hunger and malnutrition. Many experts are dealing with the challenge of the population growth, together with the evolution in eating habits and in our environment. However, they do not all agree on which recommendations to follow, in this international field of food security which remains somewhat poorly regulated by the various States!

In this context, Action contre la Faim strives to ensure that the most vulnerable ones are not forgotten.

Indeed, tensions related to the management of resources and rising food needs have led numerous States and agri-food companies to invest massively in the land, especially in Africa, where the greatest available potential is currently to be found. Arable lands have become a profitable investment for investors. International rules are needed to ensure that the threat of a deterioration in food security conditions will have no impact on the million of people in a more vulnerable situation.

How do we address the issue of food security to ensure discrimination-free global development?

How do things stand at the moment and what priorities should be taken into account?

The current situation

It is very seldom for someone to die of hunger in a developed country, except in isolated cases, due to social problems. On the other hand, there are people, especially children under the age of five, who continue to die of hunger in emerging countries, for example in India. Around one billion human beings are currently suffering from hunger, more than half of them in the Asia/Pacific region and particularly in India and China.

The FAO estimates that around 870 million people suffered from malnutrition between 2010 and 2012.

They represent 12.5% of the world population, or one in every eight people (FAO, 2012). The overwhelming majority – 852 million people – live in developing countries, where it is currently estimated that 14.9% of the population is affected by malnutrition.

On a global level, two thirds of undernourished people are concentrated in seven countries (Bangladesh, China, the Democratic Republic of Congo, Ethiopia, India, Indonesia, and Pakistan), and over 40% of them live in India and China. The percentage of undernourished people is particularly high in Sub-Saharan Africa, having reached 30% of the population in 2010.

Food insecurity is the most common outward sign in around 20 countries affected by protracted crises. Over 50 million children are emaciated and suffering from acute malnutrition, 19 million of whom "severely" so. Over one million children die every year from severe acute malnutrition (Lancet, 2008).

They live mainly in countries enduring protracted crises. Chronic malnutrition affects over 178 million preschool age children, whose growth will be definitively affected, with consequences for their intellectual and physical capacity. It has been proven that this lack of development of individual capacities has an economic impact on the affected countries.

Globally, according to UNICEF figures, over 10, 000 children under the age of five die of hunger every day, not including those falling victim to a combination of infectious factors due to food and water shortages (especially with diarrhea). Different types of malnutrition are not mutually exclusive and often coexist in the same child.

Malnutrition and development are closely related. The most severe forms of malnutrition affect at first people living in countries which are poor or in crisis. This means that you cannot effectively fight hunger without striving to contain poverty through the development of individual and collective capacities.It is also important to note that 2/3 of obese

people live in developing countries, where urban food is often unbalanced and of poor quality. Obesity is also a form of malnutrition which increases the risk of health problems and limits the capacities of development.

Although in 1950, 50% of humanity did not have the 2, 500 daily calories deemed necessary, today that figure stands at around 15%. This is an improvement in terms of percentage, however, if we take the demographic growth into account, the situation remains worrying in terms of numbers.

With regard to agriculture, there are currently 1, 550 million hectares of cultivated land and 3, 460 billion hectares of pastureland, 95% of the cultivated areas produce food ; the remaining area produces textiles, rubber, tobacco and agrofuels. In order to meet the growing demand for food, it will be necessary to double the cereal production by 2050 and to achieve an annual cereal production of around 4, 000 million tons.

How will it be possible to reach that essential agricultural growth to feed all human beings? And for whose benefit? Paradoxically, the adults who are hardest hit by malnutrition are mostly small agricultural producers.

Challenges

International food aid is not the solution for the need to develop local agricultural capacities in countries hit by food shortages. It is merely a limited response to situations of crises. For too long, governments of developed countries have sent their grain surpluses to underdeveloped countries, without taking into account the specific factors of local contexts. The perverse effects of food aid have become known since then; they include the potential to destroy local production capacities and the establishment of food- dependency relationships. Some UN agencies and certain international NGOs have often contributed to the establishment of agricultural or food aid policies that have been unsuitable in terms of sustainability and development. In recent years, there has been a significant decrease in food aid in favour of other more appropriate programmes.Food aid remains necessary at times, but in very specific contexts, based upon the needs of the populations and managed by competent professionals.

Africa remains the only continent where there has practically been no evolution in agricultural yields since the 1960s.

This situation is not inevitable, because the use of fertilizers, and certified seeds, together with the development of irrigation, may very well allow for an increase in yields.However, the issue of property is crucial in Africa, where there are at least three overlapping legal forms related to land: land use law, State law and the Roman law of private land

acquisition, introduced by commercial crops such as coffee and cocoa. The issue of land ownership is often a factor limiting the growth of agricultural yields. It is increasingly becoming a political problem in as much as foreign countries are seeking to acquire land with the primary objective of supplying their own domestic market.

Several developed or emerging countries depend on the international food market to ensure their own subsistence, an example being South Korea. Faced with the potential available in Africa, some of these countries invest in acquiring land in Africa, so as to reduce their food vulnerability. This increasingly widespread land grabbing in Africa and Southeast Asia could pose a problem with regard to the distribution of available agricultural resources. It raises the possibility that in Africa, within a few years, it will be possible to see hungry people next to pieces of land owned by foreigners. This ongoing land acquisition process, which may generate employment and increase the yield of previously unexploited areas, raises the issue of the distribution of cultivated produce.

On the other hand, there is a growing disparity with regard to agricultural holdings; you may find many small family units, as well as a concentration of large capitalist ventures.On one side, there are millions of small farmers struggling to survive; and on the other, several thousand large and well-funded agricultural industries. How should we manage and regulate the often conflicting goals of these two agricultural uni-verses, which are nonetheless necessary for our future ?

The 2008 international food crisis led to riots caused by hunger, to which the G8 countries reacted by undertaking ambitious financial commitments at the 2009 Aquila Summit. In total, 22 billion dollars were allocated to improving global food security.However, as ACF pointed out at the G20 Summit in Cannes last November, only 25% of these funds have been effectively applied thus far, ranging from agriculture to transport, including the economy and the social sphere. The absence of true priorities is regrettable, as is the inability to explain precisely which means are mobilised in the area of food safety. At the Cannes Summit, the G20 member states contended themselves by adopting measures against volatile crop prices, following widespread speculation in this area in recent years.

In a joint statement with other NGOs involved in the food security issue, ACF announced seven recommendations to the G20 countries, posted on the internet site " FeedinG20", created for this purpose.

Priorities to be implemented now

Given that natural resources and food production capacity are unevenly distributed around the world, how should we organise food security needs according to world population development ?

In order to double cereal production by 2050, three essential conditions would be necessary: support for small farmers, the protection of threatened cultivated areas and an increased productivity.

This entails resolving issues regarding access to land and property in developing countries, with the primary goal of ensuring the production capacities of small farmers.

It is important to encourage food crops and to promote the creation of agricultural cooperatives run by small farmers, who should be encouraged to conserve their water resources and preserve biodiversity.

In an urgent response to the food crisis in the Sahel, SOS Sahel (an NGO partner of ACF) encourages the creation of family vegetable gardens so that mothers can feed their families, taking care to provide a balanced diet. Thanks to the surplus produced and sold on the market, a small amount of money can be saved in order to contribute to a health cooperative that makes it possible to monitor children's health. Involvement in agricultural resilience programs is essential, together with an emergency nutritional response, so that populations do not become hostage to foreign aid in an escalating cycle of dependency. The connection between support and relaunch activities must be ensured, in order to prevent the gap that often exists between these two phases (linking relief, rehabilitation and development).

It is also important to continue raising mothers' awareness of their children's health. In the Sahel, it has been found that many mothers react too late to their children's state of malnutrition. It might seem normal to them that their children are frail and weak due to insufficient food intake, and very often they are not really aware of the physiological limits beyond which children can no longer be saved.

Today, we know how to treat acute malnutrition, however, we lack the necessary financial means, estimated at 12 billion dollars per year to save the 10,000 children under the age of 5 who die of malnutrition every day.

It is also necessary to ensure " social safety nets" for people who have been identified as being at greater risk in the event of a food crisis. When growth doesn't reach the poorest, it is essential to resort to social protection mechanisms to eliminate hunger as quickly as possible.Finally, in order for the fight against hunger to make rapid progress, governments

must provide essential goods and public services, under a system based on transparency, participation, accountability, the rule of law and respect for people's rights.

It is also important to limit and control all waste recorded in the food chain, which experts estimate at about 30% of world food production. This waste ranges from the poor condition and bad management of stocks, and transport-related losses that are common in developing countries, to the revision of expiry dates, and the establishment of quotas for developed countries.

Following the 2008 food crisis, measures were taken to release international stocks that would make it possible to regulate the market and, above all, anticipate agricultural production failures.However, it is necessary to continue this process of establishing global food reserves to regulate supply and demand at local, regional, national, and international levels, within an international level of transparency.

It is necessary to help the poorest countries establish policies to stabilise the price of cereals. These countries should also benefit from international support to expand "disaster prevention" programmes, which makes it possible to prepare competent local authorities, as well as vulnerable populations, to deal with potential food crises. These programmes have the advantage of improving local capacities, of limiting the dependence on international aid, which carries with it a much higher cost than empowering local players to deal with potential disasters, such as droughts or floods that destroy agricultural production.

A new food paradigm

At an international level, numerous initiatives have been created, so as to gradually allow all the stakeholders involved in the " Food and Development" challenge to sit around the same table. Nevertheless, what is at stake is so important that it shouldn't be left to the experts alone.It is important that we are all informed of the challenges that lie ahead and the necessary measures to be taken, so that future generations will not inherit a world with increasing food insecurity, and many more diseases. Experts on emerging infectious diseases have found that the inappropriate use of agricultural land has increasingly become one of the factors facilitating the spread of new pathogens dangerous to human beings.

Numerous interested parties currently advocate a transversal approach to nutrition, health and agriculture, jointly geared towards policies that are likely to effectively reduce poverty and promote human development

while respecting the environment. The ministries of health in developing countries should have qualified staff for the prevention and treatment of malnutrition. Coordination between the ministries and the stakeholders must be consolidated, as the prevention of malnutrition also includes the different forms of agricultural production that are being used.

Given the unequal global distribution of natural resources and food production capacities, it is our duty to organise food security, taking into account the development of the world population and in view of individual and collective development. We must foresee the challenges related to future tensions over food resources, so as to ensure that populations will not be kept away from said resources, and to prevent an increase in the number of people affected by hunger.

It is by appealing to our fellow citizens and to our policy makers that we will be able to pave the way for the establishment of a new paradigm, ensuring the harmonious development of man and nature. How couldn't we be able to carry out this duty ?

In this regard, the Gulbenkian Foundation 's initiative to promote a better understanding of the issues related to food security should be welcomed and encouraged in other European countries, so that our fellow citizens would become spokespeople of this new paradigm that is currently needed.

People have always been victims of hunger, and today there are still many who believe this to be an inevitable fate. This, however, is false. Nowadays, we know how to treat malnutrition and we can have the means to redefine together, the foundations of a food management model based on individual and collective development!

We are able to imagine and develop highly effective techniques to explore other planets, we should thus be able to adopt a global food management model capable of providing food for everyone living on our planet!

Food and the economy

Portuguese agriculture is alive and kicking

Armando Sevinate Pinto

Farming and food production and diets have recently returned to the political agenda and to the attention of the international media. This is happening even in the most developed countries, where supermarkets are still overflowing with food.

There is a simple reason for this: the upsets of successive food crises with increasingly volatile product prices have made us realise that, in the medium term, current food production has a long way to go before it can feed a population undergoing exponential growth.

Scholars get worked up, organisations and politicians discuss. What is the formula for producing more and better, using fewer resources and in a world experiencing fast demographic growth? How can we cope with this challenge? What strategy can we use and which means? These are questions that everyone asks.

Thankfully, these issues are also discussed in Portugal. What is not so good, though, is that the starting points are unclear, the discussion has nonsensical concepts, incorrect information, manipulated opinions and, most of all, is highly inaccurate.

I have always found it extremely difficult to accept the light-hearted way in which public messages in Portugal are consolidated on the basis of the hunches of people who have never consulted the available statistics. In fact, this leads to successive and naive repetitions.

If we want real debate with a fruitful outcome on the history, development, options and strategies regarding the agricultural, forestry and agro-industrial sectors, both the people directly involved and the public in general must have access to baseline information that is accurate and that is properly analysed and presented.

Despite the efforts of various public and private organisations, including Statistics Portugal, which have done sterling work, we are still bombarded by abusive conclusions thrust upon a defenceless public opinion relatively predisposed to accept what the national press most enjoys disseminating, which are the negative components of the truth.

Some topics have been particularly mistreated. The evolution of the Portuguese food production systems; the results and measures under the Common Agricultural Policy; the impact of its subsidies and the evolution of the farming incomes; the abandonment of farming activity; and the level of food self-sufficiency are just a few of the most important and mistreated topics in terms of public information.

I will start with the way our agriculture is portrayed. It is constantly considered to be "dying", "non-existent", "destroyed", "ruined by the CAP", etc. This portrait is consolidated through countless public messages in this sense, propped up by errors of perception[1] and the acceptance of this message by many farmers and farming organisations, who think that this serves their best interests.

Faced with this bombardment, what else can most Portuguese people do other than believe it all?

However, the reality is very different and the facts and statistics demonstrate the following:

- We have never had such a developed and modern wine or olive oil sector with such levels of quality and competitiveness;
- We have never had such a productive, effective and technically capable dairy sector;
- We have never had such a strong horticultural and horticultural-industrial sector that is so diversified and competitive;
- We have never had such a modernised, diversified and productive fruit-growing sector, if not in all, then in most of its segments;
- We have never had such a productive and sustainable livestock sector (including poultry and egg production);
- We have never produced maize with such technical and economic efficiency, even though the overall area cultivated has been reduced;
- We have never had such an effective, modern, safe and competitive agro-industrial sector, which has become the sub-sector of tradable goods that has contributed most to the economic value added;

1 For example, when a wheat field is replaced by pastureland, particularly permanent pasture, the first impression of those who pass by is that the land has been abandoned.

- We have never had a forestry sector with such a large export surplus;
- We have never had such a modern, safe and hygienic network of abattoirs, olive oil mills or wineries, as well as many other modern infrastructures that are comparable with the best in the world;
- We have never produced so many varieties of good quality cheeses, sausages, hams and other traditional products;
- Our production system has never offered so much food safety, such good farming practices, and so much hygiene and safety in farming and agro-industrial work.

If everything I have just said can be proved, it begs the question why the exact opposite is said, and why is it so readily accepted by public opinion? It is a mystery I am unable to answer, unless it is due to partly justified nostalgia for the traditional farmer practising a subsistence agriculture and often underusing resources. This might lead to the idea that the country's resources and land were being used to the full.

There has obviously been an important reduction in grain-growing areas and the actual amount of cereal produced, almost always being replaced by grassland and permanent pasture, though there is a story to tell about this and practical actions to consider.

It is also true that we have significantly reduced potato, bean and chick pea production and that we have abandoned beetroot-growing, which we only produced temporarily, albeit successfully.

It is also true that in almost every sector, from wine to olive oil, from fruit production to livestock, there are modern segments that continue to co-exist alongside ineffective segments that have structural issues, are technically underdeveloped and in constant crisis.

It is also true that many thousands of farmers have disappeared in the meantime, for a number of reasons. It may be because they had tiny plots of farmland that did not offer productive conditions, or because they could not keep pace with the technical and economic evolution of agriculture, or because, in all fairness, they preferred to abandon their lives of misery and deprivation in favour of activities that would guarantee them better, safer and more comfortable standards of living.

Should we therefore punish ourselves or, on the contrary, rejoice at least in relation to the cases not associated with dramatic personal and family situations?

Should we mourn the times in which few farmers had water, electricity and sanitation, when most of them could not send their children to school, had no holidays, were exposed to a host of dangers and generally died young?

It seems that some people do mourn those times. I certainly do not.

Our modern-day farming has little or nothing to do with the past. Despite facing the same great natural limitations, it does so more dynamically with modern methods, fewer people and better results.

What has changed in the last two decades is the productive paradigm in most sectors, and many people have yet to realise this. Here are three examples.

Milk

20 years ago, 80,000 milk producers produced 1 million tonnes.

At present, 7,800 producers produce 2 million tonnes.

Global production has doubled and productivity per farmer has increased 20.5 times.

Tomato for industry

20 years ago, 5,000 farmers produced 490 thousand tonnes.

At present, 500 farmers produce 1.3 million tonnes.

Total production has increased two and half times and productivity per farmer has increased 26.5 times.

Olive groves

20 years ago, around 300,000 hectares of olive groves produced between 30,000 to 40,000 tonnes of olive oil.

At present, this same production can be obtained from only 10% of that area (30,000 hectares).

Production has increased tenfold in new, modern and irrigated olive groves.

In relation to abandonment, recently an article in a prestigious and widely-read weekly newspaper announced that Portugal had 3 million hectares of abandoned farmland! This is clearly nonsense! An area that size would account for almost all of our farmland.

Furthermore, in its latest and extensive Farming Census in 2009, Statistics Portugal (INE) considered 125,000 hectares to be abandoned. The difference is so overwhelming that there is no need to comment. The problem is that most of the Portuguese population who read the news and did not check the statistics were convinced that we live in a country that has abandoned its agricultural activity.

Other recurrently wrong messages that fuel our collective masochism include our level of food self-sufficiency. According to most opinions conveyed to the public, this level is no more than 30%. Fortunately, however, the reality has nothing to do with this figure, and our food self-sufficiency is over 70% (see text by Francisco Avillez on chapter “Food and Economics”).

How is it possible that so many people, even experts and the politicians responsible, can still refer to the 30% and manage to see the reality upside down!

As far as farmers' income subsidies are concerned, there is an e-mail circulating that represents the view held by most Portuguese.

It talks rather indignantly about the absurd idea that these subsidies are immoral, that they come out of Portuguese pockets to pay farmers to do nothing so that everything eaten in Portugal would be imported!

This type of comment is so ignorant it is hardly worth responding to. The income subsidies paid to producers are 100% funded by the European Union and are designed to compensate, albeit partially, the most significant reductions in farming prices over the years, aimed precisely at protecting European consumers.

As for the Common Agricultural Policy (CAP), which receives a lot of "bad press" in Portugal, it is said to have destroyed our agriculture. The reality is that without the CAP, most of our agriculture could not survive.

One of the Policy's components comes under attack, as if it were everything. It focuses on the policy of markets and prices – which supports the income of Portuguese producers with over 500 million euros a year, so that they can cope with market prices, which are normally lower than production costs. However, it ignores the policy of rural development, which is also part of the CAP and which has given intense support to the modernisation of agriculture, forests and agro-industry, with amounts of between 500 and 600 million euros a year.

Apart from that, the CAP is often criticised for absorbing 40% of the Community Budget, without ever saying that since the policy is common, it substitutes the spending of the Member-States and represents less than 0.4% of the public spending of the group of Member-States, with which it should be compared.

As for food consumption, the subject of this seminar's second intervention, it is interesting to see, firstly, that it has changed remarkably over the last few decades, going from manifestly insufficient consumption per capita of some essential food products (e.g. milk, meat, fruit) to average levels similar to those of Western European countries. The leap we have taken in this area is nothing short of impressive.

It is true that averages mask the shortages of many and the excesses of some.

It is also true that we have embarked upon food that is easy, fast, exotic and ultra-processed, influenced as we are by the encouragement and enticement to consume led by the large supermarket chains.

We are only apparently free to make our own food choices and we forget that every time a product we buy goes through the cash register, we are voting.

We vote for natural or highly processed food, for organic or industrial food, we vote for local products or imported ones, we vote for seasonal produce or those that are in season somewhere else, on the other side of the planet (a normal meal travels on average 2,400 kilometres before it reaches our plate).

We can vote three times a day to change the system. Unfortunately, there are those who vote less, but there are others who spend their life voting.

Portuguese agriculture does what it can to keep up with the new consumption habits of Portuguese society, many of which are so exotic they cannot be produced in Portugal and have to come from all over the world, even from the furthest corners. On the other hand, many of these products at our disposal are far from essential, are often bad for our health and are almost always harmful to our economy, and can be replaced by domestic production.

In short, it would not be a bad thing if Portuguese consumers were systematically invited to pay more attention to their food behaviour and to be more demanding and critical about the accuracy of the information they receive in relation to our agriculture.

Food self-sufficiency: myths and realities

Francisco Avillez

Introduction

As a result of the current economic and social crisis, the concept of food self-sufficiency has increasingly come under the spotlight, be it in public and published opinion, or in political discourse.

It is therefore essential to understand better what this concept means and what importance should be attributed to it in the context of public policies in Portugal and in the EU-27.

This presentation will seek to address the following aspects.

Firstly, what is meant by food self-sufficiency, and which indicators can we use in order to analyse self-sufficiency within a given country?

Secondly, what is the relationship between food self-sufficiency, food autarky, food supply security and food security?

Thirdly, in the context of increasingly broad and competitive markets and of the different types of policy measures comprising the Common Agricultural Policy (CAP), to what extent can the goal of food self-sufficiency be desirable or achievable?

Fourthly and lastly, what role should the agri-food sectors in the most developed countries, in general, and in the EU-27, in particular, play in the fight against food insecurity, and what form should the creation of a strategic food reserve take in this context?

Food self-sufficiency: what it means and how it can be measured

The food self-sufficiency (or self-supply) of a given country can be defined as its capacity to meet the food consumption needs of its population through domestic production and/or food imports funded by corresponding exports.

As such, the agriculture of any given country will ensure food self-sufficiency if it is able to satisfy domestic consumption based on national agricultural production or, if this is not wholly possible, based on food imports, provided these are fully paid for by the earnings generated by food exports.

For some time now, INE (Statistics Portugal) has calculated the degree of self-supply (DSS) indicator for the main types of food products, which is based on the following formula.

$$\boldsymbol{DSS}_j^t = \frac{Production_j^t}{Available\ for\ supply_j^t} \times 100$$

where,

Available for supply $_j^t$ $= Production_j + Input_j\ (or\ Import_j) - Output_j\ (or\ Exports_j) - Existence\ Variations_j$
t *= the year to which the indicator refers*
j *= a particular food product*

As the different components of the calculation indicator of the DSS indicator are expressed in terms of volume (10^3 tonnes), it is not possible to carry out its aggregation at a national level. It thus becomes necessary to calculate an indicator based on the monetary value of the different components, which we will refer to as the national degree of food self-supply (NDSS), which is based on the following formula.

$$\boldsymbol{DSS}_j^t = \frac{National\ food\ production^t}{Apparent\ national\ food\ consumption^t} \times 100$$

where,

National food production ^{t} *= production value of foodstuffs of agricultural origin that are consumed fresh or processed in a given country, in year t*
Apparent national food consumption ^{t} *= national food production value in year t + value of national imports of fresh or processed foodstuffs of agricultural origin in year t – value of national exports of fresh or processed foodstuffs of agricultural origin in year t*
t *= the year to which the indicator refers*

It is, therefore, an indicator that includes the value of production, of imports and exports of the different sectors in a given country: agriculture, food industries and beverage industries. The fact that agricultural products are intermediate consumptions of the food and beverage industries makes it impossible for the production value of food items to correspond to the sum of the final production value of each branch of economic activity, thus making it necessary to resort to the input-output matrix of the INE's National Accounts in order to calculate the NDSS. Up until recently, a commonly made mistake has been:

- Either only to consider the value of agricultural production when calculating food production, which underestimates the value of the NDSS;
- Or to consider the sum of the production values of the three sectors concerned when calculating food production, which overestimates the value of the NDSS.

The previous formula can be set out alternatively as follows:

$$\boldsymbol{DSS}_j^t = \frac{\textit{National food production}^t}{\textit{National food production}^t - \textit{National food trade balance}^t} \times 100$$

where,

***National food trade balance**^{t} = value of domestic exports of foodstuffs of agricultural origin in year t – value of domestic imports of foodstuffs of agricultural origin in year t*

***t** = the year to which the indicator refers*

The fact that the numerator and the denominator of the formula differ only with respect to the value of the food trade balance, and that the latter is often expressed by the indicator for the rate of coverage of imports by food exports (Exp/Imp in percentage), is most probably the source of the great confusion to be found in the media, as well as in political discourse, regarding the value to be attributed to the degrees of sectoral self-supply or national self-sufficiency in Portuguese agriculture, which, as can be seen in Figures 1 and 2, are significantly different.

Figure 1 sets out INE's figures for the main Portuguese food products of the degrees of sectoral self-supply and the rates of coverage of imports by exports for the year 2008. An analysis of such values allows us to conclude that there are enormous differences, be it among the different

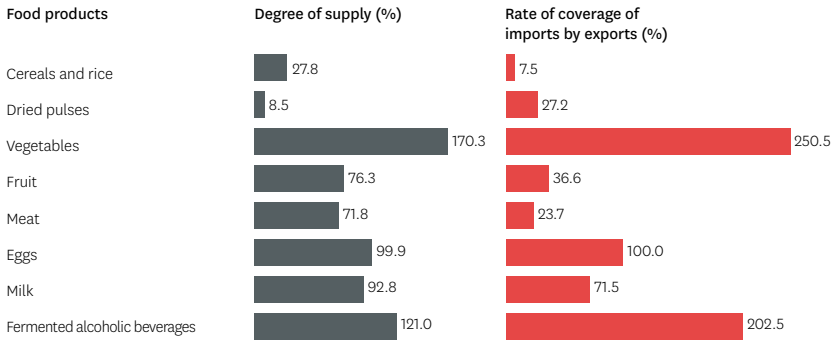


Figure 1. Degrees of self-supply of the major food products and the respective rates of coverage of imports by exports in Portugal in 2008.
Source: 2010 Agricultural Statistics, INE (Statistics Portugal).

products or between the two indicators presented for each food product.

Figure 2 brings together the figures resulting from our estimates based on the input-output matrix of INE's National Accounts in relation to 2009, for the two indicators in question: the degree of national self-sufficiency and the rate of coverage of imports by exports. Even though the indicators related to the Portuguese agri-food complex are the most significant to our analysis, I have chosen, with the objective of showing the difference between them, to include the estimated values for these same indicators in the table for:

- The two sectors comprising this complex, namely agriculture and food agro-industries;
- The Portuguese forest complex and the two sectors that comprise it: forestry and forest industries;
- The Portuguese agro-forest complex, which encompasses agriculture, forestry, food agro-industries and forest industries.

Self-sufficiency, food autarky, food supply security and food security: what differentiates these concepts.

The concept of food self-sufficiency presented above is more comprehensive than the concept of food autarky, but less encompassing than the concepts of food supply security and food security.

In fact, the concept of food autarky presupposes that all of the food consumed in a given country over a certain period of time is ensured through the national production achieved in said period or that which has been previously stored. Thus, it differs from the concept of food self-sufficiency

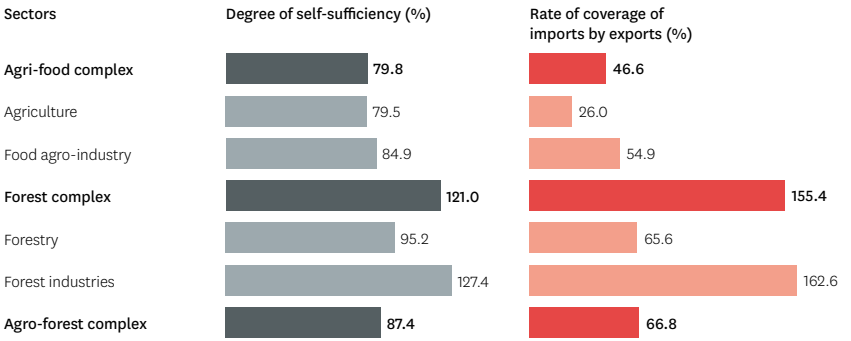


Figure 2. National degrees of food and agro-forest self-sufficiency and the respective rates of coverage of imports by exports in Portugal in 2008.
Source: Author's calculations based on the Input-Output Matrix of INE's National Accounts.

since it precludes recourse to foreign trade as a means of contributing to the supply of domestic food markets.

The concept of food supply security refers to the guaranteed normal supply of the domestic food market at affordable and stable prices, be it under normal conditions or in emergency conditions, based on national production or on imports. The difference between this concept and that of food self-sufficiency lies in the fact that food imports are not dependent on obtaining earnings resulting from the export of goods of the same type.

The concept of food security is even more encompassing as, according to the FAO's definition, food security only exists when it is possible to ensure that all people have access to quantitatively and qualitatively adequate food, that is, sufficient food to meet their nutritional requirements and preferences so as to guarantee an active and healthy life. From this perspective, it can be concluded that the concept of food security includes (in addition to a component corresponding to the concept of food supply security defined above) another component related to food access, that is, the capacity of populations to obtain food in adequate conditions from a nutritional and sanitary point of view, either by producing or purchasing it, or by means of a transfer of goods from which they may benefit.

Food self-sufficiency: how to evaluate it in as much as it is a goal of the national agricultural policy

By means of the stands taken by MAMAOT (the Ministry of Agriculture, Sea, Environment and Territorial Planning), the Portuguese government

has come to recognise that the agricultural and forest sectors in Portugal will be facing four major challenges:

- To contribute towards the growth of the national added value through increased exports of products of agricultural and forest origin, and the replacement of respective imports;
- To promote the sustainable management of land and water resources by using these in a manner that is more economically efficient and more environmentally sustainable;
- To contribute to the fight against climate change by promoting a low-carbon economy;
- To contribute towards a more balanced development of rural areas.

In this context, many references have been made to the value of national food self-sufficiency as being one of the main objectives to be achieved by the national agricultural policy.

There are essentially two issues that must be addressed in the context of the edapho-climatic limitations that characterise Portuguese agriculture, the increasingly broad and competitive agri-food markets, and the types of policy measures comprising the Common Agricultural Policy (CAP).

- Is this a desirable objective for Portuguese agricultural policy?
- And if we accept that its achievement is desirable, is this an achievable goal?

In the context of the edapho-climatic limitations characteristic of Portuguese agriculture, this option is not, in our opinion, the most desirable, as there are other alternative forms of soil use that are more economically competitive and more environmentally sustainable, which will be compromised by the adoption of an incentive system favouring the production of food products at the expense of the production of forest goods, the production of biofuels and/or the production of environmental and social public goods.

It should also be noted that within the context of the current CAP and the one that will come into effect in 2014, the agricultural policy instruments available will not make the objective in question attainable, even if, for reasons of national policy, one were to admit that its achievement was indeed desirable.

There are those who argue that proposing food self-sufficiency as an objective for Portugal in the next few years is the same as proposing an increase in national agricultural production for food purposes as an objective, by increasing exports and replacing imports, and that identical measures would be adopted in either case.

In my opinion, this argument is false as it presupposes that the available land and water resources will only be able to be used for the production of foodstuffs,

which, in the case of Portugal and from an economic and environmental point of view, conditions systems for the occupation and use of available soils.

At best, this argument would be acceptable if the intended objective was agro-forest self-sufficiency instead of food self-sufficiency, and provided the management of natural resources and climate stability occupied a privileged place in the attainment of said goal.

In this context, it is important to emphasise that the objective to be reached in Portugal over the next decade should not be to increase agricultural production, but rather to increase national agri-food and forest added value, which, in my opinion, does not depend only, nor mainly, on increased production, but on the more efficient use of the available production factors and on a greater valuation of the agri-food and forestry goods produced.

The role played by agriculture in the EU-27 in the context of food supply security

For the reasons stated above, I am of the opinion that, in terms of agricultural policies, we should favour the concept of food supply security at the expense of food self-sufficiency.

On the other hand, we believe that it is pointless to address the issue of food supply security in Portugal outside of the context of agriculture in the EU-27, whose role in this area I will seek to analyse next and which cannot be addressed without taking into account the future evolution of the world food system.

The future evolution of the world food system will be conditioned by a diverse set of factors, ranging from the growth of the world's population to climate change. It will also include improved income levels of populations in developing countries and the resulting change in their respective diet; increasing competition in the use of available resources among food production, forest products and biomass; and the future adjustment of world agricultural markets.

There is now a general consensus that, irrespective of the future evolution of the various factors in question, the issue of food security in general, and the supply of food markets in particular, will be of strategic and decisive importance in the context of national and international policies.

In the opinion of most experts, public policies will have to face the following key challenges in order to fight food insecurity:

- Ensuring a sustainable balance between food supply and demand;
- Contributing towards the future stability of food prices so as to protect the most vulnerable populations;

- Fighting poverty and ending hunger in order to ensure access to an adequate diet for the entire world population;
- Conciliating the fight against food insecurity with the demand for greater climate stability;
- Feeding the world population while ensuring a sustainable management of natural resources and biodiversity.

An appropriate response to these challenges will demand, on the part of national and global agricultural policies, the adoption of measures aimed primarily at the following aspects.

Firstly, a sustainable improvement in the economic productivity of the world food system, based on existing resources and technical expertise. Recent studies have pointed to the possibility of achieving food production gains on a global level, capable of ensuring a regular supply of the respective markets, based on:

- Expanding cultivated areas (8% of potential production increases);
- Intensifying the currently used agricultural systems (16% of potential production increases);
- Increasing physical productivities (75% of potential production increases).

However, these and other studies question the future compatibility of these improvements and greater environmental sustainability and climatic stability, given the worldwide generalisation of western food consumption models and the lack of a concentration of financial and human resources in the development of agriculture on a global scale (research, infrastructures, productive investments, etc.).

Secondly, the need, in the future, to consolidate scientific research, experimental development and the transmission of knowledge so as to identify and promote agro-food production systems and technologies capable of reconciling an increase in the future supply of agricultural and food products with the sustainable management of natural resources, biodiversity and a low-carbon economy.

Thirdly, a reduction in waste throughout the food chain, which, at a global level, is estimated to correspond to losses of between 30% and 50% of the amount of food produced.

In the fourth place, a future change in the current consumption models, through the widespread implementation of diets capable of contributing to a desirable balance between growing food demand and an economically and environmentally sustainable increase in the respective offer.

Fifthly, the demand for new forms of a wider and more effective governance of the national and global food systems.

In this context, particular importance is placed on the debate regarding the role to be played by the so-called Strategic Food Reserve, which can take on three different forms:

- A buffer stock;
- A buffer fund;
- Buffer resources (natural and know-how).

The buffer stock of food is based on the existence of food stocks to be placed on the market should there be difficulties regarding its normal supply. The great advantage of this stock is its quick response, while the major disadvantage lies in its establishment and running costs, which are almost always very high (and difficult to sustain).

The buffer fund is based on something specifically created to address the need to buy, on the world market, the food needed to ensure the normal supply of domestic markets. The disadvantages of this type of food reserve are related to a potentially slower response than the physical reserve and to possible implementation difficulties in situations of greater instability of world markets. On the other hand, the establishment and maintenance of these types of funds in less developed economies almost always runs the risk of becoming attractive for alternative uses, given the budget restrictions that the governments in question very often have to face.

The third type of food stock we have taken into account is based on the availability of national resources (land, water and human), which when not being used productively are preserved with the objective of being activated when necessary. We are thus dealing with a national agricultural reserve, whose conservation under adequate agronomic and environmental conditions has to be ensured through public subsidies and whose activation will depend on the decisions of policy decision centres stemming from the supply needs of food markets.

It should be noted that this type of food reserve, which is the most desirable in the context of agriculture in the more developed countries, runs the risk of being confronted with the argument that it is based on subsidies being given to producers in order for them not to produce. In my opinion, this is a false argument since, if this type of initiative respects appropriate agronomic and environmental conditions, it represents the best solution for agricultural areas where production within a given time period does not offer guaranteed profitability in terms of the prices practised in increasingly broad and competitive markets, and areas which should be preserved so as to be activated when the economic and social conditions so warrant.

Lastly, let us look at the role I believe will fall to agriculture in the EU-27 in the context of the fight against food insecurity.

In the first place, I would like to emphasise that, in my view, currently there is not (nor will there be in the foreseeable future) a lack of supply security in food markets in the EU-27, and that choosing food security as an objective of the post-2013 CAP is therefore not justified. It could be argued that given the economic, financial and social crisis facing the EU, access by part of its population to a desirable quantitative and qualitative diet might be at risk. Although I am sensitive to this argument, I nevertheless believe that these types of situations are not resolved by agricultural policies, but rather by appropriate social policies.

Secondly, I would like to state that despite the stand taken above, I do believe that the EU-27 should actively participate in the fight against food insecurity on a global scale by adopting the necessary measures for its contribution towards:

- Increased food production based on gains in competitiveness and not, as many seem to suggest, in protectionist policies (measures related to market price support and coupled payments);
- The suitability of the conditions regarding payments to producers decoupled from production and the creation of a strategic food reserve, based on the availability of the resources necessary for the resumption of production by agricultural areas usually lacking guaranteed profitability, when the supply of food markets justifies their activation;
- International cooperation aimed at developing the agriculture of less-developed countries, through collaboration in research, experimental development and knowledge transfer, support for public and private investment and the opening of EU borders to imports from these countries;
- The search for new forms of global agricultural governance, capable of ensuring greater future stability in agricultural and food prices, as well as a quicker and more effective response to food crisis situations.

Bibliography

/ Bruinsma, J., 2009. The Resource Outlook to 2050, Expert meeting on *How to Feed the World in 2050*. Rome: FAO.
/ Cooper, T., Hart, K., Baldok, D., 2009. *Provision of Public Goods through Agriculture in the European Union*. London: IEEP.
/ FAO, 2008. *The State of Food Insecurity in World 2008*. Rome: FAO.
/ FAO, 2009. *Food Security and Agricultural Mitigation in Developing Countries: Options for Capturing Synergies*. Rome: FAO.
/ Foresight, 2011. *The future of food and farming. Final Project Report*. London: The Government Office for Science.

Food consumption: a return to the past?

Filomena Duarte

Introduction

Despite scant information available on Portuguese food consumption within the context of the current crisis, references have been made to a possible return to the past, in terms of a shift in demand for more basic, lower added-value goods, thus contradicting recent trends.

The objective of this contribution is to question that possibility.

Firstly, I will strive to show that although agricultural products form the basis of our diet, food supply, particularly in developed countries, is the result of a chain process in which the food industry and food distribution play a significant role.

Secondly, I will identify the key trends that have marked the evolution of food consumption in developed countries in recent decades, and discuss its main determinants.

Then, we will look at how these trends have unfolded over the last three decades, in terms of the quantities of food consumed.

Finally, I will present changes that are taking place in the context of the present crisis. These will be identified and analysed, by taking into account our past experience and its determinants, in order to return to our initial question.

From agricultural products to food products: the food supply chain

Agriculture continues to be the basis of nourishment inasmuch as commercialised agricultural production, despite having other possible uses (biofuels, pharmaceutical products, seeds, plants and flowers, etc.), is

essentially aimed at feeding humans and animals. However, very few of the food products consumed in developed countries come directly from agriculture.

In fact, generally speaking, agricultural products are unmanufactured products, or products that have undergone minimal processing; they are often not packaged and are, thus, raw materials. It is in this form that farmers sell most of their production (Lagrange, 1995).

In turn, a food product is an agricultural product (obviously there are also fishing and aquaculture products) that has been handled, packaged and, in most cases, processed, and is intended for food consumption in or outside the home.

Upon leaving the farm, agricultural products do not generally possess the attributes desired by consumers when purchasing a food product.

It is thus said that there are barriers to be overcome: barriers related to distance or space, time, form and ownership (Beierlein and Woolverton, 1991).

This adjustment is essentially carried out through downstream agricultural production activities, i.e. processing and distribution activities, although it is also partly carried out by farmers themselves or by their associations (the most significant case is that of fruits and vegetables, but this is also relevant for olive oil and wine).

Processing and distribution allow the product to reach the consumer in the desired form and at the intended place and time.

Some figures for 2009 make it possible to illustrate this situation in Portugal (INE – Statistics Portugal, 2009):

- It is estimated that during 2009, Portuguese families spent only 16% on food products derived directly from agriculture, 7% on products from fishing and aquaculture, and 77% on products from the food industry (these percentages relate to the breakdown of the final consumption expenditure of households for these three types of goods, and therefore do not include beverages);
- Of the total number of uses or utilisations of agricultural products (including animal rearing and game), 61% of these were for intermediate consumption, that is, products used by other branches of economic activity, in order to carry out their own production. Of this total, 63% was allocated to processing by the food industry.

Food consumption is thus ensured by a group of economic agents linked by production, consumption and exchange who boast commercial, financial and social relationships with each other in a given geographical space, the so-called food supply chain (Eurostat 2009).

In this chain, we can find different types of economic agents participating in the exchange, processing and distribution of products, from the agricultural producer to the end consumer: agricultural companies, cooperatives, producer organisations, manufacturing companies (the food and beverage industry), distribution companies (wholesalers, retailers, importers, exporters), the hospitality industry (restaurants, cafés, canteens, etc.), and transport companies.

Among the various types of participants in the food supply chain, processing and distribution agents play a particularly important role, inasmuch as they are essentially responsible, as previously mentioned, for adjusting the attributes of agricultural products to the demands of end consumers.

This then justifies an albeit brief description of the economic agents currently found in Portugal.

In 2010, as in previous years, the food industry represented the main activity in the Portuguese manufacturing industry, with sales of around 8,400 million euros, that is, around 15% of the entire manufacturing industry (INE – Statistics Portugal, 2012). Of this sales total, 85% was allocated to the domestic market, with the most important activities in sales percentage terms being the dairy industry (14.2%), the livestock feed manufacturing industry (11.4%), and the industry for livestock slaughter and meat production (9.6%).

It is a non-concentrated industry, dominated by microenterprises (companies with fewer than 10 employees) – over 7,000 in a total of 9,426 companies in 2009. Many of these microenterprises are located in rural areas and provide an important contribution to local employment and income and, in some cases, are aimed at niche markets for quality products. There were only 31 companies with 250 or more employees.

However, with regard to turnover, the companies with 50 or more employees accounted for 69% of the total (and those with 250 or more employees, for around 30% of the total).

Another industry that must be mentioned when dealing with food consumption is the beverage industry, which had sales of around 2,400 million euros in 2010, 72% of which were earmarked for the domestic market (INE – Statistics Portugal, 2012).

Sales in this industry are dominated by the wine industry, with 44% of the total, and the beer industry, with 28%. With regard to exports, more beverages are exported than food products, primarily due to wine, where sales abroad that year represented 45% of the total.

In relation to food distribution, much like other developed countries, Portugal has undergone profound and rapid changes since the mid-1980s, with the development of large food distribution chains, commonly known as *grande distribuição* (large-scale distribution).

Of the various aspects that we could list, we draw your attention to the following:

- Retail distribution in Portugal is highly concentrated, a trend that has become more pronounced over time. In 2008, the nine groups of nationwide retailers operating in Portugal represented 72.4% of the food supply market and 83.5% of the retail commerce market. However, most importantly, of these nine, the two largest groups held a joint share corresponding to almost half of those markets: 46.5% and 45.6% of the supply and retail markets, respectively (*Autoridade da Concorrência* – the Portuguese Competition Authority, 2009).
- In recent years, there has been a major development in distributor own-name brands, whose market share rose from 12% in 2000 to 32.5% in 2010 for food products, and from 5.2% to 16.9% for beverages during the same period (Nielsen, 2010).
- From the mid-1990s onwards, there was a greater sales growth in supermarkets than in hypermarkets. While in 2000, supermarkets represented 44% of retail sales volume and hypermarkets 35%, in 2009 these percentages stood at 62% and 25%, respectively (Nielsen, 2010).

With regard to food consumption, the modernisation of manufacturing and distribution, as well as innovation in terms of products and processes, have both contributed to greater diversity, food safety and quality in relation to the supply of food products at a national level, as well as improved consumer accessibility to these products. These are undoubtedly important determinants of the changes in food consumption patterns that have taken place in Portugal in the last few decades, but they are also a factor of greater dependence on the foreign market in relation to food supply.

Before we focus on these changes, let us examine which were, generally speaking, the main determinants and trends in the changes in food consumption in developed countries prior to the present crisis.

Determinants and trends in changes in food consumption in developed countries

The analysis of food consumption behaviour brings into play very different disciplinary fields, leading to a great diversity of approaches that identify

and highlight different types of determinants: physiological, cultural, demographic, economic, sociological, psychological, marketing-related, etc.

The traditional economic theory approach seeks to explain changes in food expenditure or the quantities consumed of different foods based solely on consumer income and product prices.

As household income increases, the share of food expenditure in total consumption expenditure decreases. This is a well-documented fact in the most varied geographical and temporal contexts. In Portugal, it went from representing 21.5% of total expenditure in 1994/95 to only 15.5% in 2005/2006, according to the Family Expenditure Survey carried out by INE (Statistics Portugal).

Rising income also leads to a decrease in the relative influence of prices and income on food demand, and to an increase in the influence of preferences (Connor, 1994; Von Alvensleben, 1997).

Thus, other types of determinants become more important:

- Psychological variables (motivations, attitudes and perception), which, although individual, are themselves influenced by income level and consumers' socio-economic, demographic and cultural characteristics;
- Company marketing policies, by not only linking product availability, variety and price to consumer choice, but also the motivations, attitudes and perceptions themselves;
- Public policies, since they directly or indirectly affect prices and production costs, establish safety and quality rules for food products, and try to promote or suppress certain behaviours;
- And last but not least, socio-demographic changes that accompany an increase in income, such as weak growth and an aging population, a decrease in the average size of families, greater ethnic diversity, a growing percentage of employed women, increasing educational qualifications, sedentary work and the increased proportion of the urban population, which all characterise the evolution of developed countries in recent decades, albeit it in different ways.

The transversal nature of these socio-demographic changes, together with increased tourism, the activities of multinational companies and faster global communication, have contributed to the development of a set of common trends in food consumption in such societies, as demonstrated by various authors (Senauer, 1990; Connor, 1994; Steenkamp, 1996; Barreira, M. and Duarte, M., 1996; Van Raaij, 2000; Wijnands *et al.*, 2007; Kearney, 2010).

As consumer income increases, demand for food as a whole grows slightly, although there may be marked differences between products. In quantitative terms, food consumption necessarily tends towards saturation, but there is an increased demand for quality-differentiated products, or higher added-value products, which can be seen in the following trends:

- The demand for taste and other organoleptic attributes of products, but also the demand for socialising and enjoyable experiences; in short, the pleasure associated with eating. Consumers look to save on less important products so as to enjoy hedonistic experiences. This explains the success of distributor brands on the one hand, and on the other, the success of gastronomy, gourmet products, exotic products, etc.;
- Increased demand for convenience, associated with a lack of time to purchase and prepare food, but also with increased employment among women. This does not mean that cooking is no longer a pleasure or a socially recognised activity, but merely that these aspects are reserved for special occasions. The demand for convenience can be seen in large increases in the consumption of frozen foods, preprepared meals, ready-to-use salads, etc. It is also apparent in increased eating outside the home;
- Concerns about nutrition, health and safety (characteristic of aging, sedentary and urban societies with more information on the relationship between health and diet) lead to an increase, for example, in the demand for lower-calorie foods enriched with fibre, but also for foods thought to be more "natural" that may bring health benefits;
- For some consumers, an interest in food origin and the production process. More recent than the concerns mentioned in the previous point, concerns with environmental sustainability, animal welfare, fair trade and the defence of local products are included here. This is reflected, for example, in the increased consumption of organically produced products, or PDO and PGI products, and in the demand for products coming directly from agricultural producers and for animal products that are obtained in a less intensive manner, etc.

Although widespread, these trends can be seen in varying degrees in different countries, as well as in the same country, in different consumer segments.

The demand for convenience and health concerns are already clearly visible in Portugal, with the supply of many time-saving food preparation products, and an increase in the diversity and quantity of so-called

functional foods (low-fat products, enriched with calcium, fibre, omega 3, etc.). However, concerns with animal welfare, environmental sustainability and local products are only now beginning to emerge, which can be explained, in part, by the average low income of the Portuguese.

According to the terminology used by Grunert (2005), these trends precisely reflect the four major dimensions of subjective quality or quality perception – taste, health/safety, convenience and production process – that are identified in many surveys when consumers are asked what they consider to be a quality food product. In short, we can say that before the 2008 financial crisis, the choice of consumers in developed countries reflected different types of consumption motivations that went far beyond nutritional needs: motivations related to health and food safety (the absence of risks), to pleasure, convenience, integration with reference groups and social prestige, as well as the expression of ethical and environmental convictions.

These motivations, which can be seen in the key trends identified, provide opportunities to differentiate agricultural and food products and have thus been widely exploited, particularly by the food industry and by distribution, but also by the farmers themselves.

However, we cannot finish this point on food consumption determinants and trends in developed countries without referring to the view of French philosopher Gilles Lipovetsky, who draws our attention to the type of society we live in today. According to Lipovetsky, the developed world has entered a new stage in terms of consumption, the so-called "hyper-consumption society", where individual consumerist hedonism prevails. Regardless of class or social group, we all aspire to brands, quality and leisure activities, "the only difference being the amount of money that each person has to obtain these consumer goods" (Lipovetsky, 2010).

Since consumers cannot buy everything, they save on certain goods so as to have access to others, which simultaneously explains why both luxury and low-cost products are successful.

In this type of society, although the symbolic motivations of status and prestige persist and are important, they are not as significant as the individual search for well-being, escape and pleasure.

We will return to this topic when speaking of the effects of the crisis, but for now let us focus on how the above-mentioned trends expressed themselves in Portugal in terms of changes in the quantities of food and beverages consumed in the period between 1980 and 2008.

Principal changes in the quantities consumed of food and beverages, based on the Portuguese Food Supply (1980 – 2008)

The information provided by the Portuguese Food Supply (PFS) of Statistics Portugal allows us to outline changes in food per capita consumption (gross human consumption divided by the resident population at the halfway point of the reference period) over the past three decades in Portugal, and of the respective degree of self-supply (DSS).[1]

In order to simplify the presentation, we have divided the information from the PFS into three tables, one for products of plant origin **(Table 1)**, another for products of animal origin **(Table 2)**, and the third for beverages, for which information is only available as from 1990 onwards **(Table 3)**.

With regard to the per capita consumption of plant-origin food, I would highlight the following aspects in this period spanning almost three decades (the first available PFS dates back to 1980 and the last one refers to 2008):

- Strong growth in the per capita consumption of fruit, mainly throughout the 1980s and 1990s, which doubled from 61.5 kg to around 120 kg. There was also an increase in the consumption of fresh vegetables, but not as pronounced (around 32%) and only from the mid-1990s onwards, as prior to that it had decreased;
- A large increase in the consumption of olive oil, also from the mid-1990s onwards, although still remaining relatively low;
- Somewhat stable consumption of cereals and rice, with a slight increase in the case of wheat and rice. It should be noted that the PFS is based on the consumption of processed products (flour, bread, biscuits, breakfast cereals, etc.) in order to determine the consumption of cereals, such as wheat for example, expressed as a grain quantity;
- A reduction in potato consumption from the 1990s onwards;
- Increased consumption of dried pulses (beans and chickpeas) in the 1980s, followed by a drop. Current figures are close to those recorded at the beginning of said period.

1 This last indicator, which demonstrates greater or lesser foreign dependence in relation to food supply, is obtained by dividing internal production (IP) by internal uses (IU), and is usually expressed as a percentage. When it stands at over 100, this means that IP exceeds IUs, and we have export capacity. However, when the opposite is true, we have to resort to imports in order to meet IUs.
IUs are calculated as follows: Production + Imports – Exports – Variation in inventories = Available for supply or Internal use. In turn, Gross human consumption = Internal use-Seeding/eggs for hatching - Losses - Industrial use - Industrial processing - Animal feed (INE - National Institute of Statistics, Portugal).

Table 1. Changes in annual gross per capita consumption (kg) and in the degree of self-supply (%) of the main plant-origin food products in Portugal
Source: INE, Balança Alimentar Portuguesa (Statistics Portugal, Portuguese Food Supply)
Notes: (1) Abnormally low production of wheat in 2001; (2) Paddy rice; (3) Including table olives, except in the period 1980-1982

	1980/1982		1990/1992		2000/2002		2006/2008	
	Annual gross per capita consumption (kg)	GAA (%)	Annual gross per capita consumption (kg)	GAA (%)	Annual gross per capita consumption (kg)	GAA (%)	Annual gross per capita consumption (kg)	GAA (%)
Cereals and rice	143.4	27.8	144.9	47.0	154	33.1	152	26.9
Wheat	91.2	37.1	99.7	36.1	109	17.7[1]	108	11.5
Rice [2]	20.7	63.1	23.2	59.5	25.3	52	25.3	53.0
Maize	12.9	16	12.5	47.2	11.9	43.2	10.6	29.2
Roots and tubers	139.8	94.2	154.4	64.8	103.7	57.8	91.7	58.7
Dried pulses	3.8	80.4	6.2	49.2	4.1	16.2	4.3	10.1
Vegetable products	85.7	148.3	70.1	178.8	95.0	157.9	114.8	166.4
Tomato	11.8	431.7	11.0	627.0	20.7	432.6	17.5	612.8
Other vegetables	73.9	100.6	59.1	92.2	74.3	77.1	97.4	81.5
Fruits [3]	61.5	100.1	103.6	88.4	128.7	72.7	120.8	74.6
Olive oil	4.0	101.6	3.5	104.0	5.8	47.2	6.2	57.6
Other vegetable oils	11.3	117.5	13.4	95.5	13.0	101.9	14.0	101.5

Table 2. Changes in annual gross per capita consumption (kg) and in the degree of self-supply (%) of the main animal-origin food products in Portugal
Source: INE, Balança Alimentar Portuguesa (Statistics Portugal, Portuguese Food Supply)
(1) Total does not include butter, as it is included in the group of fats.

	1980/1982		!990/1992		2000/2002		2006/2008	
	Annual gross per capita consumption (kg)	GAA (%)	Annual gross per capita consumption (kg)	GAA (%)	Annual gross per capita consumption (kg)	GAA (%)	Annual gross per capita consumption (kg)	GAA (%)
Meat and offal	51.0	99.0	69.9	88.3	91.7	78.9	94.9	69.6
Beef	12.9	96.2	16.7	76.8	16.3	60.4	18.5	52.2
Pork	12.6	100.7	20.4	86.7	31.4	70.6	32.8	51.3
Poultry	16.3	100.0	20.0	101.3	30.7	96.7	31.5	93.0
Sheep and goat meat	2.5	100.0	3.9	92.4	3.5	70.4	2.9	79.8
Eggs	6.3	100.4	7.9	102	9.3	99.2	8.8	100.1
Milk and milk products [1]	73.5	99.5	107.7	101.2	124.7	95.9	131.6	93.1
Milk	63.5	100.0	84.4	102.1	88.5	107.9	89.3	106.2
Yoghurt	2.3	100.0	7.2	99.6	15.2	50.4	21.2	45.6
Cheese	4.6	98.6	6.5	96.6	10.0	78.6	10.6	71.1
Butter	0.8	75.8	1.1	136.5	1.8	132.7	1.6	167.5
Fish	28.6	102.1	37.4	73.7	33.2	44.6	36.6	41.1

Table 3. Changes in annual gross per capita consumption (l) and in the degree of self-supply (%) of the main beverages in Portugal
Source: INE, Balança Alimentar Portuguesa (Statistics Portugal, Portuguese Food Supply)

	1990/1992		2000/2002		2006/2008	
	Annual gross per capita consumption (l)	GAA (%)	Annual gross per capita consumption (l)	GAA (%)	Annual gross per capita consumption (l)	GAA (%)
Fermented alcoholic beverages	130.1	116.5	112.9	111.4	107.0	121.3
Wine and wine products	62.2	129.1	47.7	118.2	43.6	114.8
Beer	66.5	103.9	63	108.1	59.9	129.8
Other alcoholic beverages	4.7	53.9	4.1	64.6	3.4	60.8
Non-alcoholic beverages	77.8	98.7	141.9	89.7	187.9	94.2
Water	36.1	102.5	68.1	99.8	103.0	102.8
Soft drinks	38.9	95.1	65.8	83.4	73.4	81.9
Juices and nectars	2.9	99.6	8.0	63.1	11.6	96.2

As for the evolution in the DSS, we draw your attention to the following aspects:

- Regarding products whose consumption increased the most (fruit, olive oil and vegetables), although we were self-sufficient in the early 1980s, we have become more dependent on imports;
- In the case of cereals, even with the relatively stable growth in human consumption, import dependency has always been, and continues to be, very high. One of the factors contributing to this situation is the type of meat most consumed over this period, due to its dependency on compound animal feed.
- Finally, with regard to dried pulses, which were traditionally a part of the Portuguese diet, they are practically no longer produced in Portugal, as the IP only meets around 10% of the IUs. It would be interesting to see what factors account for this drop.

The most notable changes, however, took place in relation to products of animal origin **(Table 2)**:

- Over the last three decades, there has been a general increase in the consumption of animal-origin food products. This increase has also been reflected in Portugal going from a situation that was close to self-sufficiency in the early 1980s to import dependency, which is high in some cases (with the exception of milk, butter and eggs);
- With regard to meat consumption, we have to bear in mind the 1996 BSE crisis that adversely affected the consumption of beef, which up until then had been on the rise. Nevertheless, a recovery followed and

the last period's 18.5 kg represent a 43% growth since the early 1980s;

- The consumption of pork more than doubled in the 1980s and 1990s and then stabilised and it is the most popular meat in Portugal, followed by chicken. However, while half of the domestic supply of pork depends on imports, in the case of chicken we are practically self-sufficient;
- There were notable increases in the per capita consumption of dairy products, in particular yoghurt (900%) and cheese (230%). Butter consumption also doubled;
- Finally, it should be noted that although fish consumption grew moderately, the DSS deteriorated substantially.

Per capita consumption of beverages can be summarised as follows: a decrease in the consumption of alcoholic beverages, particularly wine (-30%), and a strong growth in the consumption of non-alcoholic beverages, in particular water (285%) and juices and nectars (400%).

Soft drink consumption, which practically doubled in the 1990s, now seems headed for stabilisation.

In short, the westernisation of the Portuguese diet, as indicated by Kearney (2010), was primarily reflected in the increased consumption of animal products (meat, milk and dairy products) and took place mainly in the 1980s and 1990s. In recent years, the consumption of these products, with a few exceptions, seems to point to a gradual stabilisation.

The well-known developments in consumption patterns over the last 28 years seems to confirm the demand for taste, convenience, and also that which is healthy – just as the determinants and trends in the previous point led us to expect.

Food consumption in Portugal in the context of crisis

There is still little information available regarding food choices in the context of the current crisis. Tax increases, salary cuts and rising unemployment will tend to reinforce budget constraint, i.e. income and prices, as determinants of purchase options.

A study recently carried out in Spain (Falguera *et al.*, 2012), shows that since 2009, the economic recession seems to have strongly affected the demand for functional and organic products, which are considerably more expensive than their conventional equivalents.

The information we have regarding the very same issue in Portugal is essentially that which is available on the site www.conheceracrise.com of the Francisco Manuel dos Santos Foundation, which does not allow us to reach that level of disaggregation. The private consumption expenditure of Portuguese

households increased by 3.8% between 2009 and 2010, and dropped by 0.4% between 2010 and 2011. In relation to food items, there was positive, albeit low growth of 1.6% and 1.9%, respectively (INE – Statistics Portugal, 2012).

Let us now look at some of the leading food and beverage products, which will allow us to see that information. It should be noted that in this case, the available information is Nielsen information, which has the advantage of showing us the situation in a continuously updated manner**,** with a greater breakdown, but it has a variable coverage rate per product.

With regard to meat and fish **(Table 4)**, there was positive growth in the value of total expenditure (sales). In the meat group, the meat with the greatest growth was pork, with there being a decrease in beef, the most expensive, in the most recent periods. This information, however, should be interpreted cautiously.

This is about monetary expenditure, including VAT, and therefore does not allow us to know what has happened in terms of quantities consumed. Furthermore, this information only takes into account sales in hypermarkets and supermarkets. Although Nielsen covers 100% of these channels, a great deal of meat is sold in butcher's shops and markets, for instance, and is also consumed in restaurants and catering-related enterprises, so that the degree of coverage is probably lower than in other food products.

With regard to fish, the situation is somewhat similar, with frozen fish accounting for the largest growth in expenditure.

In relation to other food products **(Table 5)**, such as biscuits, breakfast cereal, yoghurt or milk, consumption grew the most, or decreased the least, for the most basic (thus cheapest) products. In this case, we are really referring to quantities consumed since the variation rates are presented in terms of volume.

As for beverages **(Table 6)**, they all recorded a decrease regarding consumption in litres between 2010 and 2011 and between the first quarter of 2011 and that of 2012, particularly juices and soft drinks. We draw your attention to water, as its consumption has grown markedly over the past three decades, and seems to have endured up until early 2012, when the first negative variation appears. Thus, overall, the Portuguese population seems to have taken a step backwards in relation to the demand for differentiated, higher added-value products.

Another indicator pointing in the same direction is the consolidation of distributor brands, which, although not recent, has become more pronounced due to the crisis. In fact, in 2011 and in the first quarter of 2012, grocery, hypermarket and supermarket accounted for close to 50% of sales

Table 4. Variation rates (value) of sales of meat and fish in hypermarkets and supermarkets.
Source: Data collected by Nielsen (does not include Lidl), www.conheceracrise.com (Francisco Manuel dos Santos Foundation), last updated on 1/05/2012.

	Annual variation rate (value)		Homologous variation rate (value) Q1	
	2010/2009	2011/2010	2011/2010 (%)	2012/2011 (%)
Meat (total)	6.3	5.3	3.9	6.3
Beef	10.6	-0.7	0.7	-2
Pork	12.8	12.1	10.7	12.3
Poultry	9.0	10.4	10.9	4.1
Fish (total)	4.1	3.4	-0.3	3.6
Fresh fish	10.5	9.2	9.9	3
Codfish	-0.7	3.0	-3.5	10.4
Frozen fish	17.5	8.7	-4.9	12.4
Fresh seafood	9.0	-5.9	-7.5	-7.8

Table 5. Variation rates (volume) of sales of various food products in hypermarkets, supermarkets and grocery stores.
Source: Data collected by Nielsen, www.conheceracrise.com (Francisco Manuel dos Santos Foundation), last updated on 1/05/2012.

	Annual variation rate (volume)		Homologous variation rate (volume) Q1	
	2010/2009	2011/2010	2011/2010 (%)	2012/2011 (%)
Biscuits (total)	1.6	0.8	4	-4.4
Basic biscuits	-0.1	3.7	6.3	-0.3
Other biscuits	2.9	-1.3	2.4	-7.4
Breakfast cereals (total)	1.2	-1.0	7	-1
Basic cereals	9.9	5.3	12.4	5.3
Other cereals	0.2	-1.7	6.5	-1.7
Yoghurt (total)	2.7	-0.7	2.4	-5.7
Basic yoghurts	7.5	2.8	4.9	-0.5
Other yoghurts	1.0	-2.0	1.5	-7.7
Milk (total)	-0.7	-2.5	-0.9	-1.5
Basic milk	-2.2	-2.1	-0.7	0
Other milk	6.5	-4.5	-2.2	-8.4

Table 6. Variation rates (volume) of sales of beverages in hypermarkets, supermarkets and grocery stores.
Source: Data collected by Nielsen, www.conheceracrise.com (Francisco Manuel dos Santos Foundation), last updated on 1/05/2012.

	Annual variation rate (volume)		Homologous variation rate (volume) Q1	
	2010/2009	2011/2010	2011/2010 (%)	2012/2011 (%)
Beverages (total)	3.2	-0.3	3.3	-6.7
Wine	-1.3	-1.3	0.1	-5.9
Beer	3.5	-2.0	-1.1	-7.1
Juices and soft drinks	3.5	-2.0	1.3	-10.8
Water	6.5	1.8	6.9	-3.5

(in volume) of food products (last updated on 21/04/2012), with much higher figures in some product categories, such as frozen foods (over 80%) and refrigerated food products[2] (close to 70%).

Expenditure on catering-related activities also decreased by around 1.5% in 2011, and by 9.5% year-on-year for March 2012 (Unicre, 2012).

It could be thought that these apparent savings in food products are a reflection of the effort made by the Portuguese to maintain other types of expenses. However, this does not seem to be the case. In fact, the major decrease in household spending mainly affected durable goods (cars, furniture, and household, audiovisual and computer equipment, etc.), with an 18.1% reduction between 2010 and 2011; and spending on leisure and culture (restaurants, going out, travelling, books and magazines) decreased by an overall 6% in the same period, with some items, such as travel, even recording drops of around 11% (Unicre, 2012). The latest data available, relating to March 2012, indicate even more marked decreases in relation to the same period in the previous year, which clearly illustrates the considerable drop in income that has affected the Portuguese population.

Final issues

With regard to food products, the crisis has forced the Portuguese to change their consumption patterns in order to save money.

2 Refrigerated or chilled products: meals and side dishes, vegetables, condiments and fresh pasta, which need to be stored in refrigerators.

Budget restrictions determined by income and prices weigh heavily on purchase choices today. As such, we can talk about a certain return to the past (lower income, greater budgetary constraints, more basic products). However, some questions remain:

- Will the trends set out above (the demand for pleasure, convenience and health) disappear? Has the crisis, once and for all, done away with the hyper-consumption society?
- Will the crisis provide us with an opportunity to rethink our food consumption model, from a perspective of greater equality among the various participants in the food supply chain and improved environmental sustainability?

Acknowledgements

I would like to thank the Calouste Gulbenkian Foundation and the coordinating committee of the cycle of conferences on the Future of Food for inviting me to participate in this cycle. My thanks to Statistics Portugal (INE), in particular to Sofia Duarte, for providing me with the most recent data on the Portuguese Food Supply and for clarifying my questions. Thanks also to Florinda Veigas for her pioneering work in this field at INE.

Bibliography

/ Autoridade da Concorrência (Portuguese Competition Authority), Gabinete de Estudos Económicos e de Acompanhamento de Mercados (Office of Economic Studies and Market Monitoring), 2009. *Relações comerciais entre a Grande Distribuição Agroalimentar e os seus fornecedores* (Commercial relations between Large-Scale Agri-food Distribution and its suppliers). Relatório preliminar (Preliminary report). Available at www.autoridadedaconcorrencia.pt.

/ Barreira, M., Duarte, M. F., 1996. Analysis of changes in Portuguese meat consumption, Wierenga, B., Tilburg, A., Grunert, K., Steenkamp, J. e Wedel, M. (eds.), *Agricultural marketing and consumer behavior in a changing world*. Dordrecht: Kluwer Academic Publishers.

/ Beierlein, J., Woolverton, M., 1991. *Agribusiness marketing*. London: Prentice-Hall International.

/ Connor, J., 1994. North America as a precursor of changes in Western European food-purchasing patterns, *European Review of Agricultural Economics* 21(1994) 155-173.

/ Eurostat, 2009. *A European food prices monitoring tool: a first design*. (epp. Eurostat.ec.europa.eu/portal).

/ Falguera, V., Aliguer, N., Falguera, M., 2012. An integrated approach to current trends in food consumption: moving toward functional and organic products? *Food Control*, 26, 274-281.

/ Grunert, K., 2005. Food quality and safety: consumer perception and demand. *European Review of Agricultural Economics*, 32 (3), 369-391.

/ INE, 1994. Balança alimentar portuguesa (Portuguese Food Supply): 1980-92.

/ INE, 1999. Balança alimentar portuguesa (Portuguese Food Supply): 1990-1997.

/ INE, 2012. Estatísticas da Produção Industrial (Industrial Production Statistics) – 2010.

/ Kearney, J., 2010. Food consumption trends and drivers, *Phil. Trans. R. Soc.* B 365, 2793-2807.

/ Lagrange, L., 1995. La commercialisation des produits agricoles & alimentaires, *Tec & Doc*. Paris: Lavoisier.

/ Lipovetsky, G., 2010. Sociedade de hiperconsumo e felicidade, Soromenho-Marques (coord.), *O ambiente na encruzilhada por um futuro sustentável*. Lisbon: Coleção Gulbenkian Ambiente, Fundação Calouste Gulbenkian, Esfera do Caos.

/ Nielsen, 2010. Anuário *Food* (Food Yearbook).

/ Senauer, B., 1990. Major trends affecting the US food system, *Journal of Agricultural Economics*, 41 (3), 422-430.

/ Steenkamp, J., 1997. Dynamics in consumer behavior with respect to agricultural and food products, Wierenga, B., Tilburg, A., Grunert, K., Steenkamp, J., Wedel, M. (ed.), *Agricultural marketing and consumer behavior in a changing world*. Dordrecht: Kluwer Academic Publishers.

/ Van Raaij, W., Leeflang, P., Antonides, G., 2000. The consumer in the European Union, Blois, K. (ed.), *The Oxford textbook of marketing*. Oxford University Press.

/ Von Alvensleben, R., 1997. Consumer behaviour, Padberg, D., Ritson, C., e Albisu, L. (ed.), *Agro-Food Marketing*. RU: CAB International, Oxon.

/ Wijnands, J., Meulen, B., Poppe, K. (eds), 2007. *Competitiveness of the European food industry*. An economic and legal assessment. Luxemburg: Office for Official Publications of the European Communities.

Food and fisheries

Using the marine environment and its living resources

Carlos Sousa Reis

The theme "Food, Environment and Fisheries" encompasses a wide variety of areas, which are often closely linked in matters beyond a common denominator of the seas and oceans.

However, within the Portuguese sea cluster, there are three major categories that represent virtually all of the human means and financial transactions involved. These are ports and maritime transport (including shipbuilding and ship repair), maritime tourism and fisheries.

A number of references will be made to the use of the marine environment and its living resources in this brief chapter.

For reasons of context, it is important to highlight the 1972 Stockholm Conference, 1987's Brundtland Report/Our Common Future, the 1992 Rio Conference, the 2002 Johannesburg Summit, Rio + 10 and the recent Rio + 20 Conference, which have been the main events where the relationship between environment and marine resources has been discussed.

At these different times, an attempt was made to identify means of conciliating socio-economic development with the preservation and protection of the Earth's different ecosystems. This also involved enshrining the concept of sustained development and principles of shared responsibility, while defining the measures needed to halt environmental degradation, of which Agenda 21 is an example, focusing on protecting marine resources.

Fisheries and the exploitation of live marine resources have a very important relationship with the human diet as a significant source of high-quality animal protein that is very difficult to substitute nowadays. Portugal is a good example of this, having a per capita fish consumption of 60 kilos a year.

It is worth highlighting the importance of a sector that employs almost half a million people in the European Union, while producing close to seven million tons a year, which clearly comes nowhere near to meeting demand in Europe.

However, Portuguese coastal waters boast unique hydro-climatic and geomorphological characteristics that lead to the presence of a wide range of species that are caught using a host of techniques and methods, as well as other highly seasonal resources that are available.

These particular characteristics of Portuguese waters are sometimes misunderstood by those bodies responsible for the management and conservation of live marine resources, both nationally and particularly at the EU level, as the European Commission is responsible for the preservation of biological marine resources through the Common Fisheries Policy, as laid out in the Lisbon Agreement.

Legislation applied to the fishing industry needs to be simpler and more objective and the large number of laws applied to this sector needs to be reduced, both at the EU and the national level.

Added to this are fragmented responsibilities for the different aspects of the sea that create considerable bureaucracy, which often run counter to the interests of the communities engaged in professional, amateur, recreational and net fishing, aquaculture, fish canning and manufacturing, maritime-tourism and salt-making industries, etc.

It is also worth highlighting the low status of those working in fisheries, the lack of vocational training (training infrastructure has been partially dismantled), as well as a lack of scientific-technical support in the sector, particularly in relation to continued technological research and development (TR&D) processes regarding exploited and unexploited stocks and innovative applied research undertaken by the ex-IPIMAR for years, but which have now been compromised due to a recent lack of institutional clarity.

An analysis of statistical data on the fisheries in Portugal reveals a near-50% reduction in the numbers of professionals working in fishing and boats over the last ten years, thus justifying, to some extent, the growing deficit in the Fishing Trade Balance, which reached around 800 million euros in 2010.

Changes in the marine environment have become more frequent, stemming from a number of factors ranging from greater use of the seas and oceans, which causes high levels of pollution (dredging, effluents, waste, etc.) to the already visible effects of climate change in the marine

environment. In addition to the result of the SIAM I and SIAM II projects, there is the development of anthropogenic CO_2 emissions and consequent acidification of the seas and oceans, causing a reduction in pH levels and a concentration of carbonate ions.

Nowadays, poor fishing and fish handling practices (including the warped effects that certain "management" measures have, such as discards) are still a complex problem for those who govern the sector. There are still many bad examples, such as directed fishing and shark bycatch, which are often subject to "finning", a process sometimes carried out for social reasons in many parts of the world.

There are other situations resulting from the traditional "caldeirada" (i.e., the partial payment of fishermen in kind), which still occur in some segments of the sardine purse seine fishery and lead to poor use of the fish caught. The abundance of this type of fish depends heavily on both the natural and socio-cultural phenomena involved in its exploitaion. It is worth mentioning that sardines remain the main resource in Portuguese waters, although the certification of the sustainability of sardine fishing was temporarily suspended in 2012 by the Marine Stewardship Council for reasons related to a lack of supporting data regarding stocks.

Other practices, nowadays illegal, like the catching of European eel elvers, have put the entire European stock of this catadromous species at risk.

It is also worth highlighting the poorly understood hygio-sanitary management of bivalves for human consumption in Portuguese waters, which are very rich in this type of marine organism that Portuguese people truly appreciate. Within this context, there is a degree of confusion regarding the depuration of bivalves, which is a duly-certified process used to eliminate coliforms and salmonella. However, this does not apply to the natural phenomena of excessive abundance of bio-toxins resulting from toxic dinoflagellate species in the marine environment, which is controlled as part of the National Plan managed by the ex-IPIMAR by banning capture and sale in particular places during certain periods.

In relation to how fish are handled, it is important to look at how they are killed, as well as national legislation and community guidelines regarding animal protection. Here, it is vital to look at the system used to kill Atlantic Bluefin tuna (a species highly prized for sashimi and sushi) due to the specific physiological characteristics of this fish. This species of tuna has a body temperature of around 17ºC, which can reach up to 40ºC with the stress of the catch, producing increases in lactic acid which taints the flesh, thus reducing the value of the fish. As such, the killing process,

among other aspects, is crucial both in terms of animal welfare, as currently defined, and the significant commercial value of the species.

In relation to this short summary of the issues associated with human consumption of marine produce, which has seen considerable growth, we should also highlight the proposals encouraging the consumption of produce that is popular with the Portuguese. I would like to leave you with a final message: "Eat fresh, frozen, dried or canned fish from sustainable fishing sources".

Balancing benefits and risks of fish consumption – the role of nutrients and environmental pollutants

José L. Domingo

Abstract

It is well established that a suitable combination of diet, exercise, and adequate rest is important for a healthy life. Dietary patterns and lifestyle factors are clearly associated with at least five of the ten leading causes of death, including coronary heart disease, certain types of cancer, stroke, non-insulin dependent diabetes mellitus and atherosclerosis. Concerning fish and seafood consumption specifically, its beneficial effects on human health are clearly supported by an important number of studies undertaken in the last 30 years. These studies have repeatedly linked fish consumption, especially those species with high levels of omega-3 fatty acids, with healthier hearts in the aging population. Fatty fish are high in two kinds of omega-3 polyunsaturated fatty acids: eicosapentaenoic acid and docosahexaenoic acid. The nutritional benefits of fish and seafood are also due to the content of high-quality protein and vitamins, as well as other essential nutrients. Moreover, unlike fatty meat products, fish are not high in saturated fat. Nevertheless, a number of studies, particularly research performed in recent years, have shown that the unavoidable presence of environmental contaminants in fish and shellfish can also mean a clear risk for the health of certain consumers. Initially, those studies were mainly

focused on methylmercury and PCBs. However, recent studies have also assessed a series of other metals and organohalogenated compounds, such as PCDD/PCDFs, PBDEs, PCDEs, PCNs and PFCs, as well as PAHs. While prestigious international associations, such as the American Heart Association, have recommended eating fish (particularly fatty fish) at least two times (two servings) a week, based on our own experimental results, as well as on results from other laboratories, we cannot be in total agreement with this recommendation. Although regular consumption of most fish and shellfish species should not mean adverse health effects for consumers, the specific type of fish and shellfish species consumed and the frequency of consumption, as well as meal size, are essential issues for adequately balancing the health benefits and risks of regular fish consumption. The abovementioned issues are reviewed here.

Introduction

Omega-3 fatty acids in fish and health

Dietary patterns and lifestyle factors are clearly associated with at least five of the ten leading causes of death, including coronary heart disease, certain types of cancer, stroke, non-insulin dependent diabetes mellitus and atherosclerosis (Brunner *et al.*, 2008; Doyle, 2007; Giovannini and Masella, 2012; Nettleton *et al.*, 2009). With respect to dietary habits, a balance of nutrient consumption that avoids excess or deficiency is essential to good health and avoiding lifestyle-related diseases (Hennig *et al.*, 2007a,b, 2012). While poor dietary habits, such as a high intake of fat-rich processed foods and a low intake of fruits and vegetables, linked to sedentary lifestyles clearly contribute to worsening life quality, it is also well known that eating fish is potentially good for human health. The beneficial effects of regular fish and seafood consumption are supported by an important number of studies undertaken in the last 30 years. These studies have repeatedly linked fish consumption, especially those species high in omega-3 polyunsaturated fatty acids (PUFAs), with healthier hearts in the aging population, an effect derived from lowering triglyceride and reducing cardiovascular disease (Abeywardena and Patten, 2011; Davidson *et al.*, 2011; Delgado-Lista *et al.*, 2012; Hu and Willett, 2012; Kelley and Adkins, 2012; Kris-Etherton *et al.*, 2002; McManus *et al.*, 2011; Mente *et al.*, 2009; Musa-Veloso *et al.*, 2011; Russo, 2009; Siriwardhana *et al.*, 2012). In addition to the beneficial effects of omega-3 fatty acids on the heart, other positive effects of regular intake have also been shown. For

example, Pilkington *et al.* (2011) recently reported that omega-3 PUFAs had the potential to protect the skin from ultraviolet radiation injury through a range of mechanisms.

In spite of this body of evidence, several areas remain uncertain. As such, the optimal intake of omega-3 fatty acids has yet to be firmly established, nor is their mechanism of action fully understood, while some studies have even shown conflicting results (Chen *et al.*, 2011; de Lorgeril and Salen, 2012; Domingo, 2007; Filion *et al.*, 2010; Hooper *et al.*, 2006; Järvinen *et al.*, 2006).

The benefits of fish and seafood consumption on health are mainly due to high-quality protein content (fish and seafood provide approximately 17% of the total animal protein and 6% of all protein consumed by humans), vitamins and other essential nutrients. Moreover, unlike fatty meat products, fish are not high in saturated fat. Fatty fish are especially high in two kinds of omega-3 PUFAs: eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). It has been estimated that the consumption of one fatty fish meal per day would result in an omega-3 fatty acid (EPA and DHA) intake of approximately 900 mg/day, an amount that would have benefical effects on CHD mortality rates in patients with coronary disease (Kris-Etherton *et al.*, 2002). In addition to CHD, omega-3 fatty acids (particularly EPA) have also protective effects in reducing arrhythmias and thrombosis, lowering plasma triglyceride levels, reducing the likelihood of blood clots, reducing the risks of certain cancers, and even preventing cognitive decline and dementia (Kris-Etherton *et al.*, 2002). In order to reduce the risk of coronary disease and triglyceride levels primarily, various organizations worldwide have made dietary recommendations for EPA and DHA for fish consumption (Kris-Etherton *et al.*, 2002, 2009; Sydenham *et al.*, 2012; van den Elsen *et al.*, 2012; Wang *et al.*, 2012). Specific recommendations also been also made for DHA intake for pregnant women, infants and vegetarians/vegans. It is widely accepted that long-chain PUFAs are important for the growth and development of infants. Sufficient DHA during pregnancy and after birth is essential because it is the predominant structural fatty acid in the central nervous system and retina, its availability being crucial for brain development. According to the World Association of Perinatal Medicine, the Early Nutrition Academy, and the Child Health Foundation, the recommendations for long-chain PUFAs are the following (see Kris-Etherton *et al.*, 2009): 1) pregnant and lactating women should have an average daily intake of least 200 mg of DHA; 2) infant formula should provide DHA at

levels of between 0.2 and 0.5 weight (%) of total fat, and with minimum amounts of arachidonic acid equivalent to the amount of DHA. Dietary long-chain PUFAs should continue after the first 6 months of life, but quantitative recommendations are not made due to insufficient evidence; 3) pregnant women should consume 200–300 mg/day of DHA.

For the general population, a Dietary Reference Intake (DRI), more specifically an Adequate Intake (AI), was set for α-linolenic acid (ALA) by the Institute of Medicine (IOM) of The US National Academies. This amount is based on an intake that supports normal growth and neural development and leads to no nutrient deficiency. Although there is no DRI for EPA and DHA, the US National Academies have recommended that approximately 10% of the Acceptable Macronutrient Distribution Range (AMDR) for ALA can be consumed as EPA and/or DHA (Kris-Etherton *et al.*, 2009). This recommendation represents a current mean intake for EPA and DHA in the USA of approximately 100 mg/day, which is much lower than what many groups worldwide are currently recommending. The American Heart Association (AHA) recommends consumption of at least two 3-oz servings of fish per week, with a special suggestion for fatty fish (Kris-Etherton *et al.*, 2002). In spite of the well-documented literature concerning the benefits of dietary omega-3 PUFAs on total mortality and combined cardiovascular effects, certain doubts about these effects, as well as on the potential protective reduction of cancer risk, have recently been raised (Domingo, 2007).

Based on the AHA's strategy for reducing the risk of cardiovascular disease in the general population, in 2006 the AHA Nutrition Committee published a document that included recommendations to improve diet and lifestyle (AHANC, 2006). Among these, eating fish (especially oily fish) at least twice a week, was one of the main dietary recommendations. In 2004, Mahaffey published a review on EPA and DHA concentrations in a number of fish and shellfish species. The highest concentrations were found in mackerel, followed by salmon, while the lowest levels were found in lemonfish and tiger sharks, and Malabar sole. Moreover, Ismail (2005) reported that shark, herring and mackerel, followed by sardine and salmon, were the edible marine species with the highest levels of omega-3 fatty acids. In a previous review, Sidhu (2003) found that mackerel (from the Atlantic), herring (from the Atlantic and Pacific), and European anchovy were species rich in omega-3 fatty acids, while salmon from various origins boasted similar levels to those of anchovy. In turn, after reviewing a number of studies, Smith and Sahyoun (2005) found that

mackerel and salmon contained the highest PUFA (EPA + DHA) levels, while clams and lobsters showed the lowest concentrations.

With respect to the reduced risk of CHD derived from fish consumption, the possible contribution of some other nutrients in the fish and/or other factors related to healthy lifestyle cannot be excluded (He *et al.*, 2004). Notwithstanding, various investigations have concluded that any fish consumption is better than no fish consumption when it comes to reducing the risk of CHD (He *et al.*, 2004; König *et al.*, 2005; Mozaffarian and Rim, 2006).

Environmental pollutants in fish and health

Certain dietary habits can also contribute to poorer health if they constitute exposure to environmental toxic contaminants. Many of these pollutants are fat soluble, and thus, any fatty food often contains higher levels of persistent organic pollutants than vegetable matter. Nutrition can dictate the lipid milieu, oxidative stress and antioxidant status within cells and the modulation of these parameters by an individual's nutritional status may have profound effects on biological processes. It may also influence the effects of environmental pollutants to cause disease or dysfunction (Hennig *et al.*, 2007a,b, 2012).

A major concern regarding frequent fish and seafood consumption is the potential health risks derived from exposure to chemical pollutants contained in those species. Until recently, methylmercury and polychlorinated biphenyls (PCBs) were given the most attention. However, a number of recent studies have shown that fish and shellfish can be also a source of human exposure to other environmental contaminants, whose potential toxicity is well known. Among these pollutants are metals, polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/PCDFs) and polycyclic aromatic hydrocarbons (PAHs), as well as other organohalogenated contaminants, such as polybrominated diphenyl ethers (PBDEs), polychlorinated diphenyl ethers (PCDEs), polychlorinated naphthalenes (PCNs) and perfluorinated compounds (PFCs). Information on exposure and the adverse effects of these organic pollutants in humans is still relatively limited. As previously mentioned, in recent years, a number of authors have reasserted the important cardioprotective effects of omega-3 fatty acids, especially those longer-chain fatty acids from marine sources, suggesting that increased consumption would reduce cardiovascular risk significantly. However, it has been also suggested that we should be cautious about consuming certain fish species, depending on their levels of environmental pollutants (Engler and Engler, 2006).

Human exposure to inorganic and organic environmental pollutants

Among inorganic pollutants, toxic elements, such as arsenic (As), cadmium (Cd), mercury (Hg) and lead (Pb) are widely dispersed in the environment and persist for long periods in different media. These elements are not beneficial to humans, and there is no known homeostasis mechanism for them. Toxicity and threats to human health from any element are related to concentration. However, it is well known that chronic exposure to As, Cd, Hg and Pb at relatively low levels can cause adverse effects. Some individuals are basically exposed to toxic elements in the workplace. However, for most people, exposure to metals occurs mainly through the diet. Consequently, information about the dietary intake of metals is essential to assess the risks they pose to human health. On the other hand, persistent organic pollutants (POPs) are lipophilic, bioaccumulative and semi-volatile toxic compounds. Some POPs are produced deliberately in a number of industrial activities, while others are formed accidentally or released as by-products of various activities, such as combustion. POPs are found in several ecosystems worldwide in complex mixtures, as a result of agricultural, industrial and other human activities. They pose significant health problems due to bioaccumulation through the food web and their potentially highly toxic effects. While the carcinogenic nature of some POPs is already well established, others are endocrine disruptors with a number of adverse effects on hormone homeostasis (Domingo, 2012a,b; Li *et al.*, 2006; White and Birnbaum, 2009).

Human health risks derived from environmental exposure to metals and POPs continue being the subject of considerable research, regulation and debate. It is well known that human exposure to metals and POPs may occur via various routes: dermal absorption, air inhalation, ingestion of contaminated soils and principally through the daily intake of foodstuffs. According to a number of studies, more than 90-95% of the toxic metals and POPs to which humans are exposed originate in food, and approximately 90% of this normally comes from animal sources. Particular attention needs to be paid to fish. Although fish and other seafood generally represent only relatively small percentages of the human diet, it has been demonstrated that the frequent consumption of these marine species may be one of the major routes for chemical pollutants to enter the human body (Bocio *et al.*, 2005, 2007; Domingo, 2012a,b).

With respect to POPs and PCDD/PCDFs, together with PCBs, are the most well-known and studied. PCDD/PCDFs are among the most

hazardous environmental contaminants, being toxic in extremely tiny amounts and bioaccumulating in humans, while PCBs are ubiquitous in the environment, being found in the adipose tissue and blood of the general population, as well as in breast milk. The World Health Organization (WHO) identified various PCB congeners whose toxicity levels were similar to those of PCDD/PCDFs, and assigned toxic equivalency factors (TEFs) to them for the calculation of toxic equivalents (TEQ). On the other hand, although much less investigated than PCDD/PCDFs and PCBs, PCNs, PCDEs and PBDEs are other polyhalogenated POPs with long half-lives, which are also widely distributed in the environment. Several PCN congeners display toxicities similar to the most toxic and well-studied dioxin, 2,3,7,8,-TCDD, through mechanisms mediated by aryl hydrocarbon receptor (AhR), while the major toxicity mechanism of PCDEs seems to be also related to their ability to bind to, and activate, AhR. In turn, PBDEs are a class of brominated flame retardants that have been produced in considerable quantities and widely used in a variety of consumer products. In recent years, a marked increase in the levels of PBDEs in human tissues and fluids, especially breast milk, has been observed in some countries. As with other structurally similar classes of POPs, at least some PBDE congeners are endocrine disrupters. Although information is still rather scarce, for non-occupationally exposed individuals dietary intake is very probably the main route of exposure to PCNs, PCDEs, and PBDEs, as it also occurs for metals, PCDD/PCDFs and PCBs.

Balancing human health benefits and risks of fish consumption

In recent years, monitoring programs have been developed in various countries in order to determine the presence of chemical contaminants in foodstuffs and to assess human health risks resulting from dietary exposure to these pollutants. Although the number of reported studies is notable, most investigations have been focused only on a reduced number of contaminants. For fish and seafood in particular, they have been mainly focused on methylmercury, PCBs, and more recently, PCDD/PCDF (Burger and Gochfeld, 2009; Mahaffey *et al.*, 2011; Stern, 2007). In order to elucidate the relative risks and benefits of eating fish, various authors have reviewed the scientific evidence for the adverse and beneficial effects of such consumption. The revisions have been generally based on the assumption that fish and seafood intake should have clear health benefits, but also certain risks, as fish and shellfish species may contain chemical

contaminants. One of the most referenced reviews on this issue (cited by 542 in Scopus, September 13, 2012) is that one published by Mozaffarian and Rimm (2006). It was concluded that for major health outcomes among adults, based on both the strength of the evidence and the potential magnitude of the effect, the benefits of fish intake should exceed the risks. In fact, these authors remarked that in adults, the benefits of modest fish consumption (one to two servings per week) outweighed the risks, with the exception of only a few selected fish species among women of childbearing age. However, that review has an important limitation concerning pollutants, as only methylmercury, PCDD/PCDFs and PCBs were included in the review. Potentially toxic elements such as As, Cd or Pb, as well as PAHs, a group of pollutants with known carcinogens in humans, were not reviewed. Other environmental contaminants, such as PCDEs and PCNs, some congeners of which could act as dioxin-like compounds, or PBDEs, with potential toxic effects in humans, and PFCs among others, were not included in the review. Therefore, the conclusions cannot be generalized, and they should be strictly limited only to the few contaminants reviewed.

In recent years, the Sioen's group from the University of Ghent (Belgium) has carried out wide and comprehensive research on the nutritional-toxicological conflict regarding fish and seafood consumption in different regions worldwide. Complete information on the most important conclusions obtained by that group regarding the evaluation of benefits and risks related to food consumption, can be found in Sioen *et al.* (2007, 2008a,b,c) and Verbeke *et al.* (2008). These researchers also undertook an exposure assessment using seafood consumption data from the Global Environment Monitoring System – Food Contamination Monitoring and Assessment Program (commonly known as GEMS/Food), part of the Food Safety Department of the WHO, as well as nutrient and contaminant concentration data (Sioen *et al.*, 2009). The results showed that Japan, Korea, Madagascar and Philippines had the highest fish and seafood consumption, followed by the Nordic-Baltic countries and South-East Asia. It was observed that while the intake of nutrients such as high omega-3 fatty acids and vitamin D would still be lower than the recommendations, in terms of toxicology, the data indicate that none of the fish seafood groups had a median contaminant concentration above the European Union (EU) maximum limits. The results of Sioen *et al.* (2009) showed that the contaminant intake in some countries exceeded the international health-based guidance levels, mainly focusing on sensitive subpopulations. However, it was found that when using less stringent

guidance for non-sensitive subpopulations, the benefits of increased fish and seafood consumption would outweigh the health risks.

In 2012, a number of authors reviewed and reported data on the risk-benefit analysis of fish and shellfish consumption. Here, we discuss those revisions that we consider more relevant. Sirot *et al.* (2012) determined what level of seafood consumption would provide nutritional benefits, while minimizing contaminant-related risks. An optimum consumption level was calculated for adults in order to minimize inorganic arsenic exposure and to increase vitamin D intake. It should ensure that the consumer would achieve the recommended intake of omega-3 PUFAs, Se and I, while remaining below the tolerable upper intakes of methylmercury, Cd, PCDD/PCDFs and PCBs. According to the authors, this level of consumption, which means approximately 200 g/week of certain fatty fish species and approximately 50 g/week of lean fish, mollusks and crustaceans, should be considered in order to determine food consumption recommendations from a public health perspective. Hellberg *et al.* (2012) reviewed the risk-benefit of seafood consumption, primarily focused on risk-benefit assessments. The authors found that most studies concluded that the benefits far outweigh the risks among the general population, especially when a variety of fish is consumed at least twice per week. However, for certain populations (for example, pregnant women and young children), a more targeted approach is warranted in order to ensure that these groups consume fish that are low in contaminants but high in omega-3 fatty acids. On the other hand, Oken *et al.* (2012) summarized the issue of fish consumption choice from toxicological, nutritional, ecological and economic points of view; identified areas of overlap and disagreement among these viewpoints, and reviewed the effects of previous fish consumption advice. These authors commented that although fish provides a rich source of protein and other nutrients, because of contamination by methylmercury and other toxicants, higher fish intake often leads to greater toxicant exposure. Therefore, Oken *et al.* (2012) highlighted the importance of clear and simple guidance to effect desired changes. They also commented that more comprehensive advice might be developed to describe the multiple impacts of fish consumption.

However, the benefit-risk analysis is often a complicated process, as benefit-risk evaluations tend to be skewed towards acceptance of all that is traditional and well-known (benefits), and rejection of or suspicion regarding anything that is novel or highly processed (risks) regardless of real risks. Recent and interesting information on the state of the art

in benefit-risk analysis can be found in Pohjola *et al.* (2012), Tijhuis *et al.*, 2012, Ueland *et al.* (2012) and Verhagen *et al.* (2012).

A general conclusion of the aforementioned reviews seems to be that "the benefits of fish intake exceed the risks". However, as previously mentioned, most reviews only included a few contaminants. Another gap is the limited number of species analyzed in most surveys, which were generally limited to a few species, such as salmon, tuna and other big predators, as well as bivalves, such as mussels and clams. It must also be mentioned that, in the great majority of scientific reports, there is no information on the temporal trends in pollutant concentration in the fish and seafood species analysed.

A case-study: Catalonia, Spain

In 2000, we initiated an extensive program in our laboratory that aimed to determine the daily intake of several chemical pollutants by the general population of Catalonia, Spain. In that program, we included the inorganic elements As, Cd, Hg and Pb (Llobet *et al.*, 2003a), hexachlorobenzene (Falcó *et al.*, 2004), PCNs (Domingo *et al.*, 2003), PCDD/PCDFs (Llobet *et al.*, 2003b), PCBs (Llobet *et al.*, 2003c), PBDEs (Bocio *et al.*, 2003) and PCDEs (Bocio *et al.*, 2004), as well as PAHs (Falcó *et al.*, 2003). Initially, the group of fish and seafood included only samples of fresh hake, sardine and mussels, together with tinned tuna and sardine. The daily intake of chemical contaminants from each foodstuff was also calculated by multiplying the concentration in a specific item by the estimated daily consumption of the respective food group. Finally, the total dietary intake of each pollutant was calculated by adding up each product over all the food groups.

The results of our first surveillance program study showed that the highest levels of most inorganic and organic pollutants were, in general terms, detected in fish and seafood, which contributed most to the intake of As, Hg and Pb (Llobet *et al.*, 2003a), as well as to that of PCDD/PCDFs and PCBs (Llobet *et al.*, 2003b,c), and PBDEs and PCDEs (Bocio et al, 2003, 2004). Fish and seafood were also important contributors to the daily intake of Cd (first contributor) (Llobet *et al.*, 2003a), HCB (second contributor) (Falcó *et al.*, 2004), PAHs (third contributor) (Falcó *et al.*, 2003), and PCNs (fourth contributor) (Domingo *et al.*, 2003). However, in spite of the considerable magnitude and scope of that first survey, for technical and economic reasons the total number of samples analyzed for the different groups of foodstuffs was rather limited, with the levels of contaminants only determined in three species of fresh fish and two of tinned fish. For the purposes

of establishing recommendations concerning human consumption of fish and other seafood, and taking into account the potential important contribution of marine species to the dietary intake of environmental pollutants, we extended our original study to the 14 most consumed fish and shellfish species by the population of Catalonia (sardine, tuna, anchovy, mackerel, swordfish, salmon, hake, red mullet, sole, cuttlefish, squid, clam, mussel and shrimp). In that study, we also determined the intake of EPA and DHA by the consumers. Salmon, mackerel, and red mullet were the species with the highest content of these omega-3 fatty acids. The monthly fish consumption limits for human health endpoints based on the intake of these chemical contaminants were calculated for a 70-year exposure. Although most of the marine species analysed should not cause adverse health effects for consumers, our results showed that the type of fish and shellfish, the frequency of consumption and the meal size are essential aspects for balancing the health benefits and risks of regular fish consumption (Bocio *et al.*, 2007; Domingo *et al.*, 2006; Falcó *et al.*, 2006; Llobet *et al.*, 2006a,b).

To establish the health risks derived from the dietary intake of the aforementioned chemical pollutants versus the potential benefits derived of the intake of EPA and DHA in quantitative terms, based on the results of our studies, we designed a simple online program, RIBEPEIX (www.tecnatox.cat) with these main objectives: (1) to know the intake of the measured metals and POPs by a certain individual through his/her specific weekly fish and seafood consumption; (2) to compare the intakes of each of those contaminants with their tolerable/acceptable intakes, when these are already established by international regulatory organisms; (3) to know the intake of the omega-3 fatty acids EPA and DHA, and to compare these intakes with those recommended by international heart associations; and (4) to establish suggestions for potential changes in the particular fish and seafood consumption habits of any individual, changes that should allow the balance between benefits (omega-3 fatty acids) and risks (chemical contaminants) derived from a regular consumption to be optimised (Domingo *et al.*, 2007a).

The use of Ribepeix shows that some fish and shellfish species contain metals and organic pollutants in amounts that, hypothetically, may indicate health risks for certain consumers. The level of the risks would depend not only on the specific fish species, but also on the frequency of consumption and meal size. Thus, based on our experimental results (Domingo *et al.* 2007b), it seems obvious that various fish and shellfish species should not be consumed as frequently and in such quantities as the AHA recommends. This would be, for example, the case of tuna and swordfish for

methylmercury, or for most fish species according to the levels of PCDD/PCDFs (plus DL-PCBs) and PAHs **(Table 1)**, where potential health risks would exceed the expected benefits. The results of using Ribepeix are a clear example in human nutrition (fish consumption in this case), where potential competing health risks and benefits clearly exist. A risk-benefit analysis of high levels of French fish consumption was also evaluated by Guevel *et al.* (2008), based on the quality-adjusted life year (QALY) method. However, that analysis was only based on the risks of methylmercury and the benefits of omega-3 fatty acids. The confidence interval of the overall estimation had a negative lower bound, which would mean that the increase in fish consumption might have a negative impact due to methylmercury contamination.

As a conclusion derived from the use of Ribepeix, we cannot be in agreement with the general recommendations of the AHANC (2006) with regard to fish consumption, as no differences among species, frequency of consumption and meal size are specified in those recommendations. As such, we strongly recommend fish consumption for all its nutritional benefits, including those from the omega-3 fatty acids. However, we must highlight the potential health risks directly derived from the concurrent exposure to chemical pollutants, risks that cannot be dismissed and/or considered negligible. In this sense, Ribepeix, properly and adequately updated over the time and adapted to the dietary habits of the different countries and/or geographical areas, could be a very useful tool to improve the balance between the benefits and risks of fish consumption individually. As Ribepeix is easy to use, it may be useful not only for professionals (cardiologists, general physicians, nutritionists, toxicologists, etc.), but also for the general population.

Taking advantage of the information obtained in our laboratory about the levels of chemical pollutants in other food groups, we extended Ribepeix to a second online program: Ribefood (http://130.206.36.67/ribefood/), which allows us to simultaneously calculate the human intake of a long series of micro- and macronutrients contained in widely consumed foodstuffs (including the 14 fish and seafood species of Ribepeix), and with an important nutritional value, also determining the dietary intake of metals, PCDD/PCDFs, PCBs, PBDEs, PCNs, etc. at the same time (Martí-Cid *et al.*, 2008a).

After our initial studies, we have updated the concentrations of the above pollutants in fish and seafood, as well as in other food groups (Domingo *et al.*, 2008; Martí-Cid *et al.*, 2008b,c; Martorell *et al.*, 2010, 2011; Perelló *et al.*, 2012). Moreover, the levels of a number of PFCs have been also been

Table 1. Monthly fish consumption limits for non-carcinogenic[a] and carcinogenic[b] health endpoints (left and right values, respectively)
Source: Domingo et al., 2007b)

Pollutant	Sardine	Tuna	Anchovy	Mackerel	Swordfish	Salmon	Hake
MeHg[c]	12/–	2/–	12/–	12/–	0.5/–	16/–	4/–
Cd	>16/–	>16/–	>16/–	>16/–	>16/–	>16/–	>16/–
HCB	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16
PCDD/Fs	NA/2	NA/3	NA/3	NA/2	NA/8	NA/2	NA/16
DL-PCBs	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16
PAHs	N.D./2	N.D./3	N.D./1	N.D./1	N.D./2	N.D./2	N.D./4

Pollutant	Red mullet	Sole	Cuttlefish	Squid	Clam	Mussel	Prawn
MeHg[c]	4/–	12/–	>16/–	16/–	>16/–	>16/–	8/–
Cd	>16/–	>16/–	>16/–	>16/–	16/–	16/–	>16/–
HCB	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16
PCDD/Fs	NA/1	NA/4	NA/16	NA/4	NA/12	NA/4	NA/8
DL-PCBs	>16/16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16	>16/>16
PAHs	NA/4	NA/4	NA/4	NA/4	NA/0.5	NA/0.5	NA/0.5

An average meal size of 0.227 kg was assumed. NA: RfD (oral reference dose, mg/[kg day]) is not available in the EPA's Integrated Risk.
Information System (IRIS) for this pollutant. Monthly consumptions indicated as >16 are, in fact, equivalent to unrestricted consumptions.

[a] Chronic systemic effects. [b] Consumption limits for cancer risks were estimated using a risk level of 1 in 100,000 (10^{-5}). Cancer slope factors (CSF) expressed in (mg/[kg day]) were obtained from US EPA (2000) and are based on an exposure period of 70 years. [c] A correction factor of 0.85 was applied to account for the proportion of organic Hg vs. total Hg.

included. In a first survey on PFCs (Ericson *et al.*, 2008), we determined the levels of some PFCs in a few food samples acquired in Catalan markets and supermarkets. Among the studied food items, white fish (hake, whiting blue, sea bass, monkfish), seafood (mussel, prawn), canned fish (tuna, sardine, mussel) and blue fish (salmon, sardine, tuna) were selected separately. PFOS, PFOA, and PFHpA were the only detected PFCs, being fish, followed by dairy products and meats, the main contributors to the Catalan population's PFOS intake. In a recent study, sardine, tuna, red mullet, hake, cuttlefish, mussel and prawn were selected for analysis of 13 PFCs. Among the measured PFCs, only seven compounds could be detected in at least one composite sample, while PFBuS, PFHxA, PFHpA, PFDS, PFDA, and PFTDA were undetected in all samples. PFOS was, by far, the PFC with the

highest mean concentration in fish and shellfish, having been detected in all analyzed species with the exception of mussels. High PFOS levels were found in sardine and red mullet. With regard to PFOA, the highest concentrations were detected in prawn and hake (Domingo *et al.*, 2012). Recent studies around the world have reported that fish and seafood are generally the foodstuffs with the highest PFC concentrations (Domingo, 2012b).

Similar to the objective of our above studies, recently Hoekstra *et al.* (2012) reported a quantitative risk-benefit assessment of fish consumption, which was made by expressing risks and benefits in the same health metric Disability Adjusted Life Year (DALY). The net health effects (expressed in DALYs) of two scenarios were compared. The reference scenario was the current fish intake of the Dutch population, which is less than that recommended by the health authorities, while the alternative scenario described the health effects if the population consumed 200 g of fish per week, which is close to the recommended levels. All health effects due to fish consumption, for which there is convincing evidence, are included in the assessment. QALIBRA software (www.qalibra.eu) was used to simulate the two scenarios. The results showed that there would have a net benefit for the population if 200 g of fish were consumed every week.

Influence of cooking on the levels of environmental pollutants in fish

Most reports found in the scientific literature on the dietary intake of environmental contaminants indicate that food analyses were only made on uncooked/raw products. However, it is evident that a very important number of foodstuffs are consumed after being cooked. Therefore, we have also investigated the influence of various widely used cooking methods (frying, grilling, roasting and boiling) on the concentrations of chemical pollutants in food, including fish and seafood. Although we have observed that certain cooking processes could either reduce or increase the levels of chemical contaminants in food, our results have shown that, in general terms, the influence of cooking on the levels of these contaminants depends not only on the particular cooking process, but even more on the specific food item. Usually, cooking methods that release or remove fat from the product tend to reduce the total concentrations of the organic contaminants in the cooked food (Domingo, 2011). With specific reference to fish (sardine, hake and tuna were the species analysed), there was a clear tendency to increase metal concentrations after cooking (Perelló *et al.*, 2008). However, the cooking processes had different effects on the concentrations of PCDD/

PCDFs. Thus, cooking reduced the levels in sardine, while it increased them in hake and tuna, with very little difference in this latter species. In turn, the highest PCB levels were detected in sardine (raw and fried) followed by tuna (raw, fried and grilled). As for PCDD/PCDFs, cooking also had different effects on the levels of PCBs in fish. Cooking reduced PCB concentrations in sardine, especially in grilled samples, increased PCB levels very slightly in tuna, and reduced them in hake, while cooking methods (with the exception of frying for sardine) increased ∑PCDE levels in fish (Perelló *et al.*, 2009a). Perelló *et al.* (2009b) reported that for cooked fish, the highest PBDE levels corresponded to sardine, with notable reductions in the fried and grilled samples. In hake, all cooking processes increased the levels of PBDEs, particularly after roasting. On the other hand, the highest HCB concentrations were found in sardine, being lower in cooked fish than in raw samples. All cooking methods enhanced HCB levels in hake, while little difference was noted in tuna (raw and cooked). In turn, the highest concentrations of total carcinogenic PAHs, and total PAHs (16 individual compounds) were, in general terms, observed after frying, particularly in sardine and tuna, while the highest total PAH concentrations in hake were found in roasted samples (Perelló *et al.*, 2009b). Recently, we have added PFCs to our studies on the influence of cooking on the levels of pollutants in fish and seafood samples. Information on this issue is rather scarce. In Canada, del Gobbo *et al.* (2008) investigated the influence of cooking (baking, boiling, and frying) on the levels of PFCs in 18 fish species purchased from Canadian markets. All cooking methods reduced the concentrations of perfluorinated acids, baking being the most effective method. PFOS was the compound most frequently detected, while PFOSAs were detected only in scallops. In a recent study performed in our laboratory that focused on assessing the influence of cooking methods on the concentrations of PFCs in various food items (Ericson-Jogsten *et al.*, 2009), the results were not sufficiently clear to conclude whether cooking with non-stick cookware could significantly contribute to reducing or increasing human exposure to PFCs.

Conclusions

There is a general consensus, especially among international heart associations, on the role of fish and other seafood consumption as a rich source of omega-3 PUFAs that may confer multiple health benefits. Nevertheless, a number of studies, mainly those undertaken in recent years, have shown that the unavoidable presence of environmental contaminants in fish and shellfish can also mean health risks for certain consumers. Initially, those

studies were basically focused only on methylmercury and PCBs. However, recent studies have also included a series of other metals and organohalogenated compounds, such as PCDD/PCDFs, PBDEs, PCDEs, PCNs, PFCs, and also PAHs. While prestigious international associations like the AHA have recommended eating fish (particularly fatty fish) at least two times (two servings a week), based on our own experimental results, together with data from other investigators, we cannot be in total agreement with that general recommendation. Although regular consumption of most fish and shellfish species should be beneficial, with no adverse effects on consumers' health, the specific type of fish and shellfish species consumed, how often they are eaten and meal sizes are essential issues when assessing the health benefits and risks of fish and seafood consumption. In relation to this, I would like to strongly recommend that the National Food Safety Authorities, or other similar national/regional bodies, include the analysis of those chemical pollutants more frequently found in fish and seafood in their regular monitoring programs. This would allow the health risks associated with regular fish intake to be updated. The content of omega3-fatty acids, as well as that of important nutrients contained in the most consumed fish species in specific regions/countries (health benefits), could be also included in those programs.

Bibliography

/ AHANC, American Heart Association Nutrition Committee. (2006). Diet and lifestyle recommendations revision 2006: a scientific statement from the American Heart Association Nutrition Committee. *Circulation* 114: 82-96.
/ Abeywardena, M.Y., and Patten, G.S. (2011). Role of ω3 long-chain polyunsaturated fatty acids in reducing cardio-metabolic risk factors. *Endocr. Metab. Immune. Disord. Drug Targets* 11: 232-246.
/ Bocio, A., Llobet, J.M., Domingo, J.L., Corbella, J., Teixidó, A., and Casas, C. (2003). Polybrominated diphenyl ethers (PBDEs) in foodstuffs: human exposure through the diet. *J. Agric. Food Chem*. 51: 3191-3195.
/ Bocio, A., Llobet, J.M., and Domingo, J.L. (2004). Human exposure to polychlorinated diphenyl ethers through the diet in Catalonia, Spain. *J. Agric. Food Chem*. 52: 1769-1772.
/ Bocio, A., Nadal, M., and Domingo, J.L. (2005). Human exposure to metals through the diet in Tarragona, Spain: temporal trend. *Biol. Trace Elem. Res*. 104: 193-201.
/ Bocio, A., Domingo, J.L., Falcó, G., and Llobet, J.M. (2007). Concentrations of PCDD/PCDFs and PCBs in fish and seafood from the Catalan (Spain) market: estimated human intake. *Environ. Int*. 33: 170-175.
/ Brunner, E.J., Mosdøl, A., Witte, D.R., Martikainen, P., Stafford, M., Shipley, M.J., and Marmot, M.G. (2008). Dietary patterns and 15-y risks of major coronary events, diabetes, and mortality. *Am. J. Clin. Nutr.* 87: 1414-1421.
/ Burger, J., and Gochfeld, M. (2009). Perceptions of the risks and benefits of fish consumption: individual choices to reduce risk and increase health benefits. *Environ. Res*. 109: 343-349.
/ Chen, Q., Cheng, L.Q., Xiao, TH., Zhang, Y.X., Zhu, M., Zhang, R., Li, K., Wang, Y., and Li, Y. (2011). Effects of omega-3 fatty acid for sudden cardiac death prevention in patients with cardiovascular disease: a contemporary meta-analysis of randomized, controlled trials. *Cardiovasc. Drugs Ther.* 25: 259-265.
/ Davidson, M.H., Kling, D., and Maki, K.C. (2011). Novel developments in omega-3 fatty acid-based strategies. *Curr. Opin. Lipidol.* 22: 437-444.
/ de Lorgeril, M., and Salen, P. (2012). New insights into the health effects of dietary saturated and omega-6 and omega-3 polyunsaturated fatty acids. *BMC Med*. 21: 10-50.
/ Delgado-Lista, J., Perez-Martinez, P., Lopez-Miranda, J., and Perez-Jimenez. F. (2012). Long chain omega-3 fatty acids and cardiovascular disease: a systematic review. *Br. J. Nutr.* 107: S201-213.

/ Del Gobbo, L., Tittlemier, S., Diamond, M., Pepper, K., Tague, B., Yeudall, F., and Vanderlinden, L.J. (2008). Cooking decreases observed perfluorinated compound concentrations in fish. *J. Agric. Food Chem*. 56: 7551-7759.
/ Domingo, J.L., Falcó, G., Llobet, J.M., Casas, C., Teixidó, A., and Müller, L. (2003). Polychlorinated naphthalenes in foods: estimated dietary intake by the population of Catalonia, Spain. *Environ. Sci. Technol.* 37: 2332-2335.
/ Domingo, J.L., Bocio, A., Falcó, G., and Llobet, J.M. (2006). Exposure to PBDEs and PCDEs associated with the consumption of edible marine species. *Environ. Sci. Technol*. 40: 4394-4399.
/ Domingo, J.L., Bocio, A., Martí-Cid, R., and Llobet, J.M. (2007a). Benefits and risks of fish consumption Part II. RIBEPEIX, a computer program to optimize the balance between the intake of omega-3 fatty acids and chemical contaminants. *Toxicology* 230: 227-233.
/ Domingo, J.L., Bocio, A., Falcó, G., and Llobet, J.M. (2007b). Benefits and risks of fish consumption Part I. A quantitative analysis of the intake of omega-3 fatty acids and chemical contaminants. *Toxicology* 230: 219-226.
/ Domingo, J.L., Martí-Cid, R., Castell, V., and Llobet, J.M. (2008). Human exposure to PBDEs through the diet in Catalonia, Spain: temporal trend. A review of recent literature on dietary PBDE intake. *Toxicology* 248: 25-32.
/ Domingo, J.L., Ericson-Jogsten, I., Perelló, G., Nadal, M., Van Bavel, B., and Kärrman, A. (2012). Human exposure to perfluorinated compounds in Catalonia, Spain: contribution of drinking water and fish and shellfish. *J. Agric. Food Chem*. 60: 4408-4415.
/ Domingo, J.L. (2007). Omega-3 fatty acids and the benefits of fish consumption: is all that glitters gold? *Environ. Int.* 33: 993-998.
/ Domingo, J.L. (2011). Influence of cooking processes on the concentrations of toxic metals and various organic environmental pollutants in food: a review of the published literature. *Crit. Rev. Food Sci. Nutr.* 54: 29-37.
/ Domingo, J.L. (2012a). Polybrominated diphenyl ethers in food and human dietary exposure: a review of the recent scientific literature. *Food Chem. Toxicol.* 50: 238-249.
/ Domingo, J.L. (2012b). Health risks of dietary exposure to perfluorinated compounds. *Environ. Int.* 40: 187-195.
/ Doyle, V.C. (2007). Nutrition and colorectal cancer risk: a literature review. *Gastroenterol. Nurs.* 30: 178-182.
/ Engler, M.M., and Engler, M.B. (2006). Omega-3 fatty acids: role in cardiovascular health and disease. *J. Cardiovasc. Nurs.* **21**: 17-24.
/ Ericson, I., Martí-Cid, R., Nadal, M., Van Bavel, B., Lindström, G., and Domingo, J.L. (2008). Human exposure to perfluorinated chemicals through the diet: intake of perfluorinated compounds in foods from the Catalan (Spain) market. *J. Agric. Food Chem*. 56: 1787-1794.
/ Ericson-Jogsten, I., Perelló, G., Llebaria, X., Bigas, E., Martí-Cid, R., Kärrman, A., and Domingo, J.L. (2009). Exposure to perfluorinated compounds in Catalonia, Spain, through consumption of various raw and cooked foodstuffs, including packaged food. *Food Chem. Toxicol.* 47: 1577-1583.
/ Falcó, G., Domingo, J.L., Llobet, J.M., Teixidó, A., Casas, C., and Müller, L. (2003). Polycyclic aromatic hydrocarbons in foods: human exposure through the diet in Catalonia, Spain. *J. Food Prot.* 66: 2325-2331.
/ Falcó, G., Bocio, A., Llobet, J.M., Domingo, J.L., Casas, C., and Teixidó, A. (2004). Dietary intake of hexachlorobenzene in Catalonia, Spain. *Sci. Total Environ*. 322: 63-70.
/ Falcó, G., Llobet, J.M., Bocio, A., Domingo, J.L. (2006). Daily intake of arsenic, cadmium, mercury, and lead by consumption of edible marine species. *J. Agric. Food Chem*. 54: 6106-6112.
/ Filion, K.B., El Khoury, F., Bielinski, M., Schiller, I., Dendukuri, N., and Brophy, J.M. (2010). Omega-3 fatty acids in high-risk cardiovascular patients: a meta-analysis of randomized controlled trials. *BMC Cardiovasc. Disord.* 3: 10-24.
/ Giovannini, C., and Masella, R. (2012). Role of polyphenols in cell death control. *Nutr Neurosci*. 15: 134-149.
/ Guevel, M.R., Sirot, V., Volatier, J.L., Leblanc, J.C. (2008). A risk-benefit analysis of French high fish consumption: a QALY approach. *Risk Anal.* 28: 37-48.
/ He, K., Song, Y., Daviglus, M.L., Liu, K., Van Horn, L., Dyer, A.R., and Greenland, P. (2004). Accumulated evidence on fish consumption and coronary heart disease mortality: a meta-analysis of cohort studies. *Circulation* 109: 2705-2711.
/ Hellberg, R.S., Mireles, De Witt, C.A., and Morrissey, M.T. (2012). Risk-benefit analysis of seafood consumption: a review. *Compren. Rev. Food Sci. Food Safe*. 11: 490-517.
/ Hennig, B., Oesterling, E., and Toborek, M. (2007a). Environmental toxicity, nutrition, and gene interactions in the development of atherosclerosis. *Nutr. Metab. Cardiovasc. Dis.* 17: 162-169.
/ Hennig, B., Ettinger, A.S., Jandacek, R.J., Koo, S., McClain, C., Seifried, H., and Silverstone, A. (2007b). Using nutrition for intervention and prevention against environmental chemical toxicity and associated diseases. *Environ. Health Perspect*. 115: 493-495.
/ Hennig, B., Ormsbee, L., McClain, C.J., Watkins, B.A., Blumberg, B., Bachas, L.G., Sanderson, W., Thompson, C., and Suk, W.A. (2012). Nutrition can modulate the toxicity of environmental pollutants: implications in risk assessment and human health. *Environ. Health Perspect*. 120: 771-774.
/ Hoekstra, J., Hart, A., Owen, H., Zeilmaker, M., Bokkers, B., Thorgilsson, B., and Gunnlaugsdottir, H. (2013). Fish, contaminants and human health: Quantifying and weighing benefits and risks. *Food Chem. Toxicol.*54:18-29).
/ Hooper, L., Thompson, R.L., Harrison, R.A., Summerbell, C.D., Ness, A.R., Moore, H.J., Worthington, H.V., Durrington, P.N., Higgins, J.P., Capps, N.E., Riemersma, R.A., Ebrahim, S.B., and Davey Smith G. (2006). Risks and

benefits of omega 3 fats for mortality, cardiovascular disease, and cancer: systematic review. *BMJ*. 332: 752-760.
/ Hu, F.B., and Willett, W.C. (2002). Optimal diets for prevention of coronary heart disease. *JAMA*. 288: 2569-2578.
/ Ismail, HM. (2005). The role of omega-3 fatty acids in cardiac protection: an overview. *Front. Biosci*. 10: 1079-1088.
/ Järvinen, R., Knekt, P., Rissanen, H., and Reunanen, A. (2006). Intake of fish and long-chain n-3 fatty acids and the risk of coronary heart mortality in men and women. *Br. J. Nutr.* 95:824-829.
/ Kelley, D.S., and Adkins, Y. (2012). Similarities and differences between the effects of EPA and DHA on markers of atherosclerosis in human subjects. *Proc. Nutr. Soc.* 71: 322-331.
/ König, A., Bouzan, C., Cohen, J.T., Connor, W.E., Kris-Etherton, P.M., Gray, G.M, Lawrence, R.S., Savitz, D.A., and Teutsch, SM. (2005). A quantitative analysis of fish consumption and coronary heart disease mortality. *Am. J. Prev. Med*. 29: 335-346.
/ Kris-Etherton, PM., Harris, W.S., and Appel, L.J. (2002). Fish consumption, fish oil, omega-3 fatty acids, and cardiovascular disease. American Heart Association Nutrition Committee. *Circulation* 106: 2747-2757.
/ Kris-Etherton, P.M., Grieger, J.A., and Etherton, T.D. (2009). Dietary reference intakes for DHA and EPA. *Prostaglandins Leukot. Essent. Fatty Acids* 81: 99-104.
/ Li, Q.Q., Loganath, A., Chong, Y.S., Tan, J., and Obbard, J.P. (2006). Persistent organic pollutants and adverse health effects in humans. *J. Toxicol. Environ. Health A* 69: 1987-2005.
/ Llobet, J.M., Falcó, G., Casas, C., Teixidó, A., and Domingo, J.L. (2003a). Concentrations of arsenic, cadmium, mercury, and lead in common foods and estimated daily intake by children, adolescents, adults, and seniors of Catalonia, Spain. *J. Agric. Food Chem*. 51: 838-842.
/ Llobet, J.M., Domingo, J.L., Bocio, A., Casas, C., Teixidó, A., and Müller, L. (2003b). Human exposure to dioxins through the diet in Catalonia, Spain: carcinogenic and non-carcinogenic risk. *Chemosphere* 50: 1193-1200.
/ Llobet, J.M., Bocio, A., Domingo, J.L., Teixidó, A., Casas, C., and Müller, L. (2003c). Levels of polychlorinated biphenyls in foods from Catalonia, Spain: estimated dietary intake. *J. Food. Prot.* 66: 479-484.
/ Falcó, G., Llobet, J.M., Bocio, A., and Domingo, J.L. (2006a). Daily intake of arsenic, cadmium, mercury, and lead by consumption of edible marine species. *J. Agric. Food Chem*. 54: 6106-6112.
/ Llobet, J.M., Falcó, G., Bocio, A., and Domingo, J.L. (2006b). Exposure to polycyclic aromatic hydrocarbons through consumption of edible marine species in Catalonia, Spain. *J. Food Prot.* 69: 2493-2499.
/ Mahaffey, K.R. (2004). Fish and shellfish as dietary sources of methylmercury and the omega-3 fatty acids, eicosahexaenoic acid and docosahexaenoic acid: risks and benefits. *Environ. Res.* 95: 414-428.
/ Mahaffey, K.R., Sunderland, E.M., Chan, H.M., Choi, A.L., Grandjean. P., Mariën, K., Oken, E., Sakamoto, M., Schoeny, R., Weihe, P., Yan, C.H., and Yasutake, A. (2011). Balancing the benefits of n-3 polyunsaturated fatty acids and the risks of methylmercury exposure from fish consumption. *Nutr. Rev.* 69: 493-508.
/ Martí-Cid, R., Bocio, A., Llobet, J.M., and Domingo, J.L. (2008a). Balancing health benefits and chemical risks associated to dietary habits: RIBEFOOD, a new Internet resource. *Toxicology* 244: 242-248.
/ Martí-Cid, R., Llobet, J.M., Castell, V., and Domingo, J.L. (2008b). Human dietary exposure to hexachlorobenzene in Catalonia, Spain. *J. Food Prot.* 71: 2148-2152.
/ Martí-Cid, R., Llobet, J.M., Castell, V., and Domingo, J.L. (2008c). Human exposure to polychlorinated naphthalenes and polychlorinated diphenyl ethers from foods in Catalonia, Spain: temporal trend. *Environ. Sci. Technol.* 42: 4195-4201.
/ Martorell, I., Perelló, G., Martí-Cid, R., Castell, V., Llobet, J.M., and Domingo, J.L. (2010). Polycyclic aromatic hydrocarbons (PAH) in foods and estimated PAH intake by the population of Catalonia, Spain: Temporal trend. *Environ. Int*. 36: 424-432.
/ Martorell, I., Perelló, G., Martí-Cid, R., Llobet, J.M., Castell, V., and Domingo, J.L. (2011). Human exposure to arsenic, cadmium, mercury, and lead from foods in Catalonia, Spain: temporal trend. *Biol. Trace Elem. Res.* 142: 309-322.
/ McManus, A., Merga, M., and Newton, W. (2011). Omega-3 fatty acids. What consumers need to know. *Appetite* 57: 80-83.
/ Mente, A., de Koning, L., Shannon, H.S., and Anand, S.S. (2009). A systematic review of the evidence supporting a causal link between dietary factors and coronary heart disease. *Arch. Intern. Med*. 169: 659-669.
/ Mozaffarian, D., and Rimm, E.B. (2006). Fish intake, contaminants, and human health: evaluating the risks and the benefits. *JAMA*. 296: 1885-1899.
/ Musa-Veloso, K., Binns, M.A., Kocenas, A., Chung, C., Rice, H., Oppedal-Olsen, H., Lloyd, H., and Lemke, S. (2011). Impact of low v. moderate intakes of long-chain n-3 fatty acids on risk of coronary heart disease. *Br. J. Nutr*. 106: 1129-1141.
/ Nettleton, J.A., Polak, J.F., Tracy, R., Burke, G.L., and Jacobs, D.R. (2009). Dietary patterns and incident cardiovascular disease in the multi-ethnic study of atherosclerosis. *Am. J. Clin. Nutr.* 90: 647-654.
/ Oken, E., Choi, A.L., Karagas, M.R., Mariën, K., Rheinberger, C.M., Schoeny, R., Sunderland, E., and Korrick, S. (2012). Which fish should I eat? Perspectives influencing fish consumption choices. *Environ. Health Perspect*. 120: 790-798.
/ Perelló, G., Martí-Cid, R., Llobet, J.M., and Domingo, J.L. (2008). Effects of various cooking processes on the concentrations of arsenic, cadmium, mercury, and lead in foods. *J. Agric. Food Chem*. 56: 11262-11269.

/ Perelló, G., Martí-Cid, R., Castell, V., Llobet, J.M., and Domingo, J.L. (2009a). Influence of various cooking processes on the concentrations of PCDD/Fs, PCBs and PCDEs in foods. *J. Food Prot*. 21: 178-185.
/ Perelló, G., Martí-Cid, R., Castell, V., Llobet, J.M., and Domingo, J.L. (2009b). Concentrations of polybrominated diphenyl ethers, hexachlorobenzene and polycyclic aromatic hydrocarbons in various foodstuffs before and after cooking. *Food Chem. Toxicol*. 47: 709-715.
/ Perelló, G., Gómez-Catalán, J., Castell, V., Llobet, J.M., and Domingo, J.L. (2012). Assessment of the temporal trend of the dietary exposure to PCDD/Fs and PCBs in Catalonia, over Spain: health risks. *Food Chem. Toxicol.* 50: 399-408.
/ Pilkington, S.M., Watson, R.E., Nicolaou, A., and Rhodes, L.E. (2011). Omega-3 polyunsaturated fatty acids: photoprotective macronutrients. *Exp. Dermatol.* 20: 537-543.
/ Pohjola, M.V., Leino, O., Kollanus, V., Tuomisto, J.T., Gunnlaugsdóttir, H., Holm, F., Kalogeras, N., Luteijn, J.M., Magnússon, S.H., Odekerken, G., Tijhuis, M.J., Ueland, Ø., White, B.C., and Verhagen, H. (2012). State of the art in benefit-risk analysis: environmental health. *Food Chem. Toxicol.* 50: 40-55.
/ Russo, G.L. (2009). Dietary n-6 and n-3 polyunsaturated fatty acids: from biochemistry to clinical implications in cardiovascular prevention. *Biochem. Pharmacol.* 77: 937-946.
/ Sidhu, K.S. (2003). Health benefits and potential risks related to consumption of fish or fish oil. *Regul. Toxicol. Pharmacol.* 38: 336-344.
/ Sioen, I., De Henauw, S., Van Camp, J., and Verh, K. (2007). Evaluation of benefits and risks related to seafood consumption. *Acad. Geneeskd. Belg.* 69: 249-289.
/ Sioen, I., Leblanc, J.C., Volatier, J.L., De Henauw, S., and Van Camp, J. (2008a). Evaluation of the exposure methodology for risk-benefit assessment of seafood consumption. *Chemosphere* 73: 1582-1588.
/ Sioen, I., De Henauw, S., Verbeke, W., Verdonck, F., Willems, J.L, and Van Camp, J. (2008b). Fish consumption is a safe solution to increase the intake of long-chain n-3 fatty acids. *Public Health Nutr.* 11: 1107-1116
/ Sioen, I., Van Camp, J., Verdonck, F., Verbeke, W., Vanhonacker, F., Willems, J., and De Henauw, S. (2008c). Probabilistic intake assessment of multiple compounds as a tool to quantify the nutritional-toxicological conflict related to seafood consumption. *Chemosphere* 71: 1056-1066.
/ Sioen, I., De Henauw, S., Van Camp, J., Volatier, J.L., and Leblanc, J.C. (2009). Comparison of the nutritional-toxicological conflict related to seafood consumption in different regions worldwide. *Regul. Toxicol. Pharmacol.* 55: 219-228.
/ Siriwardhana, N., Kalupahana, N.S., and Moustaid-Moussa, N. (2012). Health benefits of n-3 polyunsaturated fatty acids: eicosapentaenoic acid and docosahexaenoic acid. *Adv. Food Nutr. Res.* 65: 211-222.
/ Sirot, V., Leblanc, J.C., and Margaritis, I. (2012). A risk-benefit analysis approach to seafood intake to determine optimal consumption. *Br. J. Nutr.* 107: 1812-1822.
/ Smith, K.M., and Sahyoun, N.R. (2005). Fish consumption: recommendations versus advisories, can they be reconciled? *Nutr. Rev.* 63: 39-46.
/ Sydenham E, Dangour, A.D., and Lim, W.S. (2012). Omega 3 fatty acid for the prevention of cognitive decline and dementia. *Cochrane Database Syst. Rev.* 13: 6.
/ Stern, A.H. (2007). Public health guidance on cardiovascular benefits and risks related to fish consumption. *Environ. Health*. 23: 6-31.
/ Tijhuis, M.J., de Jong, N., Pohjola, M.V., Gunnlaugsdóttir, H., Hendriksen, M., Hoekstra, J., Holm, F., Kalogeras, N., Leino, O., van Leeuwen, F.X., Luteijn, J.M., Magnússon, S.H., Odekerken, G., Rompelberg, C., Tuomisto, J.T., Ueland, Ø., White, B.C., and Verhagen, H. (2012). State of the art in benefit-risk analysis: food and nutrition. *Food Chem. Toxicol.* 50: 5-25.
/ Ueland, Ø., Gunnlaugsdottir, H., Holm, F., Kalogeras, N., Leino, O., Luteijn, J.M., Magnússon, S.H., Odekerken, G., Pohjola, M.V., Tijhuis, M.J., Tuomisto, J.T., White, B.C, and Verhagen, H. (2012). State of the art in benefit-risk analysis: consumer perception. *Food Chem. Toxicol.* 50: 67-76.
/ van den Elsen, L., Garssen, J., and Willemsen, L. (2012). Long chain N-3 polyunsaturated fatty acids in the prevention of allergic and cardiovascular disease. *Curr. Pharm. Des.* 18: 2375-2392.
/ Verbeke, W., Vanhonacker, F., Frewer, L.J., Sioen, I., De Henauw, S., and Van Camp, J. (2008). Communicating risks and benefits from fish consumption: impact on Belgian consumers' perception and intention to eat fish. *Risk Anal*. 28: 951-967.
/ Verhagen, H., Tijhuis, M.J., Gunnlaugsdóttir, H., Kalogeras, N., Leino, O., Luteijn, J.M., Magnússon, S.H., Odekerken, G., Pohjola, M.V., Tuomisto, J.T., Ueland, Ø., White, B.C, and Holm, F. (2012). State of the art in benefit-risk analysis: introduction. *Food Chem. Toxicol.* 50: 2-4.
/ Wang, Q., Liang, X., Wang, L., Lu, X., Huang, J., Cao, J., Li, H., and Gu, D. (2012). Effect of omega-3 fatty acids supplementation on endothelial function: a meta-analysis of randomized controlled trials. *Atherosclerosis* 221: 536-543.
/ White, S.S., and Birnbaum, L.S. (2009). An overview of the effects of dioxins and dioxin-like compounds on vertebrates, as documented in human and ecological epidemiology. *J. Environ. Sci. Health C Environ. Carcinog. Ecotoxicol. Rev.* 27: 197-211.

The importance of fish product consumption in Portugal

Carlos Cardoso
Maria Leonor Nunes

Summary

Fish products are an important source of high biological value proteins, vitamins and minerals (such as selenium). Recent research has shown how important they are as a source of omega-3 fatty acids, particularly eicosapentaenoic (EPA) and docosahexaenoic (DHA) acids, which are beneficial for cardiovascular health and foetal development. In general, nutritional guidelines recommend the consumption of fatty fish once or twice a week. However, eating fish is the main source of exposure to contaminants such as mercury (Hg) and one of its most toxic forms, methylmercury (MeHg), represents around 90% of the total mercury in fish. The accumulation of MeHg in fish is therefore a growing concern that poses serious risks to public health, especially to vulnerable groups such as pregnant women and children. This dichotomy warrants the gathering of more detailed information on the consumption of fish products in Portugal and a more thorough and systematic nutritional study of them. With this in mind, a survey was conducted into the habits of fish product consumption in Portugal. The survey not only allowed the consumption frequencies to be estimated for a set of 23 products, but also made it possible to ascertain the main cooking methods used. This data then enabled a sampling plan to be drawn up which could give an overview of the nutritional information and possible contaminant problems of the most commonly consumed products. This plan also resulted in a detailed picture of the nutritional impact of fish products in the Portuguese diet.

Aims

- To show the importance of fish products in Portugal and in the world.
- To portray the patterns of fish product consumption in Portugal.
- To present the nutritional profiles of fish products.
- To assess the benefits associated with consumption.

Introduction

Fish products have played an important role in human development since pre-historic times. In fact, the first Homo sapiens to leave the African continent spread along the ocean coastlines and lived off fish, bivalves and crustaceans. Later, the feats of sea-faring peoples led to the creation of important civilisations in the Mediterranean basin. Sea and marine organisms decisively and profoundly influenced Minoan, Greek and Roman mythology. Many of the references of Roman culture are based upon the Mediterranean Sea, the so-called *mare nostrum*. The Roman Empire itself was built around the Mediterranean and the search for marine resources was one of the causes of Roman expansion. This era saw the development of the curing and salting industries, which produced garum (viscera of fish such as chub mackerel and tuna macerated in salt for several months) and other similar products. In the Middle Ages, salting and smoking processes were improved and the fish trade expanded, allowing marine-origin fish products to reach inland continental Europe. In northern Europe, salted and/or smoked herring production was developed. This particular marine resource had great economic, social and political repercussions. The founding of cities and the growth of the Hanseatic League benefited precisely from the herring trade.

In Portugal, fishing also expanded during the Middle Ages. Tuna fishing expanded considerably, making the *almadrava* (art of fishing) a source of wealth. Salt cod also gained importance in the national diet during this era. The search for new fishing waters was one of the driving forces behind the Discoveries, namely Gaspar Corte-Real's discovery of the New World, which boosted cod fishing and the consumption of salt cod. In the 18th century, the economic importance of fishing led to the sector being incorporated into the policies of the Marquis of Pombal. Accordingly, the *Companhia Geral das Reais Pescarias do Reino do Algarve* (General Company of the Royal Fisheries of the Realm of the Algarve) was established, which was dedicated primarily to tuna fishing and trading. There were a number of measures to encourage fisheries, such as tax exemption for cod fishing and improved fishing ports. In the 19th century,

the early years of the Industrial Revolution and a series of technological advances played a decisive role. These included the first canned fish based on a process invented by a Frenchman named Nicolas Appert, who, in the heyday of the Napoleonic era, was decorated by the Emperor himself, who coined the phrase: "An army marches on its stomach". And, in fact, canned fish came to be used as a combat ration in various conflicts. Although these innovations took some time to reach Portugal, during the late 19th and early 20th century, the canning industry underwent major developments due to the country's wealth of natural marine resources. In particular, national production of canned tuna and sardine grew significantly.

Apart from their obvious historical importance, fish products also played a major role in the cultural origins of various civilisations, both in the West and East. In fact, over the various tides of history, fish products have been a source of inspiration for symbolising immaterial and religious values, composing musical themes (for example, *The Trout*, by Franz Schubert) or featuring in sculptures and paintings, such as *The Birth of Venus* by Sandro Botticelli.

Nowadays, the fishing sector has its strong points but also faces problems that represent fundamental challenges. In fact, fishing and aquaculture products have great potential due to the diversity of species, wide range of applications and nutritional value, namely the health benefits of a diet rich in fish. Furthermore, consumers' growing concern with food safety and health has led to greater demand for these products. However, the use of these resources beyond their capacity to regenerate (only 20% of the resources can be considered underused, while overused resources already represent around one third of the total), as well as environmental changes, have prevented fishing from keeping up with changes in demand, which has naturally led to an increase in fish-farming. Yet the latter is only one possible response to the problems. There are large amounts of fish with no commercial value treated as waste or used in the production of fish meal. This means that there are many underused resources, such as fish that are caught and rejected or sub-products of the fish processing industry. Typically, these resources have no commercial value for several reasons, which include unpleasant taste, poor texture, too many bones, excessive fat, or even the small size of the adults. However, these are valuable resources which, just like the commercial products, contain proteins, vitamins, minerals and omega-3 PUFA of high nutritional value, as long as the appropriate handling and storage conditions are provided.

Within this context, new fish have appeared on the national market, such as certain farmed species from other countries (salmon, panga and others) and various processed products prepared from sub-products and under-used species. This group includes emulsified products (such as Frankfurter sausages), surimi jelly products and derivatives (such as crab sticks), meat substitutes (fish hams), restructured products (fillet substitutes simulating the myotome structure) and many others (pâtés, fish tagliatelle, etc.). Added to this are emerging processing technologies: quick-freezing, modified atmospheric packaging, high hydrostatic pressures, ohmic heating, etc. Nevertheless, these new solutions have come up against the tradition of fish product consumption in Portugal, which favours less processed fish and ideally the whole fresh fish. Consequently, there has been little industrial preparation of these new products or widespread use of these new technologies. Equally, fish-farming in Portugal has progressed slowly and has not managed to make up for the decrease in wild fishing.

In this context, it is important to gain a better understanding of the consumption habits of fish products in Portugal by using different (and ideally complementary) tools. Apparent consumption can be estimated (calculated by adding national production to volume of imports and subtracting the volume of exports) or consumption surveys can be carried out. The latter can include different features and may be conducted in several ways, by phone, on paper/face-to-face or electronically/online.

It was decided that a survey should be carried out on the consumption patterns and consumption frequency of the Portuguese, taking into consideration the abovementioned situations.

Methodology

Before explaining the methodology, it should be mentioned that this survey was produced as part of a research project funded by the Portuguese Science and Technology Foundation: the GOODFISH project. This project, which began two years ago, aims to assess the risks and benefits associated with the Portuguese population's fish product consumption. For this purpose, several products were analysed chemically, quantifying the main nutrients (such as omega-3 fatty acids or selenium and other minerals) and contaminants (such as methylmercury). In addition to this, the project sought to gain a better understanding of the Portuguese diet in relation to these products. It should be noted that a beneficial nutrient only becomes a benefit to public health when significant amounts of food products with that nutrient are consumed. Here, the survey became a main objective.

The survey consisted of five different areas, which were: fish type preferences (frozen vs. fresh or wild vs. farmed); consumption frequencies of 23 fish products; amounts consumed of each product per meal; cooking methods used and personal data of those surveyed. The survey was carried out on the internet and on paper at canteens used by the older population and those with limited access to new technologies and means of communication, thus allowing greater representativeness of the Portuguese population. Around 1,400 completed surveys were obtained during the first quarter of 2012 (1,100 on the internet and 300 on paper).

Results

The definitive results of the electronic online survey showed the following sample profile: 64% of the respondents were female; 85% of the respondents were aged between 25 and 65; only 2% were elderly (over 65); 60% of the respondents had a normal weight and 40% were overweight or obese. With regard to geographic distribution, the percentage of respondents from coastal zones (86%) was similar to the proportion of the population who live on the Portuguese coast. There was some over-representation of the Lisbon area and Tagus Valley and under-representation of the North.

In terms of habits and frequencies of fish product consumption in Portugal, there were some interesting results:

- the male population is less likely to consume farmed fish;
- the preference for wild fish is greater as age increases;
- inversely, the preference for farmed fish decreases sharply with age;
- the preference for wild fish increases with body mass;
- the coastal population appreciates wild fish more;
- the preference for whole fresh fish increases with levels of education;
- the male population more often consumes squid and octopus;
- the female population more frequently consumes hake, redfish and ling;
- the frequency of salt cod and (fresh and canned) sardine consumption is greater among older people;
- salmon has greater acceptance (conveyed through higher consumption levels) among the younger age groups (under 45);
- consumption of canned tuna reaches higher levels among the youngest groups;
- the frequency of consumption of the various fish products tends to increase with body mass; however, in the obese category, this is not the case, especially for salt cod and sardines;

- the coastal population eats more prawns;
- sardine consumption is higher in the south of the country;
- black scabbardfish is more frequently consumed in the Madeira archipelago;
- mussel and clam consumption rises with the level of education;
- on the contrary, the frequency of salt cod consumption drops as the level of schooling rises;
- the most educated population is more likely to consume new products on the market, such as panga;
- the consumption of redfish and black scabbardfish is more frequent among sectors of the population with lower levels of education;
- the highest frequencies of sardine, canned tuna and canned sardine are found among the population with the least education.

As for the food preparation options, salt cod, hake and ling are mainly consumed boiled, sardines and horse mackerel are normally grilled, salmon and seabream grilled and baked in the oven and bivalves and crustaceans boiled, with salmon being the only product consumed raw. As for the most consumed products, there are seven that stand out: salt cod, hake, canned tuna, seabream, salmon, horse mackerel and sardine.

Together with this data, certain fundamental aspects should be mentioned regarding the nutritional value of these products. The fat content is one of these aspects, given the association between the fat in fish products and health. Of the seven most consumed products, salmon is the highest in fat (16.8%), followed by canned tuna (12.9%) and sardine (10.5%). These are followed by seabream (8.7%), horse mackerel (3.0%), salt cod (1.0%) and, finally, hake (0.5%). However, the fat in these products is considered healthy as a result of the content of omega-3 fatty acids. It is therefore important to quantify this content, namely: sardine (3.8 g omega-3/100 g), salmon (2.7 g omega-3/100 g), seabream (2.3 g omega-3/100 g), horse mackerel (0.7 g omega-3/100 g), canned tuna (0.5 g omega-3/100 g), salt cod (0.4 g omega-3/100 g) and hake (0.1 g omega-3/100 g). Salmon and canned tuna drop down the list in comparison to the first, while sardine goes up. This is because some fish products are richer in omega-3 fatty acids than others, which can be expressed in the ratio of omega-3/omega-6. Horse mackerel and sardine maximise health benefits since they have ratios above ten, 13.8 and 12.3 respectively, and they are fatty fish. The ratios in cod and hake are also high, 12.1 and 9.1, respectively, but they are non-fatty fish. Farmed fish, seabream and salmon, and canned tuna (with vegetable oil) are poorer in omega-3 fatty acids, relatively speaking, with

4.4, 1.4 and 0.1, respectively. Finally, it should be mentioned that fish products are also rich in other nutrients, such as vitamin D (17.3 mcg/100 g in sardine) or mineral potassium (438 mg/100 g also in sardine).

Significance of the results

As for the significance and relevance of the results presented, it is worth saying that there are scientific studies on the biological evolution of humanity that show a link between fish product consumption and higher intelligence in human beings. In particular, several authors (Richards *et al.*, 2001; Bradbury, 2011) have argued that while Neanderthal man essentially consumed meat from land animals, 10 to 50% of the food ingested by modern man was of an aquatic origin. The reason for this link may lie in the DHA (docosahexaenoic acid, a fatty Omega-3 acid), which exists fundamentally in fish products. Thus, a diet rich in fish products provides a high intake of DHA. This acid has unique structural properties which are excellent for various functions of the cellular membranes – and grey neuronal matter is precisely a tissue with high membrane density. Therefore, DHA guarantees healthy neuronal development, especially for the foetus and new-born child (through the mother). There are also other beneficial aspects of omega-3 fatty acids for health, which can be listed in decreasing order of scientific evidence: reduction in the occurrence and mortality rate of cardiovascular diseases (scientific evidence considered probable); less likelihood of neurological and inflammatory diseases (possible) and prevention of macular degeneration (insufficient). Based upon this picture resulting from a large number of epidemiological and intervention studies, the World Health Organization recommends a minimum of one to two fish meals per week, so as to ensure 200-500 mg of EPA (eicosapentaenoic acid, another fatty Omega-3 acid) and DHA.

Conclusions

The following conclusions can be drawn:

- fish products have played an important role in the history of humanity and Portugal;
- the Portuguese diet boasts a strong fish product element;
- salt cod, hake and canned tuna are the most consumed products;
- horse mackerel and sardine are the fish that contribute most to the intake of nutrients not found in other foods (omega-3);
- recent estimates (Cardoso *et al.*, 2010) indicate a 66% probability of ensuring the recommended doses of EPA and DHA in Portugal.

Acknowledgements

This study was supported by the GOODFISH project (Ref. PTDC/SAU-ESA/103825/2008, funded by the FCT). Thanks also go to Isabel Castanheira, Narcisa Bandarra and Irineu Batista for their valuable collaboration in drawing up the survey, and, obviously, to the Calouste Gulbenkian Foundation for inviting the authors of this paper to participate in the "Food, Environment and Fishing" conference, as part of the "The Future of Food: Environment, Health and the Economy" conferences.

Bibliography

/ Bradbury, J., 2011. Docosahexaenoic acid (DHA): An ancient nutrient for the modern human brain. Nutrients, 3, 529-554.

/ Cardoso, C., Bandarra, N., Lourenço, H., Afonso, C., Nunes, M., 2010. Methylmercury risks and EPA+DHA benefits associated with seafood consumption in Europe. Risk Analysis, 30, 827-840.

/ Richards, M.P., Pettitt, P.B., Stiner, M.C., Trinkaus, E., 2001. Stable isotope evidence for increasing dietary breadth in the European mid-Upper Paleolithic. Proceedings of the National Academy of Sciences, 98, 6528–6532.

Food, agriculture and environment

Agriculture and the environment: roles for technology and public policy

José Lima Santos

Most environmental problems of agriculture can be traced back to different agricultural techniques. This relationship becomes clearer when we analyse the technological model as a whole rather than scrutinise individual agricultural techniques separately. The technological model includes not only the knowledge base used to generate innovative agricultural techniques to meet new challenges, but also how these techniques are combined to do so (Bonny and Daucé, 1989).

A new technological model has emerged in post-war European agriculture (as well as other developed countries and, at a later stage, in many developing countries) to meet the challenge caused by the decline in the agricultural labour force, as the agricultural population was transferred to the expanding industry and service sectors.

With labour increasingly scarce and respective opportunity costs rising, the productivity of labour in agriculture became the main thrust of the new technological model and its technical solutions.

Labour productivity in agriculture is the result of two factors: cultivated area per worker and productivity per hectare of cultivated land. Therefore, to increase labour productivity, the new technological model focussed on these two factors based on a double substitution:

- substituting human labour and animal traction with machines and motors, in order to increase the area of cultivated land per worker (the mechanical component of the model);
- substituting biological processes that occur in the agro-ecosystem (for example, atmospheric nitrogen fixation by soil bacteria being replaced by industrial chemical inputs, like nitrogen fertilizer) in order to increase the productivity of every hectare of cultivated land (the chemical component of the model).

Due to the equal importance of the model's two components, it is called the chemical-mechanical model (Bonny and Daucé, 1989). Both components were based on solid global advances in science and agronomy (in contrast to innovation based on local knowledge in traditional agriculture) and the use of large quantities of cheap fossil fuel energy to produce inputs, both mechanical (machinery and fuels) and chemical (industrial fertilizers and pesticides). As a result, agriculture has become highly dependent on this energy subsidy: in Portugal, the consumption of fossil fuel energy in agriculture to produce each Kcal of food energy was multiplied by ten between 1953 and 1989 – rising from 0.17 to 1.70 Kcal (Santos, 1996).

The new varieties of plants genetically improved as part of the chemical-mechanical model are generally very productive. However, this productive potential is only demonstrated when these plants are cultivated in profoundly modified agro-ecosystems, where water and nutrients are found in abundance and there is little in the way of pests, diseases and other competing plants, due to the systematic use of pesticides.

A small number of these new, highly-productive plant varieties generated by modern agricultural science have been replacing a broad range of crops adapted to the local agro-ecosystems nurtured over centuries by the local knowledge of many generations of farmers. The genetic basis of the chemical-mechanical model became much narrower, which made the model, as a whole, increasingly dependent on the permanent availability of cheap energy, and thus vulnerable to increases in energy prices.

At the socio-economic level, the spread of the chemical-mechanical model meant agricultural production systems gradually became part of the market economy. Markets for agricultural produce, markets for new industrial inputs and also credit markets providing the capital to be invested in buying new inputs now influence most farmers' production decisions. Farmers (until then those most responsible for creating local knowledge which their production systems were based on) became

dependent on global scientific knowledge, which was first held by the State and its system of rural research and development, then possessed by the commercial suppliers of new inputs.

The double substitution of the chemical-mechanical model allowed for greater food production per farm worker, which facilitated much of the population's move from agriculture to emerging sectors of industry and services. As such, it has given us the much-cherished freedom to choose our occupations. In addition to this, it has reduced the overall risk of food insecurity – nowadays food security has more to do with the inequality of income distribution than the shortage of food production potential.

The agro-ecosystems modified by the chemical-mechanical model are also very different nowadays. They produce more food, but are also more dependent on foreign energy subsidies to guarantee operation and stability. The fact that agro-ecosystems were made more artificial by the chemical-mechanical model made it possible to increase agricultural production during the second half of the 20th century, mainly by increasing production per hectare (intensification) rather than by expanding agricultural area. This boasted obvious advantages in terms of less pressure to convert natural habitats into farmland. However, the inefficient use of chemical inputs led to major pollution problems, which are far from being just local. The use of nitrogen fertilizers has doubled the overall nitrogen cycle on earth (Vitousek *et al.*, 1997) and the presence of bio-accumulated pesticides can now be found in remote areas, like Antarctica, where they have never been used.

Overall, the widespread nature of the chemical-mechanical model, even in developing countries (the so-called green revolution), has meant that cereal production has trebled since 1950, based on: (1) the adoption of high-yield varieties of wheat, rice and maize, (2) the trebling of irrigated land area and (3) the 11-fold increase in the use of industrial fertilizers (Brown, 2004).

The challenges ahead

Today, the decrease in cultivated areas due to soil degradation or urbanisation, the unacceptable ecological costs of expanding cultivated areas at the expense of the remaining natural ecosystems (deforestation, biodiversity crisis and CO_2 emissions) and the need for increased agricultural production (to deal with demographic growth, changing diets in developing countries and the demand for agricultural raw materials for non-food purposes, such as biofuels) have set enormous challenges for

the next half-century (Brown, 2004). It is worth asking if the chemical-mechanical model, which has helped us in the past, can overcome such obstacles.

However, there are a number of issues with the chemical-mechanical model. First, the model's environmental footprint needs to be reduced, in terms of both pollution (including greenhouse gas emissions) and impact on the planet's biodiversity.

Second, the genetic improvement of plants seems to be falling short of expectations, in terms of growth response to fertilisers and pesticides, increased land productivity, reduced costs and controlled pollution. These limitations are related to the chemical-mechanical model's method for increasing land productivity, which focusses on concentrating most of the cultivated plant's photosynthesis' product on the grain, by using plants with a lot of grain and little straw, rather than increasing photosynthetic production of the agro-ecosystem as a whole. The fact is that plants need roots, stalks and leaves, and they cannot be made up only of ears and grain. As such, this impressive path of plant improvement has travelled so far that it is coming to a dead end without any alternatives of equal potential in the short or medium term having been found yet (Brown, 2004).

Third, the depletion of water resources today affects many agricultural areas, particularly in the most populated regions of the planet, such as China and India (Brown, 2004).

Fourth, the expected impacts of climate change on crop yield and water resources, especially in areas that already have low productivity, such as sub-Saharan Africa, cast doubt on our global agricultural capacity in the future.

Fifth, dependence on cheap fossil fuels, induced by the chemical-mechanical model, has made agricultural production vulnerable to energy scarcity, which is particularly important in the current context of rising energy prices. **Figure 1** shows that, in Portugal, the prices of energy-intensive agricultural inputs (energy and fertilizers) have risen over the last seven years much more than the slight increase of intermediate agricultural inputs in general. **Figure 2** shows the reduced use of these energy-rich agricultural inputs by farmers over the same period, in response to this steep price increase.

As there is not enough space in this chapter to look at all of these issues, we will discuss only one (agriculture's footprint on the planet's biodiversity) as a case study to raise awareness of the complexity of many of the environmental problems of agriculture.

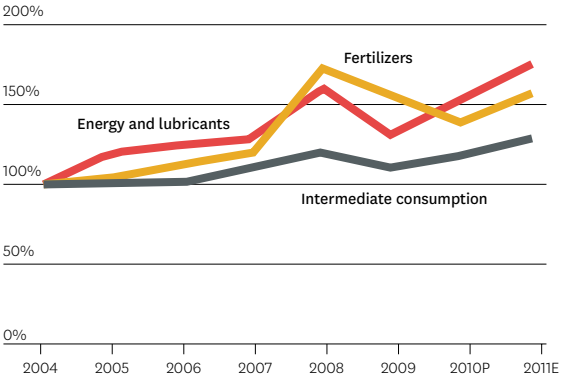


Figure 1. Price changes[1] in intermediate consumption overall and in energy and fertilizer consumption in particular (Portuguese agriculture).
Source: INE (Statistics Portugal), Contas Económicas Nacionais.

1 Implicit price index of intermediate consumption (base year 2004)

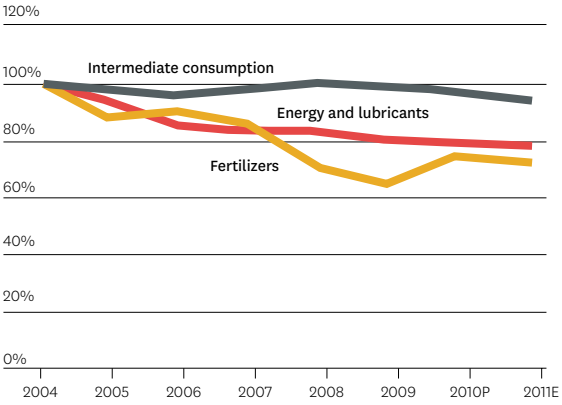


Figure 2. Volume changes in intermediate consumption overall and in energy and fertilizer consumption in particular (Portuguese agriculture).
Source: INE (Statistics Portugal), Contas Económicas Nacionais

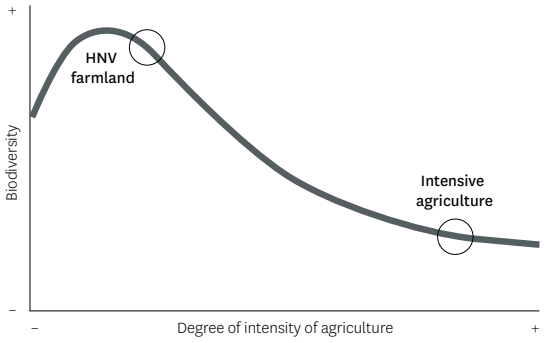


Figure 3. Relationship between agricultural intensity and farmland biodiversity underlying the concept of High Nature Value (HNV) farmland.
Source: EEA (2004)

Agriculture and biodiversity loss

Nowadays, alongside climate change, the loss of biodiversity is one of the most significant factors of global unsustainability. The main direct cause of biodiversity loss on a global scale is the destruction of habitats, particularly that which is driven by the conversion of natural habitats to farmland (Myers, 1997). According to the Millennium Ecosystem Assessment (2005), only biomes relatively unsuited to crop plants, such as deserts, boreal forests and tundra, have remained largely untransformed.

The levels of land productivity (agricultural intensity) associated with the chemical-mechanical model have made it possible to save natural habitats that would have been converted into farmland if a less intensive form of agriculture (using more land to produce the same) had been employed (Green *et al.*, 2005).

However, in regions that have long been transformed by agriculture, like in the case of Europe, the overwhelming majority of the biodiversity under threat is in areas where low-intensity agricultural systems are the norm. In these cases, the intensification of production systems and the resulting artificialisation of agro-ecosystems are an important driver of biodiversity loss; abandoning agriculture and the resulting re-naturalisation of agro-ecosystems also lead to biodiversity loss.

In Europe, two thirds of endangered and vulnerable bird species are dependent on agricultural habitats, with 40% being affected by the intensification of agriculture and 20% by the abandonment of low-intensity farming systems (Tucker and Heath, 1994). Similarly, 15% of the area designated for conservation purposes under the Habitats Directive (35% in the case of the Western Iberian Peninsula) are natural habitats that are dependent on low-intensity agricultural management. This European farmland biodiversity is also in decline, but now as a result of the abandonment of low-intensity agricultural land use or its intensification (EEA, 2004) and not because of the conversion of natural habitats into expanding farmland.

These positive associations between extensive agriculture and biodiversity have led to concerns about maintaining low-intensity farming systems (Bignal and McCracken, 1996), which were later incorporated into the European Environment Agency's work on high nature value (HNV) farmland. According to the European Environment Agency, this HNV farmland occupies 15-25% of the European Union's utilised agricultural area (UAA). What these areas have in common is low levels of production intensity, a high level of biodiversity and two mutually exclusive threats

to biodiversity: the abandonment of farmland management, including afforestation of HNV farmland, and agricultural intensification. The link between productive intensity and biodiversity is understood like a graph that associates the "peak" of biodiversity with an intermediate level (low but not zero) of farming intensity (see **Figure 3**).

As such, there are two distinct views on the relationship between agriculture and biodiversity: one, which is relevant at the global level, is that the expansion of farmland is the main driver of biodiversity loss; the other, which is particularly pertinent to Europe and other older agricultural regions, is that this phenomenon has more to do with agricultural abandonment and intensification (and not the expansion of farmland).

These two perspectives offer diametrically opposed solutions for public policy on agriculture and conservation: one is the intensive use of areas with the greatest potential for agriculture, in order to save large areas of natural habitat for the strictest protection of nature (spatial segregation of production and conservation functions), an option largely taken in the USA, Australia and New Zealand; the second is employing less intensive farming, which needs larger areas, but where it is possible to make production and conservation compatible in the same multifunctional space (spatial integration of production and conservation functions), which is an option generally favoured by the EU.

The two perspectives are probably both valid in their respective geographical areas, where the duration of agricultural occupation is quite different. This is a good example of the complexity of agricultural and environmental problems, which demand different solutions in different places.

The role of technology: sustainable intensification?

Defined as raising the level of production per hectare rather than the amount of inputs per hectare, agricultural intensification may be the key to avoiding mass conversion of natural habitats into farmland as a result of the growing demand for food, bioenergy and biomaterials.

However, within the chemical-mechanical model, production increases per hectare were generally achieved in the past through increases in inputs, with the use of fertilisers, pesticides, water and energy increasing across the board over recent decades.

This increased per-hectare consumption of inputs has led to them being used less efficiently in agricultural production, thus making it necessary to increase the amount of input used to achieve the same production increase. This dwindling efficiency, the corresponding growth

of waste and pollutant emissions, and the widespread increase of input consumption have caused a range of environmental problems, such as the eutrophication of aquatic ecosystems, the poisoning of food chains, the decline of groundwater levels and water flows and the emission of greenhouse gases by agriculture. In addition to this, this has often meant higher costs, lower-quality produce, lower competitiveness and greater economic vulnerability of agriculture, as we reach the end of the cheap energy era.

As such, it seems appropriate to decouple the increase in production per hectare from inputs per hectare as much as possible. This change of direction would allow us to create a form of agriculture that could be more competitive, more environmentally friendly and more resilient to water shortages and rising energy prices. This change of direction, which may (or may not) become an alternative technological model to the chemical-mechanical model, has become known as sustainable intensification (Royal Society, 2009).

How much it is possible to decouple production per hectare from input use per hectare is not yet clear. There are certainly limits to this technological strategy of producing more with less, thus reducing trade-offs between the environment and the economy. These limits are more obvious in the short term, mainly due to so-called technological lock-ins.

For example, the full expression of the genetic potential of the plant varieties that we use nowadays in agriculture depends on simple agro-ecosystems (with reduced competition but also with less help from predators and parasitoids, leading to a greater need for pesticides) and high levels of nutrients in the soil (hence copious fertilising). This example illustrates the interconnectedness and resistance to change within the current technological model: it is not possible to change the individual techniques one by one; change needs a new, alternative technological model in which new techniques (based on particular knowledge areas not emphasised in the current model) combine to meet new needs and challenges.

In order to make the transition from the current technological model, there are at least two strategic routes we can predict that can lead us to decouple per-hectare production from per-hectare input use. The first of these is based on increasing the efficiency of input use through more precise application in time and space; inputs should be used only at appropriate rates, when and where they are really needed. This approach is generically described as precision agriculture, but it also includes new irrigation methods (e.g. sensor-controlled drop irrigation) and many other technologies. The second route (which is not necessarily an alternative to the first) is

based on copying ecological processes (predation, parasitism and diseases, symbiotic nitrogen fixation, mycorrhizae, combinations of permanent and annual cultures, or pollination by insects) and redesigning agro-ecosystems so that these processes are promoted and used as ecosystem services that replace purchased industrial inputs (pesticides, fertilisers and energy).

It is possible to devise techniques that facilitate both routes. A good example is that of "economic threshold levels of attack" used to trigger pesticide application in integrated production as an alternative to pesticide application by "schedule" (i.e. regardless of the levels of attack), which was customary in the chemical-mechanical model. Economic thresholds mean not treating except when the level of pest attack allows us to predict that the cost of non-treatment (production loss) exceeds the cost of treatment (pesticide price plus application costs). This technique simultaneously increases pesticide input-use efficiency by applying them more selectively (first route), and, because it is less harmful for auxiliary predators and parasitoids (often more susceptible to pesticides than pests themselves), it also enhances ecological processes that do the same work as pesticides for free – thus replacing chemical inputs by ecological processes (second route).

The first route (efficient use of inputs applied in a more targeted and selective fashion) principally depends on innovative information technologies, including geographical information systems (GIS), and sensor technology (including remote sensing). The second route (substituting inputs with ecological processes) is based on a better understanding of how agro-ecosystems work. Both may also use biotechnologies to resolve issues of efficiency (e.g. draught-resistant, water-efficient crops) or substitution (e.g. nitrogen-fixing plants), respectively.

It should be noted that many of the abovementioned innovative techniques already exist or are being developed. What does not yet exist is an alternative technological model that facilitates faster development of these techniques and encourages coordinated, complementary and synergetic innovations.

It is also worth highlighting an important difference between the two transitional routes towards a new technological model. A better understanding of the way agro-ecosystems work (second route) is a public good, economically speaking. Once this better understanding is available, it becomes free for any farmer to use to improve their productive agro-ecosystem, making it difficult for those who produced the technology to be remunerated for their technological research and development effort. As this is knowledge-related, it is difficult to patent, to limit access to it and charge a fee for its use, which

is why private investment in technological research and development associated with the second strategic route will always be necessarily limited.

On the other hand, increased input-use efficiency through more targeted application (first route) generally involves objects, equipment, software or seeds (in other words, private goods) that can be more easily patented and sold to compensate for the costs of technological research and development. So, the first route is naturally more attractive for private research investment.

This difference between the public or private nature of the final output of the technological research and development process explains why diverse branches of science and technology are at very different stages of development, when the lion's share of research and development investment is private.

However, it is clear that public investment priorities in science often coincide with those in the private sector, which means that, contrary to expectations, the desirable complementary nature (division of labour) of private and public funding in technological research and development does not occur. This complementary relationship would involve the State giving priority funding to research that essentially generated public goods (such as knowledge about how agro-ecosystems work), where the private sector has no interest. For its part, the private sector would invest (as it normally does) in research that essentially produces private goods that can be patented (predominant in the first route, which focuses on the targeted use of inputs).

Vanloqueren and Baret (2009) use precisely this idea of a lack of complementary relationships to explain the incipient development of agro-ecological innovation when compared to the advanced situation of genetic engineering within the context of the agricultural research system.

The obvious conclusion is that, in the field of research, priority should be given to areas that produce non-patentable knowledge, such as that which refers to how agro-ecosystems function.

Role of public policy: compensating public goods and correcting market failure

Agricultural production occurs at the heart of modified ecosystems (agro-ecosystems) and not within a factory context that is totally divorced from nature. Therefore, agricultural techniques have major effects on environmental quality. Some of these effects are positive (e.g. biodiversity associated with low-intensity farming systems), while others are negative (pollution, habitat conversion and soil erosion).

Unlike the food produced from it, most of the environmental effects of agriculture are not bought and sold in markets. Farmers and the technological research and development system react most to market prices, which can compensate their efforts. Everything else (water quality, biodiversity, basic environmental sustainability as a whole) is a side effect of decisions made on the basis of price. As such, the market systematically fails in the realm of environmental regulation in agriculture (at least if we compare its role in food supply and demand regulation). The idea of the invisible hand, as suggested by Adam Smith (father of modern economics), where the decisions we make in our own individual interests ultimately generate maximum common good, would only really work if all the consequences of our decisions had a market price. As some of these consequences, such as the environmental effects of agriculture, are not (nor cannot even be) exchanged in the marketplace, the invisible hand no longer leads to the maximum common good – something which is known as market failure.

Market failure, which is a concept that all sorts of economists accept, requires public intervention by the state. In this case, it requires public policies to deal with environmental sustainability issues in agriculture. These policies can take different guises, ranging from simple environmental regulation to product differentiation according to their ecological footprint, helping guide consumers' buying behavior towards sustainability; they also include direct economic incentives for farmers that produce environmental public goods.

In the rest of this chapter, some examples of these economic incentives will be discussed, particularly those related to the Common Agricultural Policy (CAP) and the European Union's nature conservation policy.

The majority of the measures to encourage agriculture to produce environmental public goods in the EU are included in the second pillar of the CAP (the so-called rural development policy). Some of these measures were designed before 1992; however, rural development policy explicitly arose only within the context of successive CAP reforms between 1992 and now. It became the second pillar of the CAP in 1999 (Agenda 2000 CAP reform). Throughout this period, there was a successive "greening" of the CAP and the main political reason for this transition was the change in the very nature of CAP reforms since 1992.

The 1992 reform was justified in terms that were internal to the CAP itself: reform was needed to do away with food surpluses, which were one of the CAP's internal problems. As such, it reformed measures to deal with this issue without changing either the objectives or the basis of the CAP's legitimacy as a public policy.

However, the 1999 and 2003 reforms were forged to address problems unrelated to the CAP, which were the EU's position in the World Trade Organization (WTO) negotiations and the financial implications of enlargement to the East, combined with a tighter budget constraint. Now the CAP needed a new language to legitimise the new production-decoupled payments that the WTO demanded to make sure that income support to farmers would not cause market distortion. Deprived of their output-regulatory function, these decoupled payments now resembled pure political rents, where farmers received public money and society received nothing in return.

The language found to legitimise these new decoupled payments was that of the "greening" of the CAP itself: farmers would be paid to produce environmental public goods (biodiversity, climatic stability, landscape amenities) that the market would not pay for.

Meanwhile, alongside this transformation of the CAP, there were also new developments in the EU's nature conservation policy.

The issue of community funding for the implementation of the Natura 2000 conservation network had blocked the negotiations of the Habitats Directive until 1992. Member States (such as Spain and Portugal) that predicted that a considerable part of their territory would be affected by this new conservation network demanded that EU funds were made available to compensate farmers who were affected by a policy whose conservation goals were, essentially, for the EU at large. Other funding needs arose, as the option of working with farmers, rather than against them, was also adopted by many environmental NGOs (e.g. Birdlife International and WWF).

The problem of EU funding for Natura 2000 was eventually resolved via the definition of the EU Financial Perspectives for 2007-2013. The solution adopted was based on Member States using existing funds (particularly the rural development fund) to implement Natura 2000.

In conclusion, in order to work with farmers and not against them, it became necessary to allocate sufficient funds to environmental public goods not paid for by the market. With agricultural policy needing the environment as a new basis for its legitimacy and conservation policies geared towards working with farmers and treating them as important players in nature conservation, the conditions for a "marriage" (if not for love then at least for mutual interest) between these two areas of public policy were created.

Bibliography

/ Bignal, E. M. and McCracken, D. I., 1996. Low intensity farming systems in the conservation of the countryside. Journal of Applied Ecology, 33, 413-424.
/ Bonny, S. and Daucé, P., 1989. Les nouvelles technologies en agriculture: une approche technique et économique. Cahiers d'Economie et Sociologie Rurales, 13, 5-33.
/ Brown, L., 2004. Outgrowing the Earth: The Food Security Challenge in an Age of Falling Water Tables and Rising Temperatures. Earth Policy Institute. www.earth-policy.org/index.php?/books/out
/ EEA, 2004. High nature value farmland – Characteristics, trends and policy challenges. Copenhagen: European Environment Agency.
/ Green, R., Cornell, S., Scharlemann, J. and Balmford, A., 2005. Farming and the Fate of Wild Nature. Science, 307, 550-5.
/ Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. Washington DC: World Resources Institute.
/ Myers, N., 1997. Global Biodiversity II: Losses and threats. In: Meffe, G. K. and Carroll, C. R. (eds.). Principles of Conservation Biology. 2nd edition. Sunderland, Massachusetts: Sinauer Associates Publishers, 123-158.
/ Royal Society, 2009. Reaping the benefits: science and the sustainable intensification of global agriculture. London: The Royal Society.
/ Santos, J. L., 1996. Modelo técnico, espaço e recursos naturais. Os balanços energéticos da agricultura portuguesa (1953 and 1989). Anais do Instituto Superior de Agronomia, 45, 263-288.
/ Tucker, G. M. and Heath, M. F., 1994. Birds in Europe: their Conservation Status. Birdlife Conservation Series, 3. Cambridge: Birdlife International.
/ Vanloqueren, G. and Baret, P. V., 2009. How agricultural research systems shape a technological regime that develops genetic engineering but locks out agroecological innovations. Research Policy, 38, 971–983.
/ Vitousek, P. M., Mooney, H. A., Lubchenco, J. and Melillo, J. M., 1997. Human domination of Earth's ecosystems. Science, 277, 494–499.

A sustainable agriculture for Europe? From evidence to policy reform

David Baldock

As well as being the source of food supply, agriculture is the largest user of land in Europe, and farming activities affect all the environmental media – soil, air quality, climate dynamics, water, fauna and flora, landscapes and other aspects of the rural environment. Both slow and rapid changes occur simultaneously because of the continuous interplay between agricultural management and the natural environment found in Europe. This interplay is more complex than in many other sectors and varies over time and between locations. Natural systems are involved; even seasonal variations in weather can be significant. Consequently, simple relationships are rare.

Over the last two decades we have been moving towards a more balanced view of the relationship between agriculture and the environment in Europe. There is increased evidence of the nature and scale of the pressures created, particularly by intensive agriculture on arable land. The debate over climate change and the introduction of targets for mitigation has increased the focus, both on the emission of greenhouse gases from agricultural activities and the importance of carbon sequestration in soils under agricultural management. On the other hand, the contribution of certain kinds of farming to the provision of ecosystem services and the protection of semi-natural habitats has been better documented and the subject of wider appreciation. The greater recognition of High Nature Value farming and the expanded role of organic farming have underlined the role of appropriate agriculture in managing the rural environment sustainably.

There is now an opportunity to bring this debate closer to the heart of agricultural policy. First, it is clear that real, long-term food security

depends on the sustainability of agriculture in a broad sense and that Europe has a duty to safeguard its resources if it is both to maintain output and potentially produce more in future, as the world population climbs towards nine or ten billion. Second, there will be a new phase of the Common Agricultural Policy beyond 2014 and for the first time, it is proposed that a significant share of the funds spent on the primary support scheme for farmers, 30%, should be earmarked only for those following environmentally preferable forms of management. This would be a significant change if agreed to in a meaningful form, but only one stage in a real "greening" of the Common Agricultural Policy (CAP).

Agriculture's footprint

Agriculture has been practised in Europe for millennia and, at present, it accounts for approximately 39% (168 million hectares) of the territory of the 27 Member States of the EU. As a productive activity – the primary purpose of which is the production of food and other materials – it both transforms and shapes the routine management of much of the natural environment. It has a fundamental influence on the pattern of resource use, on the functioning of natural systems and the number and abundance of species present in different locations. Forestry covers a further 41% of the EU land area (177 million hectares). Forests and woods vary in terms of their origin, character, composition, density and the types of management practised. Consequently, the environmental impact of agriculture and forestry – both positive and negative – is critical, both to the sustainability of these sectors and our future food supplies and to the stewardship of Europe's diverse rural environment.

There can be trade-offs between different environmental considerations. For example, more intensive farming systems may be both more energy efficient per unit of food produced and, at the same time, more demanding of water resources and more inhospitable to wildlife. A mixture of appropriate practices adapted to local conditions is required.

Starting with the pressures, there is a considerable body of evidence on the challenges facing the rural environment in Europe and the particular role played by agriculture. There is still a long way to go to meet European targets on climate change and biodiversity and significant problems remain in relation to water scarcity and quality (EEA, 2009b and 2010c) and achieving good soil management. Data from a range of environmental indicators (for example EEA, 2005b; EEA, 2009a; OECD, 2008) and other literature show a continued large-scale deterioration in the state of

several environmental media affected by agriculture. There are, however, some notable exceptions – for example, improvements in some aspects of air quality and some regional improvements in soil functionality and water quality, as well as reductions in greenhouse gas emissions from agriculture, partly due to a falling number of livestock (EEA, 2010c).

The most recently published State of the Environment Report (EEA, 2010c) highlights the fact that, although the EU is on track to meet its current Kyoto targets, this will not be sufficient to keep global temperature increases below 2°C. To achieve this, emission cuts of 25%-40% will be needed by 2020, which will require greater efforts to mitigate greenhouse gas emissions and an increased focus on adaptation measures. The agricultural sector has already achieved a significant decrease in GHG emissions (more than 20% since 1990) but will have a role to play in achieving further reductions, both to 2020 and the next phase of the mitigation effort to 2030 and 2050. The main sources of GHG emissions from agriculture include: CH_4 emissions from enteric fermentation in ruminant livestock and the emissions of CO_2 from soils, resulting from land management, including changes in use, particularly the drainage of organic soils, with peatland in particular. They have been estimated to amount to 20-40 tonnes of CO_2 per hectare per year in the EU (Alterra *et al.*, 2008). Other sources include emissions of N_2O from soils; N_2O and CH_4 emissions from manure management and CH_4 emissions from rice cultivation (UNFCC, 2008).

In relation to biodiversity, agriculture is highly significant as a determinant of species composition and abundance over sizeable areas and the integrity and value of many semi-natural habitats is influenced by farming practice. Major efforts will be needed to reach the EU's target of halting biodiversity loss by 2020 and agriculture will have an important role to play here. One leading indicator is the population of common farmland birds. This has declined over time but has become more stable in recent years. Recent policy changes, such as the cessation of set-aside, could lead to further declines in the future, if suitable alternative measures are not put in place (Tucker *et al.*, 2010). In parallel, the status of rarer threatened farmland bird species continues to be of considerable concern (BirdLife International, 2004). Other, more sensitive, species groups may have declined further, although the data tends to be not to be as good as for birds. For example, data on grassland butterflies continue to show significant declines (more than 50% since 1990). In addition, national reports on the conservation status of species and habitats of Community interest (i.e. those accorded priority for conservation under the EU's key legislation

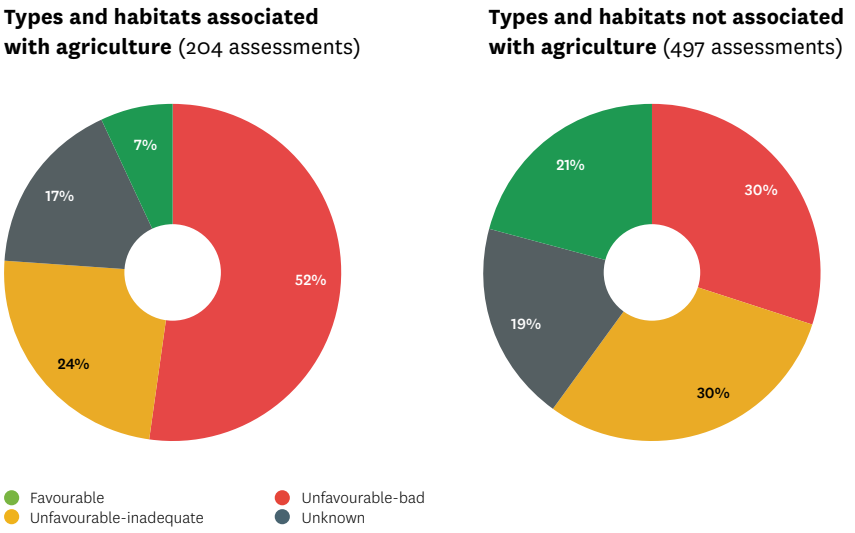
on this topic, the Habitats Directive) indicate that habitats associated with agricultural activity, particularly grassland habitats, are in very poor condition. For example, less than 10% of grassland habitats of Community Interest had a favourable conservation status in 2008. More broadly, according to a Commission report published in June 2009, 50% of species and up to 80% of habitats of European conservation interest have an unfavourable conservation status (European Commission, 2009).

Overall, only 7% of habitats linked to agro-ecosystems have a favourable conservation status, compared to 17% for habitat types not related to agro-ecosystems **(Figure 1)**. The reasons for these poor results are likely to be the shifts towards more intensive agriculture in some areas and reduced management in others, leading, in some cases, to outright agricultural abandonment.

Overall, and more positively, the agricultural nutrient balance for nitrogen and phosphorous has improved in recent years for many countries. Nonetheless, diffuse pollution from agriculture remains a major cause of the poor water quality currently observed in parts of Europe. Agriculture contributes 50% to 80% of the total nitrogen load observed in Europe's fresh water (EEA, 2010). Nitrogen loads for the agricultural sector are predicted to remain high over the coming years as increases of 4% in nitrogen fertiliser use are predicted for the EU to 2020 (EFMA, 2009). Linked to this, a study of draft River Basin Management Plans prepared by authorities from all over Europe published before 2009 showed that diffuse and/or point source pollution by nitrogen is reported in 124 out of 137 River Basins reporting to the EU, with phosphorus in 123 cases and pesticides in 95 cases (Dworak *et al.*, 2010). The main sources of nitrogen and phosphates are inorganic fertilisers, organic manures and slurries, livestock feed and silage effluent. Indeed, the EEA has stated that "a significant number of water bodies face a high risk of not achieving good ecological status by 2015" (EEA, 2010c).

The agricultural sector also exerts significant pressure on the quantity of water resources available in many parts of Europe. It is one of the largest consumers of water, utilising a combination of natural precipitation, water extracted from aquifers and surface sources, and that stored in tanks and reservoirs, for irrigation and use by livestock. On average, the sector accounts for 24% of total water abstraction within the EU. However, agricultural water use is distributed unevenly, and in some southern European regions it accounts for up to 80% of water extraction. In the context of climate change, the problem of water scarcity is of growing

Figure 1. Conservation status of habitat types listed under Annex I of the Habitats Directive associated with agriculture and other land use
N.B.: The percentages relate to the assessments made.
Source: European Environment Agency, 2009a



concern, and the number of regions experiencing seasonal or long-term droughts has increased over the years.

Although soil degradation processes vary considerably from region to region, and exhibit different degrees of severity, soil degradation remains an issue all over the EU. An estimated 115 million hectares or 12% of Europe's total land area are subject to water erosion, and 42 million hectares are affected by wind erosion (EEA, 2005a). More recent estimates using the "Pesera" model may give a more satisfactory estimate of the area of agricultural land in Europe at risk of soil erosion. The outputs from this model indicate that approximately 57.7 million hectares of agricultural land are at risk of erosion of more than 1 tonne/ha/yr and that 47.2 million hectares are at risk of soil erosion of more than 2 tonnes/ha/yr (Jones, pers. comm.), with the Mediterranean Member States particularly affected.

An estimated 45% of European soils have low organic matter content (i.e. have below 3.4% soil organic matter or 2% soil organic carbon), although this varies considerably between regions. In southern Europe, approximately 75% of soils have low organic matter content, partly reflecting the

nature of the soils, the bioclimatic environment and the extended cultivation periods in these countries. Soils in certain areas of France, the UK and Germany also suffer from low soil organic matter content. Attempts to model the potential risk to soil organic matter from climate change indicate that, without changes to management, soil organic matter is at risk on the majority of arable soils across Europe. Compaction from regular cultivation and heavy equipment is also widespread, although data on the scale of the problem are difficult to obtain.

The pressures and threats facing the environment result from two main trends in agricultural land management, notably increasing specialisation, concentration and intensification of production at one end of the spectrum, and marginalisation and abandonment at the other (EEA, 2005a; Stoate *et al.*, 2009; EEA, 2010c). Each of these trends will result in changes in farm management practices, as well as changes in farm structures, including the move towards fewer, larger farms, with resulting impacts on the environment.

Intensification, specialisation and concentration of production have tended to lead to an increased use of inputs, such as fertilisers and pesticides; the conversion of grass to arable land; higher stocking densities; the conversion of hay to silage making; the use of maize as a fodder crop; and the removal of, or disregard for, the management of boundary features, such as hedgerows, stone walls and other farmland features, such as ponds and individual trees. Although this trend is less marked than previously, the less-intensively farmed regions, particularly in Central and Eastern Europe, have considerable potential to intensify their production methods, given low levels of investment in the agricultural sector. The prospects of further increases in fertiliser use in many parts of Europe to 2020 (EFMA, 2009), both on arable land and grassland, will continue to put pressure on a range of environmental media, including biodiversity, water quality, soil functionality and emissions of GHGs.

Marginalisation and eventual land abandonment generally lead to a decline in the extent of grassland and arable habitats and an increase in scrub and forest in the landscape. Whether these changes are beneficial or detrimental to the environment largely depends on their context and local priorities. In predominantly open landscapes, small-scale abandonment can lead to increases in habitat and species diversity that can be beneficial, although the species that may benefit are often generalist species of low biodiversity value (IEEP and Alterra, 2010). Large scale abandonment, however, can lead to declines in habitat heterogeneity and species

diversity across the landscape. All land abandonment affects the character of the agricultural landscape and whether or not this change is viewed as positive or negative in landscape and cultural terms will depend on the geographic location, cultural heritage of the area and social preferences. In semi-arid areas, land abandonment may also lead to soil erosion where vegetative growth is slow, leaving land susceptible to erosion from wind and rain (Cerda, 1997; Pointereau *et al.*, 2008).

The environmental benefits of sustainable agriculture

Agriculture is, by definition, the deliberate alteration of more natural systems for human benefit and is bound to carry an environmental price. However, this can be minimised by selecting appropriate practices and systems and, given our need for food production, agriculture can contribute to environmental goals in several positive ways. This positive dimension needs to be seen alongside the pressures set out above. For example, many of the landscapes that we value most in Europe are semi-natural, cultural artefacts, created by generations of farmers and, in many cases, their livestock. Traditional orchards, the *montados* in Portugal, the hedges and pastures in Normandy and Western Britain are all good examples. In the virtual absence of wilderness in Europe, many species of wildlife are now dependent on farmland and, quite frequently, on the continuation of certain practices, such as the grazing of pastures. Better adapted agricultural practices, even in intensively farmed areas, can cut air and water pollution for example. Many of these benefits can be classified, in policy terms, as environmental "public goods", outcomes that will not arise because of the normal dynamics of markets. To some degree, farmers may choose voluntarily to "produce" these public goods, perhaps quite incidentally to their main purpose. However, often this will not occur and intervention will be required, incentivising farmers with payments from the public purse in some cases.

There is a significant variation in the degree to which environmental benefits are provided by different farming systems, with extensive livestock, mixed livestock and cropping systems and less intensive permanent crop systems delivering the greatest range, along with organic farming. These farming systems tend to be characterised by low-intensity land use and contain a high proportion of semi-natural vegetation and landscape features, as well as a diversity of land cover. As many of these systems are associated with relatively high levels of biodiversity, these types of farming systems are often characterised as "High Nature Value". It has

been estimated that there are about 74 million hectares of HNV farmland in the EU, with the highest proportion being found in the Mediterranean and central and eastern Member States (Paracchini *et al.*, 2008).

The types of management involved in HNV systems are generally less intrusive on the environment. For example, they do not involve deep ploughing, irrigation, high use of pesticides and fertilisers or high stocking densities, or the removal of landscape features and other semi-natural habitats. Many correspond to those used in more traditional extensive farming systems, such as the maintenance of extensive livestock grazing, shepherding and transhumance practices, the use of traditional breeds of livestock or types of crop, the maintenance of field boundaries, including a high proportion of fallow within the crop rotation, or the use of green manures.

The twin challenges of maintaining environmentally well adapted but less profitable farming systems and reducing the pressures caused by increasingly specialised high yielding systems are depicted in broad terms in **Figure 2**, which was devised by the European Environment Agency. This divides Europe into large zones according to a dominant issue, although in practice most countries contain a mix of farming systems and a variety of pressures. The distribution of High Value Nature farmland dominated by low intensity systems, particularly permanent pasture in southern, central and parts of North West Europe is shown in the background. These areas tend to contain many of the most valued cultural landscapes, as well as being richer in biodiversity.

Some policy questions

In responding to these issues, the EU has relied on a combination of regulations seeking to influence farming practice on the one hand and various incentives for farmers, with or without an environmental component, driven by the CAP. Generally, these are devised at European level, although there are some measures within the CAP which can be tailored to local conditions.

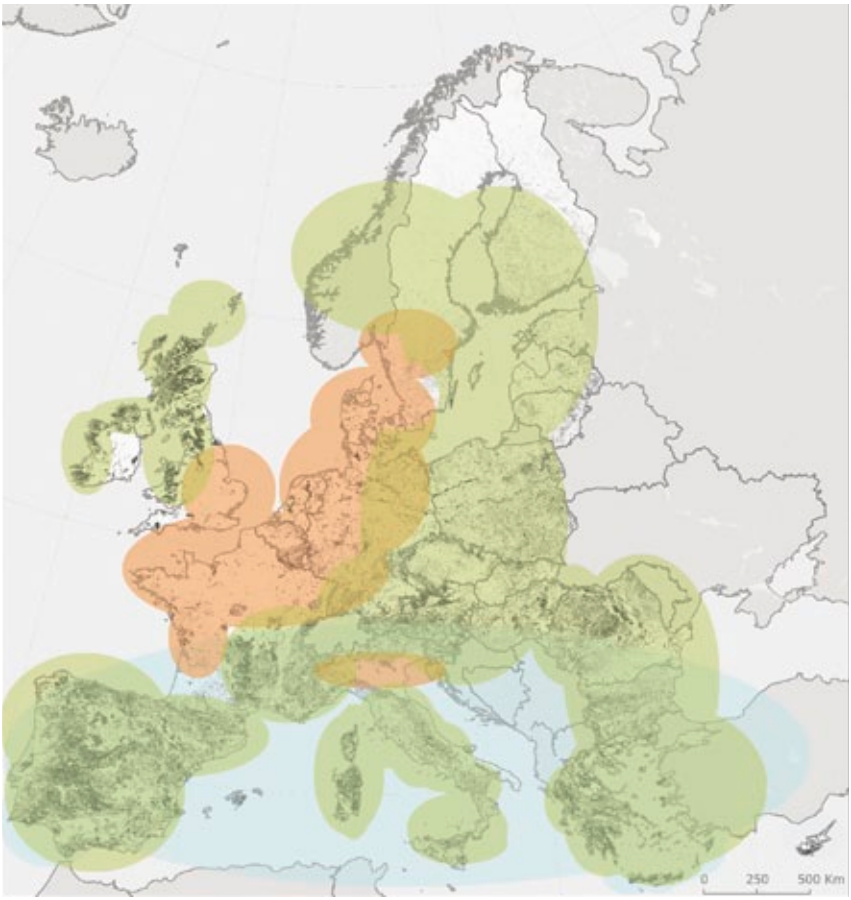
The environmental regulations are mostly in the form of directives and cover a range of issues, particularly in relation to water quality, biodiversity and the use of agro-chemical inputs in agricultural. For example, there are directives on permissible pesticides, maximum levels of acceptable residues of pesticides and nitrates in drinking water, broader ecological standards for fresh water, measures related to ammonia emissions and directives relating to the protection of wildlife and their habitats. The extent to which these measures are monitored and enforced on individual

farms varies considerably within Europe and it is more challenging for the authorities in countries with large numbers of very small farms, where regular inspections would be expensive and cumbersome. Nonetheless, considerable improvements have been achieved, particularly with respect to issues where inspection problems are more manageable. A significant number of more toxic and persistent pesticides have been removed from the market and a new measure devised to promote integrated pest management on farmland.

In principle, the CAP provides a useful means of directing public sector support for farmers who are delivering environmental public goods alongside income from the market. In practice, the CAP has not been focused particularly on this objective and payments have been related more to historical levels of production than to public good provision. In consequence, direct payments per hectare under the CAP are greater in intensively farmed areas, such as the Paris basin, East Anglia and Northern Germany, than in the farming areas of higher environmental value. Most HNV areas remain at below-average incomes and, in many cases, are no longer viable economically. In Portugal, for example, it is thought that all HNV farmland associated with small farms is severely threatened (including the *baldios* and *lameiros* of the North) and that on many *montados* there is localised intensification and abandonment despite better market returns (Pinto-Correia & Carvalho-Ribeiro, 2012).

The main environmental components of the CAP lie in the rural development element or "Pillar 2" of the policy. This includes support for farm investment, the continuation of farming in "less favoured areas", support for afforestation and payments for farmers joining agri-environment schemes, including certified organic practices. Agri-environment measures have grown from a very minor part of the rural development policy to become one of the largest measures and the only one which all governments are required to implement, using a mixture of CAP and national funds. Support for agri-environment measures now runs to more than €4 billion a year in Europe and it has become a critical tool for supporting both the continuation of sustainable practices, which might otherwise not be viable, and for changes in practice, such as organic conversion, destocking of overgrazed areas and the conversion of arable land prone to erosion to permanent grassland. Most challenging has been the design of voluntary agri-environment schemes to reverse the decline of farmland biodiversity, although there has been success with some measures, for example with corncrakes in the UK (Polakova, *et al.*, 2012).

Figure 2. Environmental challenges for European agriculture
Source: European Environment Agency (2012)



Marginal agricultural areas
Challenges: maintain on-field biodiversity, stimulate favourable practices, increase profitability without intensifying

Prime agriculture areas
Challenges: reduce pressures on air, soil and natural habitats, nature reserve approach to remaining high nature value agri patches

Main irrigated areas
Challenge: reduce water stress

Background
(dark grey patches)
HNV farmland distribution

A greener CAP?

Looking ahead, one challenge is to strengthen the effectiveness of environmental policy on farmland. This can be done by improving advice and support for farmers, as well as by more determined implementation of existing legislation. On larger farms in particular, sensitivity to legislation and national standards can be raised through "cross-compliance", a mechanism for linking eligibility for payments under the CAP with compliance to environmental, public health, animal health and animal welfare legislation.

However, at present the most immediate challenge is to reach agreement on a "greener" version of the CAP, since the policy is in the process of a periodic overhaul, with a new regime scheduled to be introduced from 2014. From an environmental perspective, the goals for European agriculture could be summarised as follows:

- A response to the global challenge of producing more than less so that agriculture is more efficient and more frugal in its use of resources, so that we can feed a larger population over time.
- The creation and maintenance of agricultural systems that are sustainable and more resilient to climate change.
- Agricultural systems that alleviate environmental challenges, e.g. by cutting GHG emissions and halting biodiversity decline by 2020.

These will require appropriate farm and forest management, so that policy must seek to balance sustainable production at the same time as providing public goods. This must be achieved without excessive administrative burdens, either on farmers or the state. It is not an easy challenge, but Europe is well placed to take the lead in fashioning policies of this kind. This would be a bigger contribution to achieving global food security than trying to step up short-term output in Europe through further intensifying production.

How far are these themes being captured in the current debate on the CAP?

The Commission's proposals for the CAP for 2014-2020 were launched on 12 October 2011[1] under the rubric of providing "a new partnership between Europe and its farmers, in order to meet the challenges of food security, sustainable use of natural resources and growth". The Agriculture Commissioner, Dacian Cioloș, has billed this reform as one of the most

1 A summary of the proposals and the legislative texts can be found on DG Agriculture's website at: http://ec.europa.eu/agriculture/cap-post-2013/index_en.htm

ambitious for many years, claiming that the changes will make it possible to "fight against climate change, support employment and growth, promote innovation and enhance both the economic and ecological competitiveness of agriculture" (European Commission, 2011). Environmental concerns are more prominent than in any previous manifestation of the CAP, although it is uncertain whether they will figure so large in the final outcome.

This is the first time since the late 1990s that the reform process has involved all elements of the CAP at the same time. In principle, there is a chance of a significant overhaul of the whole policy so that its design and focus is coherent and in keeping with the priorities and challenges that face rural areas and food production in the years ahead. However, reforming agricultural policy in a coherent and visionary way is far from easy in Europe and this time is no exception. Initial indications and hopes that this reform might serve to reorient the CAP towards a greater focus on the delivery of environmental and social public goods, setting the path for a long-term future of a sustainable and competitive agricultural sector in the EU, are yet to come to fruition. Many of the "green" elements are under attack and it is possible that this reform process could end up being a damp squib or even a step backwards for the integration of environmental concerns into the CAP. For the moment, the negotiations are still underway and much is still to play for before final legislative texts are agreed upon in spring 2013 – or later. The views of those in Portugal, including the government, MEPs and civil society, will be contributing to the outcome.

The proposals for a proportion of direct payments to be provided in return for the carrying out of three 'green' measures specified constitute perhaps the most radical change to the structure of the CAP, as well as offering significant potential to extend and enhance the level of environmental management taking place on the majority of farms in the EU. The three greening measures are:

- **Permanent Grassland:** Requires farmers to maintain the area of permanent grassland present on their holdings from the reference year 2014
- **Crop Diversification:** Requires farmers with more than three hectares of arable crops to have at least three different crops, with the minimum crop covering at least 5% and the most extensive no more than a maximum of 70 % of the farm's arable land
- **Ecological Focus Area:** Requires farmers to ensure that at least 7% of their land eligible for CAP payments, excluding areas under permanent grassland, "comprises ecological focus area". The precise

definition of types of land that would fall into this category has yet to be determined, but the examples referred to in the Commission's proposal included landscape features, terraces, arable fallow land, buffer strips and areas of forest that had been planted on previously farmland under certain grant schemes.

These three measures are intended to be sufficiently simple and relevant to the majority of farms but they could be applied throughout the EU, predominantly on farms with arable or permanent crops. However, they do not cover all the key issues. For example, there is no support for maintaining HNV farmland or direct aid for farmers maintaining environmentally valuable permanent grassland. The ecological focus areas could cover a range of different features and could be a valuable innovation but the land in question would need to be managed appropriately.

The proposals provide little detail on how these measures might work in practice, with the Commission retaining the power to define the detail through delegated acts. Many stakeholders involved in the CAP debate have questioned whether the Commission's proposals for green direct payments are a cost-effective way of bringing about a substantial improvement in the environmental management of the EU's agricultural land, triggering a serious debate about the best strategy for large-scale greening of agricultural policy. The current debates focus on ways of amending their design and implementation but, as might be expected, the discussions are driven from two different directions. On the one hand, there are those who seek to improve the environmental benefits that can be achieved through the measures, while on the other, there is a larger group who want to maintain the status quo and minimise the degree to which the measures impinge on productive farm activities.

The rural development "pillar" of the CAP has been the main source of aid for environmentally sensitive farming up to now. It is best suited for funding voluntary measures that can be targeted closely to local conditions and subject to regular monitoring and evaluation. Consequently, it is of concern that the current CAP proposals both reduce the funding available for Pillar 2 and expand the number of measures that qualify for funding; more is to be extracted from a smaller pot. At the time of writing, further cuts in the budget were being considered as part of an overall budget settlement for the EU for 2014-2020.

One significant new element in the Commission's Pillar 2 proposals, aiming at the long term, is the introduction of a new initiative, the European Innovation Partnership (EIP) for agricultural productivity

and sustainability. This aims to harness innovative approaches to integrate sustainability into all components of agricultural production and "promote a resource efficient, productive and low-emission agricultural sector, working in harmony with the essential natural resources on which farming depends" (European Commission, 2012). Pillar 2, the rural development component of the CAP, would provide funding to help set up operational groups to develop innovative projects, as well as an EIP network to disseminate the findings of these projects. Although it is as yet unclear what the EIP and its associated groups and networks might amount to in practice, this does demonstrate a welcome commitment to harnessing new ideas and ways of working and offers the potential to help drive innovative approaches for environmental improvement.

In conclusion, securing food supplies in the longer term means building and sustaining agricultural systems that are efficient but can be managed within environmental constraints. In making choices about the food they wish to eat, consumers are sending a signal about the types of agriculture they are willing to support, although this can be difficult to discern from the information available at the point of sale. The often arcane debates over agricultural policy need to be linked more clearly to the social and environmental discourse building up around food. Whether society continues to be willing to support agriculture on the current scale will depend partly on whether this link can be made.

Bibliography

/ Alterra, CEH, SYKE, UNAB (2008) *Review of Existing Information on the Interrelations between soil and climate change*, CLIMSOIL Final Report to DG Environment, December 2008.
/ BirdLife International (2004) *Birds in the European Union: a status assessment*, BirdLife International: Brussels.
Cerdà, A. (1997) *Soil erosion after land abandonment in a semiarid environment of Southeastern Spain*, Arid Soil Research and Rehabilitation vol. 11 pp. 163-176.
/ Dworak, T., Berglund, M., Thaler, T., Fabik, E.L., Amand, B., Grandmougin, B., Ribeiro, M.M., Laaser, C. and Matauschek, M. (2010) *Assessment of agriculture measures included in the draft River Basin Management Plans – Summary Report*.
/ European Environment Agency (EEA) (2005a) IRENA Indicator Fact Sheet, *IRENA 15 – Intensification/ extensification*, European Environment Agency, Copenhagen, Denmark.
/ EEA (2005b) *Agriculture and the Environment in the EU-15 – the IRENA Indicator Report*, EEA Report 6/2005, European Environment Agency, Copenhagen, Denmark
/ EEA (2009a) *Progress towards the European 2010 biodiversity target – indicator fact sheets*. Compendium to EEA Report No 4/2009, EEA Report No. 5/2009 European Environment Agency: Copenhagen, Denmark.
/ EEA (2009b) *Water resources across Europe – confronting water scarcity and drought*. EEA Report / No 2/2009.
/ EEA (2010a) *10 messages for 2010 – Forest Ecosystems*, EEA Message No5, European Environment Agency: Copenhagen, Denmark.
/ EEA (2010b) *EU Biodiversity Baseline 2010* – EEA Technical report No 12/2010.
/ EEA (2010c) *The European Environment: State and Outlook 2010*, Synthesis Report, European Environment Agency: Copenhagen, Denmark
/ EEA (2012), Agriculture and the Green Economy. European Environment Agency: Denmark
EFMA (2009) *2020 fertiliser outlook*.

/ European Commission (2009) *Report from the Commission to the Council and the European Parliament: Composite Report on the Conservation Status Habitat Types and Species as required under Article 17 of the Habitats Directive*, COM(2009)358 final, 13 July 2009, Brussels.
/ European Commission (2011) The European Commission proposes a new partnership between Europe and the farmers, EC Press Release IP/11/1181, 12 October 2011. Available at: http://europa.eu/rapid/press-release_IP-11-1181_en.htm?locale=en (accessed 19 November 2012)
/ European Commission (2012) *Communication from the Commission: Communication on the European Innovation Partnership 'Agricultural Productivity and Sustainability'*, COM(2012) 79 final, 29 February 2012, Brussels.
/ IEEP and Alterra (2010) *Reflecting environmental land use needs into EU policy: preserving and enhancing the environmental benefits of "land services": soil sealing, biodiversity corridors, intensification / marginalisation of land use and permanent grassland*. Final report prepared by the Institute for European Environmental Policy.
/ Alterra Wageningen UR on Contract ENV.B.1/ETU/2008/0030 for the European Commission, DG Environment: Brussels.
/ OECD (2008) *Environmental performance of agriculture since 1990*, OECD Publications: Paris.
/ Parachini, M.L., Petersen, J.E., Hoogeveen, Y., Bamps, C., Burfield, I. vanSwaay, (2008) *High Nature Value Farmland in Europe – An estimate of the distribution patterns on the basis of land cover and biodiversity data*, Report EUR 23480 EN. 87 p.
/ Pinto-Correia, T. & Carvalho-Ribeiro, S. (2012) "Portugal" in Opperman, R. *et al.* (eds) *High Nature Value Farming in Europe: 35 European Countries – experiences and perspectives*. Verlag Regionalkultur: Ubstadt-Weiher.
/ Pointereau, P., Coulon, F., Girard, P., Lambotte, M., Stuczynski, T., Sanchez Ortega, V., Del Rio, A.; Editors: Anguiano, E., Bamps, C., and Terres, J-M. (2008) *Analysis of Farmland Abandonment and the Extent and Location of Agricultural Areas that are Actually Abandoned or are in Risk to be Abandoned*, Institute for Environment and Sustainability, Joint Research Centre, EC.
/ Poláková, J, Tucker, G, Hart, K, Dwyer, J, Rayment, M (2011) *Addressing biodiversity and habitat preservation through Measures applied under the Common Agricultural Policy*. Report Prepared for DG Agriculture and Rural Development. Institute for European Environmental Policy: London.
/ Tucker, G., Hart, K., Baldock, D., Farmer, M. and Hegarty, J. (2010) *Recent and possible EU agricultural policy developments and their potential implications for farmland birds*. BOUPROC Supplement.
/ UNFCCC (United Nations Framework Convention on Climate Change) (2008) *Challenges and opportunities for mitigation in the agricultural sector*. Report No FCCC/TP/2008/8.

Food, culture and ethics

The Mediterranean diet and access to healthy food

Pedro Graça

Food rules and standards were established in societies via the dynamic between culture and nature, which were mutually influential (Mennell, 1992). On one hand, nature has set conditions within a relatively stable climatic framework for the last 8,500 years. On the other, man has adapted, using his ability to find technical solutions for the successive problems he has encountered. This interaction between culture and nature, especially in countries bordering the Mediterranean, has allowed a dietary pattern that was well suited to the needs of a growing and concentrated population, sometimes in towns and cities, despite a difficult climate that included low rainfall, many hours of sunshine, hot summers and uneven farmland, often with poor soils.

The importance of the Mediterranean in eating habits

The term "Mediterranean" is generally used not in relation to the sea itself, but rather to define an area that includes the sea and surrounding lands, as well as an idea, concept or place brimming with symbols that alternate between myth and reality. In fact, when we say "Mediterranean", unless we are talking explicitly about an exact maritime aspect, we rarely think only about the sea or a defined territory, but rather about tangible and intangible qualities (albeit relatively real) that go beyond a physical space. The Mediterranean way of eating should be seen within this context, where the culture and the environment helped establish a way of eating that goes beyond the local situation. The Mediterranean diet could be defined as the efficient management of a group of different foods and cooking techniques

that facilitated the survival of several Southern European communities and, at the same time, the result of a social and cultural construction adapted to certain environmental conditions. In this man-nature adaptation, the calm waters of the Mediterranean play an important role.

It is via this sea that communication is made easy; where technology, food, plants, animals and people move relatively safely and speedily, something that would be unthinkable over thousands of kilometres of rugged land and countless natural obstacles and human hazards.

The Mediterranean Sea facilitates and unifies habits and customs, allowing us to speak of a Mediterranean way of life, not only provided by nature but also via the communication between distant communities that it permits.

The actual geographic confines of the North Mediterranean are also intensely shaped by agriculture, agro-industry, animal husbandry and fisheries. It is here, in this area, that the most impressive agricultural changes have occurred over the last few thousand years, beginning in the most easterly parts before quickly moving to the most westerly zones of the region; from the terraces and ledges that allow hundreds of kilometres of slopes to be used, utilising thousands of tons of stone, to the introduction of hundreds of vegetable species; from the initial cultures of vines, fig and olive trees to the most recent foods, such as beans, potatoes and tomato. The region's improved agricultural situation was the result of the expansion of its civilisation. Alexander the Great's conquests probably brought the first fruit trees from the East, like peach, while the Arabs introduced rice, lemon trees and irrigation techniques. Later, maize, potato and cocoa were brought from America and during the Discoveries the Portuguese contributed by making oranges common fare in the region; only later would the growing of tomato (considered a quintessentially Mediterranean product nowadays) be perfected and disseminated.

This well-integrated and adaptable agriculture, as well as a very rich urban culture easily transmitted via the sea, dispel the idea of a poor and isolated Mediterranean diet; instead, it is something that has evolved and adapted until today. However, this evolution was affected by the impasses of the 18th and 19th century, which saw the industrial revolution and the later agricultural and urban revolutions of Northern European countries take considerable time reaching the South. Southern European societies maintained a strong rural model with fragmented farms boasting little industrialization and intense manual labour, where animals were used for work and not for consumption. A large percentage of the population made a living from agriculture, and their dietary, cultural and religious habits

were closely associated with this agricultural experience and its festive seasons. These characteristics, which encourage a diet based on vegetable produce and little consumption of animal fat, surprised the American epidemiologists who studied these communities in the mid-20th century.

Recognition and appearance of the term "Mediterranean diet"

The Mediterranean diet was first studied and described in Crete, in the 1940s. Researchers from the Rockefeller Foundation visited the island and discovered unexpected good health and longevity, despite the apparent poverty and limited access to health care. As there were many fewer deaths from heart disease than in the United States and the diet of the local people was very different, the researchers began to suspect that there was a connection between the Mediterranean diet and the onset and development of chronic diseases, which was confirmed by Ancel Keys and his team in the ensuing decades. Since then, thousands of scientific studies have confirmed that there is a link between good health and the food patterns typically adapted in these regions with climatic similarities. This diet is frugal; it is made up of a lot of seasonal fruits and vegetables; there is little animal produce, with the exception of some dairy products, which are often used for flavour; olive oil is the core fat; food preparation is simple and textures are firm; acidic and aromatic substances are important; people drink wine or tea with meals and water throughout the day; meals are structured and sociable.

The Mediterranean diet and health

The "Mediterranean diet" represents a complete and balanced food model with countless benefits in terms of health, longevity and life quality (Antonia Trichopoulou, Bamia, and Trichopoulos, 2009). In nutritional and dietary terms, the following are important features:

- Abundant unsaturated fats (mostly monounsaturated) from olive oil consumption, the main provider of oleic acid, omega-3 polyunsaturated fatty acids consumption from fish and nuts and the reduced consumption of saturated and trans fatty acids found in red meat are important nutritional factors in protecting cardio and cerebral-vascular health (Martinez-Gonzalez, et al., 2009; A Trichopoulou, 2003; Antonia Trichopoulou, Bamia, and Trichopoulos, 2005; Willett, 2006);
- A wide variety of vitamins, minerals and substances with high

levels of antioxidants, such as flavonols, isoflavones, catechins, anthocyanins and proanthocyanins, among others, which are found in vegetables, fruit, fresh legumes and aromatic herbs, which also contribute to reducing the risk of developing neurodegenerative diseases, cardio and cerebral-vascular problems and various types of cancer (Scarmeas et al. 2,009; Sofi, Cesari, Abbate, Gensini and Casini, 2008);

- Wholegrain or less refined cereals, particularly wheat and rice (and to a lesser degree the cereals adapted to less productive farmland, like rye), along with potato and pulses (chickpea, broad bean, peas, lentils, beans), which provide the main source of complex carbohydrates and energy (Qué es la Mediterranean diet?, 2002);
- Consumption of large amounts of vegetable produce instead of animal-based foods, which contributes to an adequate distribution of daily energy balance, where 55% to 60% of daily energy is derived from carbohydrates, 25% to 30% from lipids and 10% to 15% from protein, particularly that of plant origin (pulses and cereals) (Qué es la Mediterranean diet?, 2002);
- Frugal and simple daily meals are also important in maintaining an energy balance by reducing the risk of obesity and other chronic metabolic disorders, such as type 2 diabetes and hypertension (Martínez-González et al., 2008; Panagiotakos, Polystipioti, Papairakleous and Polychronopoulos, 2007; Willett, 2006).

The Mediterranean diet and culinary creativity

In culinary terms, Mediterranean food boasts simple ingredients; however, it is rather complex when it comes to the knowledge that has shaped it.

This is the only way to explain its variety, despite frequent shortages of some of its ingredients. It is very inventive and adapted to poverty and the seasonality of its basic produce. It includes soups, stews and chowders made with vegetables and pulses and modest amounts of meat, while using onion, garlic and herbs to enrich its flavours and aromas. This simplicity contrasts with richer and more elaborate food on feast days (Valagão, 2011).

Diet and the way we relate to food is the result of a long learning process that has protected us and given us cultural identity. Ingredients and the art of combining them, passed down from generation to generation, symbolises the most profound Mediterranean culture. If it were possible to trace the history of our relationship with nature over time; if it were possible to trace the history of our relationship with the climate,

the plant and animal species that have been introduced, water scarcity, orographic lift or soil quality ... the best way to do so would be to look at the art of Mediterranean cooking, in particular, the way it has adapted to what nature has provided, serving the physiological needs of populations while simultaneously allowing the culture of each group or community to flourish. This demonstration of culture, this reflection and vehicle of local identities, evolved slowly until the middle of the last century. It remained relatively stable, far from the industrial upheavals of Northern Europe. It was also the result of a certain political, economic and social isolation of some countries in Southern Europe.

The Mediterranean diet and environmental protection

From an environmental perspective, encouraging the Mediterranean diet is also an interesting opportunity to promote nature conservation. The Mediterranean way of eating involves the frequent use of locally-produced, vegetable-based produce, stimulating food diversification and enhancing local biodiversity, reducing transport time and excessive packaging.

The changing Mediterranean diet

Although the relationship between food and health is emphasised by this way of eating, and clearly observable via epidemiological research undertaken over the past 50 years, this diet both allows and obliges us to look at food from different angles: food as a cultural act and as something decisive in environmental protection. These two points are even more critical to Southern European communities, where climate change and cultural erosion are seriously affecting human systems.

This diet, which remains the foundation of most of our current eating habits, began to change with the increasing economic, social and political openness of Southern European societies during the 1970s. The changes that came with alterations in the socio-demographic factors of society, such as progressive urbanisation, the mass influx of women into the workplace and changes in commerce and food distribution have meant that food supply has changed relatively quickly, despite there being certain traits distinguishing the different countries (in terms of food intake). These identifying traits can be seen in high levels of fish consumption, a preference for vegetable fats, such as olive oil and for certain processed foods such as soup. These are eating habits that differentiate as well as protect these communities, due to the fact that they allow the consumption of protective and regulating substances, often with low caloric value.

We are currently faced with climate change that will affect our access to food at a rate unprecedented in our recent history. In addition to this, and contrary to what has happened until now, these changes will mean that agricultural production structures and methods will have to change. These have always been important for a section of the population with fewer resources and less ability to adapt. What will happen to an increasingly urban population that is divorced from food production? What will happen to a farming population that has to make major changes to the way it produces? What effect will these changes to how we produce and consume have on health?

The Mediterranean diet and the right to healthy food

Recently, the FAO (FAO, 2010) defined a sustainable diet as one that guarantees food for future generations, generating minimal negative impact upon the environment. For this diet to be sustainable, it must be based on foods that are locally-produced, readily available and affordable for all, as well as being safe and nutritionally suitable. The FAO also linked sustainability to the protection of farmers' and other workers' incomes, as well as the protection of consumers' and communities' cultural values.

Sustainable food consumption places nutrition, food production and biodiversity at the core of sustainable development, as well as people's right to a diet that ensures health and well-being. In order to be sustainable, amongst other things, the "Mediterranean diet" should boast low environmental impact, protect and respect biodiversity and ecosystems and optimise natural resource use.

The combination of environmental and social catastrophe on such a widespread scale, in such a short period of time, is practically unprecedented in this region. Its impact on our lifestyle and the way we eat is already visible. The accelerated erosion of a food culture that protected people will, in turn, speed up the onset of illness and disease, leading to a cycle of poverty, malnutrition, disease, disability and reduced productivity, resulting in well-known impacts on the environment and the ability of populations to have a healthy diet that facilitates well-being. The need to introduce measures to safeguard this dietary heritage have become pressing. In the area of food, these measures range from the cataloguing of ancient culinary heritage to the identification of population groups that still practise this way of eating. At a later stage, it also involves safeguarding it via measures in which citizens and the state participate; measures where citizens and the state can assess what they do and make each other accountable.

Bibliography

/ FAO, 2010. *Biodiversity in Sustainable Diets*, Report of a Technical Workshop, Rome, FAO.
/ Martínez-Gonzalez, M. A., Bes-Rastrolo, M., Serra-Majem, L., Lairon, D., Estruch, R., and Trichopoulou, A., 2009. Mediterranean food pattern and the primary prevention of chronic disease: recent developments. *Nutrition Reviews*, 6 (Suppl. 1), S111-S116.
/ Martínez-González, M. A. *et al.*, 2008. Adherence to Mediterranean diet and risk of developing diabetes: prospective cohort study. *BMJ*, 336(7657), 1348-1351.
/ Mennell, S., Murcott, A., van Otterloo, A., 1992. The sociology of food: eating, diet, and culture. A Special Issue of *Current Sociology Series*, 40(2), Sage.
/ Nestle, M., 1995. Mediterranean diets: historical and research overview. Am J Clin Nutr, 61(Suppl), 1313S-1320S.
/ Panagiotakos, D. B., Polystipioti, A., Papairakleous, N., and Polychronopoulos, E., 2007. Long-Term adoption of a Mediterranean diet is associated with better health status in elderly people; a cross-sectional survey in Cyprus. Asia Pac J Clin Nutr, 16(2), 331-337.
/ *Qué es la dieta mediterránea?*, 2002. Barcelona: Fundación Dieta Mediterránea.
/ Reddy, S., Dibb, S. and Lang. T., 2009. *Setting The Table. Advice to Government on Priority Elements of Sustainable Diets*. London: Sustainable Development Commission.
/ Scarmeas, N., Stern, Y., Mayeux, R., Manly, J. J., Schupf, N., and Luchsinger, J. A., 2009. Mediterranean Diet and Mild Cognitive Impairment. *Archives of Neurology*, 66(2), 216-225.
/ Serra-Majem, L. *et al.*, 2004. Does the definition of the Mediterranean diet need to be updated? *Public Health Nutrition*, 7(07), 927-929.
/ Sofi, F., Cesari, F., Abbate, R., Gensini, G. F., and Casini, A., 2008. Adherence to Mediterranean diet and health status: meta-analysis. *BMJ*, 337:a1344.
/ Trichopoulou, A., 2003. Adherence to a Mediterranean Diet and Survival in a Greek Population. *N Eng J Medicine*, 348(26), 2599-2608.
/ Trichopoulou, A., Bamia, C., and Trichopoulos, D., 2005. Mediterranean Diet and Survival Among Patients With Coronary Heart Disease in Greece. *Archives of Internal Medicine*, 165(8), 929-935.
/ Trichopoulou, A., Bamia, C., and Trichopoulos, D., 2009. Anatomy of health effects of Mediterranean diet: Greek EPIC prospective cohort study. *BMJ*, 338.
/ Valagão, M. M., 2011. Dieta Mediterrânica, Património Imaterial da Humanidade. APH magazine, 105 (May-June), 23-27.
/ Willett, W. C., 2006. The Mediterranean diet: science and practice. *Public Health Nutrition*, 9(1A), 105-110.

The Mediterranean diet: from necessity as a virtue to virtue as a necessity

Jesús Contreras

The Mediterranean diet

If Braudel (1949) "discovered" the Mediterranean for historians, then the "dietetic" Mediterranean was discovered in 1959 by Ancel Keys (1980) with his famous *Seven Countries* study, which was undertaken in Italy, Greece, ex-Yugoslavia, Holland, Finland, United States and Japan in the late 1950s. On the one hand, this study established a link between a diet featuring few animal-based products and saturated fats, and on the other, low levels of cholesterol and low mortality rates due to ischaemic heart disease. The same study demonstrated a strong inverse relationship between the intake of monounsaturated fatty acids (the main source of fat from olive oil) and total mortality and specific mortality due to ischaemic heart disease (Serra, 2005). Since then, nutritional research has emphasised the benefits of the Mediterranean diet overall and its constituent ingredients in particular.

Since these beneficial effects on health were discovered, anything related to the food from this geographical area has been made into something to aspire to and a symbol of everything that is healthy and positive. This is a model based on the "discovery" of a hypothetical indigenous food that helps prevent a range of diseases. From the early seventies onwards, it explains the success of the olive oil, grilled meat and fish, herbs, as well

as couscous, gazpacho, paella, brandade, pizza, pasta, mezze, etc. on restaurant menus and supermarket shelves in Northern Europe, the United States and Japan. The Mediterranean diet and cuisine have become increasingly popular models, and the adjective Mediterranean is commonly used for advertising purposes in cafes, on restaurant menus and for food classification (Capatti, 2005).

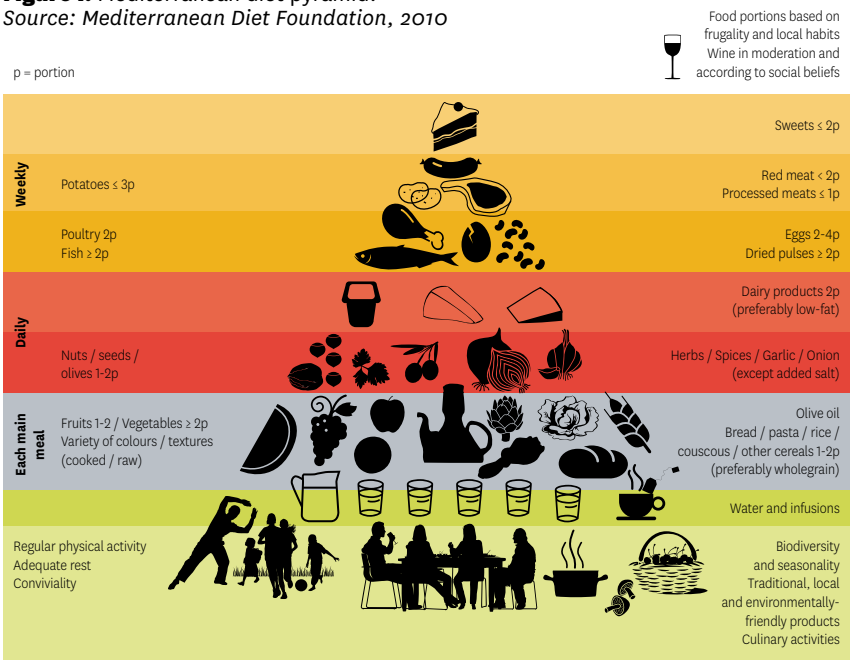
But what is the Mediterranean diet?

According to the Mediterranean Diet Foundation (www.dietamediterranea.com): "The Mediterranean Diet is a lifestyle [...] that modern science recommends us to adopt for the benefit of our health; making the Mediterranean Diet an excellent model for healthy living. The Mediterranean Diet is a valuable piece of cultural heritage that from simplicity and variety has resulted in a complete and balanced combination of food based on fresh, local and seasonal food as much as possible. It embraces all the people of the Mediterranean [...]. It has been passed down from generation to generation for centuries, and has been closely linked to the lifestyle of the Mediterranean people throughout its history [...]. The Mediterranean Diet is characterized by abundant plant-origin foods, such as bread, pasta, rice, vegetables, legumes, fruits and nuts; the use of olive oil as the main source of additional fat, moderate consumption of fish, seafood, poultry, dairy products (yogurt, cheese) and eggs, as well as small amounts of red meat and a daily moderate intake of wine generally at meals." (Author's italics.) **(Figure 1)**

A Mediterranean identity?

To what extent does the historical and ethnographical documentation we have confirm or deny the above statements? The analysis of food historians (Contreras, Riera and Medina, 2005; Montanari, 2005; Pitte, 2005, Riera 1996) indicates that, throughout history, the diets of the different peoples of the Mediterranean region have not only been different from each other, but also there have been major changes throughout the centuries. In fact, Mediterranean identity (also in terms of food) has been mutable and a product of history rather than geography. Culturally speaking, the Mediterranean was never homogenous. Mediterranean "homogeneity" was constructed at different times and by different people. A first "construction" was that of the Roman Empire, which was the main commercial market and driving force that encouraged the meeting of different cultures. The *Mare Nostrum* was the focus of cultural and culinary values: bread, wine and olive oil (the Mediterranean system invented by

Figure 1. Mediterranean diet pyramid.
Source: Mediterranean Diet Foundation, 2010



the Greeks, who passed it on to the Romans) were an essential reference point, an aspect of economic and cultural identity that was inextricably linked to working the land. The last "construction" is perhaps associated with the supposed Mediterranean diet.

Throughout history (Contreras, Riera and Medina, 2005) there has been much borrowing and adaptation. Produce not only circulated from and to Asia, Africa and America but it also became part of the landscape, changing it in the process. Cereals and pulses arrived in *Mare Nostrum* from the Fertile Crescent. The Phoenicians, Greeks and Romans encouraged the substitution of olive groves and wild vines for other crops, which increased productivity substantially. Islamic expansion, from Syria to Andalusia, acclimatised sugar cane, rice, citrus fruit, aubergine and spinach, all plants that originated from the Far East. Later, the Spanish and Portuguese introduced tomatoes, bell peppers, beans, potatoes, maize, sweet potatoes and turkey. The transformation of Mediterranean landscapes was not just due to the incorporation of new cultures. Advances in navigation also allowed certain Mediterranean produce to travel more easily, which saw it become more popular abroad. Wine trading became widespread and many vineyards were planted, particularly in regions

close to ports. Similarly, developments in long-distance navigation increased the need for the vitamin C that only citrus fruit could provide. As such, many citrus groves were planted near ports for this very reason.

The agrarian revolution of the 18th century and the industrial revolution of the 19th century occurred around the North Sea and the North Atlantic, and it was some time before their effects reached Mediterranean countries. England, Germany, the United States and northern France became advanced nations, imposing their culture and food on the world. Little by little, meat, animal fats, beer and quickly prepared food took the place of broths, soups and Mediterranean salads and wine, which were seen as more or less incompatible with the demands of modern life. From the mid-19th century onwards, progress in the field of transport (rail and road) gave rise to remarkable changes in agro-food production and the landscape itself, with increased trade encouraging specialisation. This was the origin of the Mediterranean gardens that specialised in fruit and vegetables and whose success depended mainly on the early seasonal nature of what they produced. From the second half of the 19th century, the first Mediterranean produce reached the major cities of central and northern Europe (Pitte, 2005).

For all of the above reasons, talking about a hypothetical "Mediterranean diet", both in terms of space and time, is truly impossible. History and anthropology talk about diets in the plural, thus establishing that, from the outset, plurality and diversity were key aspects of a hypothetical Mediterranean culinary, food or nutritional identity.

Mediterranean food of the 19th and 20th century: necessity made virtue?

Let us now take a closer look at what was eaten in one of the Mediterranean regions (Spain) between the mid-19th century and the 1960s, in order to see to what extent this coincides with how the Mediterranean diet has been described. Our sources are called medical topographies, and they were written by orthopathic doctors who belonged to a school of thought that developed from the late 18th century and one that can be considered the forerunner of modern epidemiology (Urteaga 1980: 5-6). Medical topographies dedicated quite extensive and detailed chapters to the food habits of the population, especially the lower classes. These topographies are a unique documentary source, providing us with an accurate and detailed picture of what the people in Mediterranean coastal areas ate. The information provided by these sources allows us to get an overview, which demonstrates

that diets clearly differed from one population cluster to another, as well as within each cluster, depending on the social class and/or occupation or trade, and that many of these "diets" were very different to the so-called Mediterranean diet. Here we present, in chronological order, some dietary habits as observed by orthopathic doctors. **(Tables 1, 2, 3)**

From these descriptions of Valencia, it is worth highlighting the huge variety of diets according to people's social class or occupations. Landowners, farmers and industrialists, bankers, craftsman, traders, labourers, sailors, fishermen, shepherds, miners, factory workers, etc. have very different eating habits from one another, some of which are very dissimilar to what is described as the Mediterranean diet.

We also have another description of a medium-sized cluster with an agricultural and manual labouring population in the municipality of San Genís de Vilassar (now Vilassar de Dalt), located north of Barcelona and two kilometres from the Mediterranean sea. **(Table 4)**

Based on testimonies included in these and other medical topographies, the main features of the working class diet in Catalonia in the early 20th century can be summarised as follows (Prats, 1996: 102):

- five basic meals (breakfast, morning snack, lunch, afternoon snack and dinner), sometimes complemented with a *beguda*;
- all main meals include bread and wine;
- stew as the main midday meal, with more or less meat, depending on circumstances;
- scarcity of meat, the predominance of pork and salted fish (cod, herring, etc.);
- dinner essentially vegetarian, based on potatoes, greens and vegetables;
- use of vegetables in salads;
- consumption of wine or brandy on an empty stomach;
- consumption of fruit and dairy products related to the specific character of each region;
- the introduction of "new" products, like coffee and chocolate;
- important class differences, for example, where the poorer strata had a more vegetarian and monotonous diet, while the upper classes enjoyed a more varied diet with more animal protein.

In the opinion of the doctors of the time, this diet was unsatisfactory and the state of workers' health was very poor. Bread and wine were the most common foods. Vegetables were the basis of the diet, and in terms of animal protein, they ate little more than cod (the "meat of the poor"), *escabeche* and bacon. As for labourers, meat consumption was normally limited

Table 1. Diet in Valencia in the late-19th century (Peset, 1878).
"Rich people": wealthy landowners, bankers, major traders, upper class.
Two large meals a day, "French style".

Breakfast:	* Glass of milk or hot chocolate, or a cup of coffee with milk + Toast with lard
Lunch (11h-12h):	* One or more soups * Legume stews * Meats prepared differently (veal, lamb and/or poultry) * Alternating with more delicate fish * Milk and eggs * Various cheeses for dessert + Sugar syrup, nuts and seasonal fruit
Dinner (18h-19h):	Same as lunch but more generous.

Additional notes:
* Dinner tables boast a good variety of snacks and appetisers, especially slices of salami and other sausages, olives and vegetables and fish preserves
* Regional wines and dessert, liqueurs and coffee
In terms of stews, French cuisine or strong seasoning

Table 2. Diet in Valencia in the late-19th century (Peset, 1878)
"Lower class": farmers, rural labourers, workers, artisans, sailors, street vendors

Breakfast:	* Small glass of brandy, sometimes accompanied with pasta or nuts (many look like they are drinking coffee, using a cup sold to them by street vendors) * Women enjoy hot chocolate (1 small half-an-ounce cup) with a white roll
Morning snack (8h):	* Soup + A sardine with a little olive oil and garlic, or poorer quality chorizo (*botifarrón*)
Lunch:	* Valencian rice in a frying pan (*paella*) + Legumes, seasonal vegetables, a little meat or bacon, black pudding, cod or other fish. + Fruit or salad for dessert + Bread and basic wine
Snack:	* Salad or fruit
Dinner:	* Bread soups or potato broth + A little bacon, sardine or cod In the field: snail sauce In the tavern: fried broad beans + Large amounts of wine

Condiments: salt and paprika, chilli

Additional notes:
* *Farmers:* rice, legumes and vegetables ... bolstered with a little meat and bacon. Usually raise a pig every year. Lots of tomatoes and peppers (roasted, raw and in brine), olives and chilli peppers. Some fruit. Generally, bread is made with their own wheat (+ a little millet). Basic wine.
* *Workers from the capital:* Rice soup at midday (which rarely had any meat or fat). More robust supper (outdoors).
* *Sailors:* frequent alcohol consumption (a lot of wine, brandy, rum, among others). Salty food (sardines, cod, dried tuna, tuna roe, among others). Fresh fish and rice (with seafood).
* *Street vendors* (cart pullers, porters, vendors, fishermen, farmers from outside the region, young people of both sexes who flock to Valencia on a daily basis): have a very light breakfast at home.
Lunch usually involves no fixed time or rules: small amounts of cold meat, some bread with fish or eggs, fruit and salads. Very frugal supper.

Table 3. Diet in Valencia in the late-19th century (Peset, 1878).
Middle Class.

Breakfast (very early):	* Hot chocolate with bread or cup of coffee with milk + Biscuits or toast with lard
Morning snack (9h):	* Soup + Roast chops or fried fish + A little wine
Lunch (13h-14h):	* One or more soups + Rice with stew broth ("olla"): meat, bacon, chickpeas, chorizo, black pudding, vegetables. + Meat or fish dish (which many families did not eat) + Desserts of sugar syrup, cheese or fruit + Bread and dry regional wine
Snack: **(children and young people)**	* Hot chocolate with bread and biscuits, jam or cheese or seasonal fruit, with bread.
Dinner (21h):	* Salad + Soup + Fried, roasted or stewed meat, eggs or fish + Light desserts + Bread and wine

Condiments: saffron, paprika, salt and lemon.

Additional notes:
Due to their professions and lifestyles, some sections of the middle class adhere to French-style system (two main meals and a light breakfast).

to animal guts and giblets. Among the most common animal-based foods eaten were salted herring, *badejo*, barbel, boga, ox, eel, goat and thrush. However, people's diet was mainly based on vegetables: chard, jujube or Chinese date, watercress, celery, artichoke, lettuce, garlic, apricots, plums, almonds, blueberries, rice, oats, hazelnuts, azaroles, olives, potatoes, purslane, broccoli, calabash, thistles, chestnuts, onions, rye, cherries, barley, chicory, mushrooms, cabbage, cauliflower, endive, peas, spinach, broad beans, common beans, figs, cactus pear, fennel, oranges, lentils, apples, quinces, pasta, watermelon, melons, corn, strawberries, turnips, loquat fruit, nuts, bread, poppy, parsnips, peaches, pine nuts, horseradish, pomegranates, sorbus, wheat and grapes. For orthopathic doctors, the main health problems were associated with dietary deficiencies, alcoholism, and the adulteration and poor state of certain foods (Larrea, 2005).

Now let us jump to the 20th century and look at some basic food numbers. These figures cannot be considered generally applicable, as one has to take into account when and where they were collected; however, they still represent an interesting reference point and a term of comparison. According to a doctor living in Viella (Anonymous, 1913; in Contreras and Garcia, 2005), the daily quantities of foods eaten during summer agricultural work were as follows:

Table 4. Diet in the late-19th century (Sant Genis de Vilassar – Anonymous, 1880). **"Ploughmen" and "labourers"**

Breakfast (particularly labourers):	* *Barreja* (brandy...)
Morning snack:	In winter: * Bread soups in hot wine (some farmers) + An orange In summer: * Tomatoes and peppers with salt and olive oil + Toast with herring
10h-11h: **Farmers:**	* "A chunk and a swig" + A grilled chop
Lunch (13h- 14h):	* Soup + Stew with mutton, bacon and a little chicken (especially those working in factories)
Snack:	* ?
Dinner (21h):	* Soup + Salad + Cooked vegetables (potatoes, beans, peas) with herring or cod (few families eat meat)

Condiments: saffron, paprika, salt and lemon.

Additional notes:
* Bread is made from wheat flour ("xeixa"). Some farmers mix it with rye or bean flour.
* Chicken: in 1850 chickens were only sold on feast days or to feed the sick; now, in 1880, thirty chickens a day are sold at market.
* Before (?), peasant and wealthy families raised a pig for food ("Hort i porc" was the basic diet: bacon, vegetables and legumes). Nowadays (1880), this custom is becoming less common, perhaps due to the high price of the cereals used to feed pigs.
* Fish is scarce and expensive (despite the sea being close by).
* In 1840, there were no coffee houses (coffee was only consumed by "optional prescription", and factory owners and tradesmen when they went to Barcelona). Today there are four cafes and coffee and tea consumption has become widespread.
* In 1840, only the sick and convalescent drank milk [12 goats supplied S. Genís Vilassar, Vilassar Mar and Premià de Dalt]. In 1880, milk consumption is common (among half the population, especially women, because of its taste, because of gluttony or because it is fashionable. They drink cow's or goat's milk and "without consulting their doctor"). Because there are not enough pastures for the number of goats needed for so many people, the milk is adulterated with water.

Bread 1,000 grams
Potatoes and vegetables 750 grams
Bacon, cod, meat 150 grams
Cheese 150 grams
Coffee 15 grams
Sugar 25 grams
Wine 3 litres
Brandy 0.05 litres

At the same time, the daily diet of the Andalusian rural worker was made up of a large loaf of bread (about 1,400 grams). On a monthly basis, they also consumed three litres of olive oil, four of vinegar, half a kilo of salt and several heads of garlic, the ingredients used to make gaspachos, *açordas*

and stews. Less frequently, they ate olives, oranges, peppers, tomatoes, etc. "The only ones eating hot meals were housekeepers, foremen, train drivers and guards, who prepared a stew at night consisting of chickpeas or fava beans with potatoes or rice, seasoned with olive oil and sometimes with fifty grams of bacon per person" (Argente del Castillo, 1924 : 37) .

Now let us advance to the 1960s and have a look at an ethnographic document on rural workers of the Cordoba plain. According to Martínez Alier (1968), the workers' diet was "traditional", as it appeared in the household budgets that the workers' organisations drew up in support of their claims for wage increases. In these documents, workers claimed that they did not want "luxuries". In terms of food, they mentioned bread, olive oil, chickpeas, beans, "and little else". A family budget drafted in 1919 stipulated the daily need for 600 grams of bread per family member, and the same can be seen in a budget for 1961. Both documents indicate similar amounts of olive oil, chickpeas and beans, and neither mention meat, eggs or milk. Bread was so important that, in certain cases, the value of a day's work was determined in kilos of bread. Olive oil was the product that boasted the lowest price per calorie, hence its popularity (let us not forget that we are talking about the Cordoba plain). The "typical" diet of a labourer (82 grams of protein and just over 4,600 calories) was as follows: bread (700 grams), olive oil (250 grams), tomatoes (500 grams), chickpeas (80 grams), potato (250 grams). This was the common diet in 1964 and 1965, both on the farms and in workers' homes, and consisted of traditional food: *joyos* (bread with olive oil), chickpea stew (sometimes replaced by bean or rice stew), *migas*, gazpacho, *mojadetes*, etc. It was common to buy a bit of salami, cheese or jam to eat with bread – which were calls *ayudas* (help). When they compared their food to that of "señoritos", the workers ironically commented: "We eat the tasty thistles and delicious purslane, and they eat smelly cured ham and disgusting sausage." (Martínez Alier,1968: 93-99.)

Informe Foessa sobre la situación sociológica de España (Fundação Foessa, 1970: 717-718) outlined the following profile of the Spanish diet in the 1960s compared with other European countries:

- *intermediate* cereal consumption between the levels of Central and Southern Europe;
- a *very high level* of potato consumption;
- *low levels* of sugar consumption, although with a tendency to increase;
- *very high consumption* of legumes, although starting to decline and much lower than Portugal;

- consumption of vegetables is *very high* and for fruit *very low*;
- meat consumption is still *intermediate* between the extremes of Portugal and France;
- in contrast, the importance of fish in the Spanish diet is very high, approaching the *exceptional consumption levels* of Sweden and Portugal;
- consumption levels of fat are *very high*, almost at the level of France;
- consumption of eggs has risen sharply in recent years, although it was *very low* in 1965;
- it is worth highlighting the *very low level* of milk consumption, which is much lower than in Greece and only higher than in Portugal.

However, these general descriptions should not overshadow the persistent and major contrasts between the different sectors of the population, according to their capacity to acquire and/or their occupation, and between the "rural" and the "urban" diet. According to the previously-cited *Informe*, living in the city meant a better chance of "a more balanced and modern diet" for all social groups. Thus:

- generally speaking, wealthier groups consume greater quantities of almost all products, or, at least, their consumption of more traditional things, such as legumes and cereals, is not much lower than that of the poor;
- potato is the most common food in modest households;
- the diet most closely associated with higher incomes is that which includes fruit, milk, meat, vegetables and greens;
- generally speaking, we can state that the urban middle class have a typically European diet (with the exception of high levels of fish consumption). The urban working class and the rural classes are those most associated with the *typical Spanish diet* (lots of potato and legumes and little meat and milk). (Author's italics)

Towards a "modern diet"

According to Soler Sanz (1992, 171-172), in the 1960s there was a decline in carbohydrate-rich foods (cereals and potatoes) and significant increases in the consumption of meat, milk and dairy products. Less vegetable protein was consumed and more animal protein was eaten, with an increase in animal fat consumption. Similarly, during this decade, average spending on food declined from 50% of salary to around 26%.

Throughout the 1970s, food consumption in Spain changed much more than between 1961 and 1971. According to the Foessa Foundation (1976), this change is "very favourable" as a result of:

- a considerable decrease in the consumption of baked cereals. The decrease is 34.6 kg per inhabitant per year (32.9%);
- a slight decline in the consumption of potatoes and legumes;
- stabilisation of vegetable, fruit and citrus fruit consumption;
- consumption of rice and fish is equally stable;
- alongside a slight increase in vegetable oil consumption, there is a major decline in animal fat use;
- a sharp rise in sugar consumption, which has increased by 10.3kg per capita per year (57.9%);
- a sharp rise in meat, eggs, milk and dairy product consumption. Meat consumption has increased from 19.9kg per capita per year to 45.1kg (an increase of 126.6%). In the case of milk and eggs, the increase is 63.2% and 38.6%, respectively;
- compared to other more developed European countries, bread consumption is higher and meat, milk and butter consumption lower.

The findings of *Informe* in 1975 merit some comment. We find the use of expressions like *typically European diet* (associated with greater consumption of meat, milk, vegetable and greens, and attributed to urban middle classes) and *typically Spanish diet* (made up of cereals, potatoes and legumes), which were the preserve of the "urban working class" and "the rural classes", rather odd. The use of these general terms does not help us understand the differences in Spanish diets and behaviour, or the reasons underlying them. Similarly, our italics and the qualification of "very favourable" for a dietary change distinguished by less consumption of legumes, bread, potatoes, etc., and an increase in the consumption of meat, eggs, sugar and milk, for example, are very significant and illustrative of the scientific and social ideology implicit in the various conclusions about the different types of consumption. In fact, stating that legumes were "low in nutritional value" or considering this produce to be "inferior", demonstrates a slanted view of diet, which is even clearer when compared to contemporary views on the same food. In truth, many of the reports on food written in the 1960s and 1970s are distinguished by prejudices originating from particular ideas of "progress" and "modernisation". We can see this in the following passage: "Progress in the diet of a nation implies [...] *increasing the proportion of food of animal origin in diets* [...]. In terms of the socio-economic development of countries, the first achievement in terms of food is consuming sufficient calories; later, increasing the consumption of animal protein" (Foessa Foundation, 1976). (Author's italics)

The Mediterranean diet: a modern idea or traditional practice?

The sample that we have given covers over a century and is limited to Spain; however, it is important as evidence of the great diversity of diets, as well as the significant changes over time. Given these differences and changes, it is difficult to continue to support the descriptions of the Mediterranean diet previously mentioned, and particularly statements regarding a *cultural heritage* [...] *handed down from generation to generation for centuries and which includes all the peoples of the Mediterranean basin.* Although we have only referred to Spain, we have spoken of diets in the plural, highlighting the fact that plurality and diversity are features of a hypothetical Mediterranean identity, in terms of cooking, food and nutrition. Nevertheless, the fashionable concept of the Mediterranean diet, in the singular, has been presented via a generalizing, uniform, abstract and utopian description (despite the reference to the Mediterranean and the even more localized island of Crete) and expressed graphically via a pyramid. As previously stated by Aubaile-Sallenave (2005), nutritionists present a "disembodied" Mediterranean diet that does not consider local contexts or inhabitants' energy expenditure, nor the beliefs and cultures that determine their diet, their economies and social relations or the variety of their diets...For their part, *Mediterranean diets*, in the plural, show that they are impossible to identify and describe, unless based on the diversity and range of ingredients, preparations and combinations amongst them, resulting from an accumulation over time rather than a selection determined by more or less specific health goals.

As such, the so-called "Mediterranean diet" is more an "idea" than an empirically contrasted "tradition". In fact, what Mediterranean are we talking about if, geographically, historically and anthropologically speaking, it is the plural that arises: a diversity of biotopes, various religious influences, profound and diverse changes to the different existing food models, huge variability from the bottom to the top of the social pyramid within a society, etc.? One of the most "emblematic" products of the Mediterranean diet, olive oil, is an excellent example of Mediterranean diversity and the inadequate generalisation that this concept implies. It is true that, as Braudel stated (Braudel, 1949), olive trees demarcate the boundaries of the Mediterranean ecosystem. It is also undeniable that olive oil consumption has evolved since ancient times and the classical world disseminated many of its uses, which were extended to almost the entire Mediterranean during Roman rule. What we are not so sure of (González Turmo, 2005; Pitte, 2005) is whether olive oil was the most consumed type of fat. In the kitchen, olive

oil was used in preserving, seasoning, stewing and frying methods that distinguished a culinary tradition that has endured until now. However, although olive trees and their fruit are very old, becoming widespread from an early stage, during many eras and regions in the Mediterranean, olive oil was little used. Its role was to accompany cereals, binding greens, vegetables and meats; an essential role, if we consider the extent to which fats determine the character of cuisine – however, they could be replaced, and at worst, resisted. In terms of the different uses of olive oil, the increased number of fasting days among Catholics to one hundred and eighty, after the Council of Trent, implied the division of the calendar into lean days, when only olive oil was permitted, and fat days, when lard and bacon could be consumed (González Turmo, 1995: 190-6). The situation was complex: in the northern Mediterranean, foods were stewed with butter, lard or olive oil, according to the ecclesiastical precepts and the produce that the land and markets had to offer in each place and time. In the Islamic world, people alternated between different types of fat, and the practice continues until today on the east coast of the Mediterranean, like in Lebanon, for example, where peasants cook with both olive oil and clarified butter.

Need made virtue

In any case, if the Mediterranean diet was a "tradition", according to Poulain (2005), then it would be a timeless "tradition", created in response to modern junk food. And why does the Mediterranean diet choose fast food as its opposite? Because we are dealing with the construction, on the part of nutritional science, of a food model that idealises certain moral qualities, such as frugality, while mystifying other aspects, like tradition.

"[The Mediterranean diet] is the food that we have always eaten in our country and is one of our great cultural assets. It consists of a varied and balanced diet characterised by high consumption levels of fruit, fresh vegetables, cereals, legumes, fish, vegetable oils (especially olive oil), moderate consumption of meat and dairy products, eggs and sweets, and relatively little use of solid fats, such as butter and margarine. A feature of this diet is also moderate consumption of wine with meals." (Departament de Salut de la Generalitat de Catalunya, 2005)

And why is there interest in the abovementioned construction? According to Fischler (1990), until the 1950s and even the 1960s, good food for the working classes was "nutritious"; in other words, healthy. However, most importantly of all, it had to be abundant and substantial. Nowadays, societies of abundance are concerned with the need to manage and regulate their

diets. This sense of urgency is sporadic: people alternate between a passion for cooking and worrying about diets and overall health. Our society seems to be satiated, or at least has achieved overabundance, judging by the fact that the annual quantity of food consumed per person reached its zenith in Spain in the mid-80s – a little over 800 kilos of food a person per year. In industrialised countries, now that quantitative needs are satisfied, to the point where some people are actually overfed, diet is guided mostly by the desire for variety and diversity. In addition to this, modern-day society is increasingly characterised by shows of individualism, autonomy and anomie, and less and less by the outside rules that have always influenced man's relationship with food. Currently, the challenge is no longer in sharing resources. Now the problem is regulating individual appetite in relation to almost unlimited food, and the crucial issue of "knowing what to eat" and "in what proportion". Nowadays, the issue of quantity is presented mostly in terms of "restriction", which, according to surveys, demonstrates that between a quarter and a fifth of the population are on some kind of restrictive diet. How do we explain this major change in attitudes to food? The production and distribution of foodstuffs have also undergone major change, becoming industrialised and mass-produced. Modern abundance and the industrial processing of the majority of food brings with it a new freedom and, at the same time, a new lack of confidence regarding the industrial modification of foodstuffs. Pre-cooked food, ready to be heated in a microwave oven, entered the same door through which women left the house on their way to work. A large number of foods became objects with no known history, true "UEOs" (Unidentified Edible Objects), and they do not have the references necessary to help us choose what we eat. There are a host of products with low levels of salt, calories, sugar, caffeine, fat and food "enriched" with omega-3, calcium, vitamins... products that are "light", "free", "un", "with", etc.

The globalisation of the Mediterranean diet

The Mediterranean diet has gained acceptance throughout the world. Its virtues are based on food that is rich in fibre, vitamins, minerals and mono-unsaturated fatty acids – in other words, "lots of vegetables and fruit, little meat, fish and olive oil", as communicated by the mass media to the public at large. As such, given the dietary advantages it brings and deep-rooted health concerns in Northern countries, the South "discovered" that it is possible "to export the Mediterranean diet": one can "sell health" via the export of agricultural products from Mediterranean countries **(Table 5)**.

Table 5. Probability correlations between diet and health/illness and recommendations for consumption according to "scientific studies"

* "The Spanish National Research Council recommends drinking up to a litre of beer a week for health reasons."
* "People who drink between 1-6 glasses of wine a week reduce the risk of stroke by 34%."
* "Eating one egg a day does not constitute a greater risk for your heart."
* "Eating five pieces of fruit and vegetables a day reduces the chances of a stroke by 31%."
* "The daily consumption of yogurt delays the appearance of certain tumours."

Table 6. Beneficial properties of certain foods according to the media

Product	Substance	Benefits
Olive oil	Antioxidants (vitamin E) Polyphenols	Prevents cancer Prevents heart attacks Reduces aging Prevents diabetes Reduces cholesterol
Yogurt	Bifidus LCI etc.	Improves the immune system Improves the digestive system Protects against colon cancer Reduces cholesterol and triglycerides
Wine	Flavonoids Tannins	Prevents some types of cancer Protects against strokes Reduces vision loss
Beer	Ethyl alcohol Vitamins Phosphorus, calcium Folic acid Polyphenols Soluble fibre	Combats bad cholesterol Prevents birth defects Slows cell aging Prevents colon cancer

As the Mediterranean diet was presented as a healthy model, this led to an analysis of its individual ingredients (olive oil, fruit, vegetables, nuts, wine, etc.) in order to establish potential health benefits **(Table 6)**.

The *nutritional breakdown* of the Mediterranean diet (we no longer talk so much about "food" but rather "components" of foods) means that surrogates can take the place of Mediterranean products (e.g., rapeseed oil margarine has a level of linoleic acid similar to that of olive oil). In fact, in terms of traditional ingredients or even their habitat, they no longer exist and have been replaced. People no longer need to live in Crete to have a diet as healthy as a Cretan. All you have to do is follow the recommendations of books that have information about their ancient heritage. The development of "assembly" cooking, which uses pre-prepared food, using ingredients from distant lands, combining recipes from different parts of the world, all this shows that the Mediterranean can move and be reconstructed anywhere else. Gastronomically-speaking, fusion cooking also

responds to the desire to move dishes from their original place and repeat recipes and dishes, substituting landscapes and ingredients. This is how a globalised diet and cuisine evolve; where recipes expand and change without losing their geographical reference or health benefits. This is how the Mediterranean represents a concept rather than a reality, and one that can be duplicated and reproduced anywhere in the world.

Bibliography

/ Argente Del Castillo, B., 1924. *La reforma agraria*. Madrid: Real Academia de Ciencias Morales y Políticas.
/ Aubaile-Sallenave, F., 2005. Dialética entre unidad y diversidad del sistema agroalimentario de los países mediterráneos, in Contreras, J., Medina, X. and Riera, A. (eds.), *Los sabores del Mediterráneo*. Barcelona : Institut Europeu de la Mediterrània, 24-40.
/ Braudel, F., 1949. *La Méditerranée et le monde méditerranéen à l'époque de Philippe II*. Paris: Armand Colin.
/ Capatti, A., 2005. Identidad culinaria y transposición de modelos alimentarios en el área mediterránea, in Contreras, J., Medina, X. and Riera, A. (eds.), *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània, 174-181.
/ Contreras, J. & Gracia, M., 2005. *Alimentación y cultura. Perspetivas antropológicas*. Barcelona: Ariel.
/ Contreras, J., Medina, X. and Riera, A. (eds.), 2005. *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània.
/ Departament de Salut de la Generalitat De Catalunya, 2005. *Guía de salut per a joves*. Barcelona.
/ Fischler, C., 1990, *L'Homnivore: le goût, la cuisine et le corps*. Paris, Odile Jacob.
/ Gonzalez-Turmo, I., 1995. *Comida de rico, comida de pobre. Los hábitos alimenticios en el Occidente andaluz (siglo XX)*. Sevilha: Universidad de Sevilla.
/ Gonzalez-Turmo, I., 2005. Algunas notas para el análisis de las cocinas mediterrâneas, in Contreras, J., Medina, X. & Riera, A. (eds.), *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània, 44-64.
/ Fundacion Foessa, 1970. *Informe sociológico sobre la situación social de España 1970*. Madrid: Editorial Euramérica.
/ Fundacion Foessa, 1976. *Estudios sociológicos sobre la situación social de España 1975*. Madrid: Editorial Euramérica.
/ Keys, A., 1980. *Seven Countries. A multivariate analysis of death and coronary heart disease*. Cambridge: MA, Harvard University Press.
/ Larrea, C, 2005. Higienismo y alimentación en la Cataluña del siglo XIX, in Contreras, J., Medina, X. and Riera, A. (eds.), *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània, 188-196.
/ Martínez Alier, J., 1968. *La estabilidad del latifundio*. Paris, Ruedo Ibérico.
/ Montanari, M., 2005. Continuidad y ruturas, incorporaciones, diversificaciones en la época medieval y la era moderna, in Contreras, J., Medina, X. and Riera, A. (eds.), *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània, 122-130.
/ Peset Peset y Vidal, J. B., 1878. *Topografía médica de Valencia y su zona, o apuntes para una medicina práctica valenciana*.
/ Pitte, R., 2005. Las transformaciones de la agricultura, del paisaje y de la alimentación del Mediterráneo: del Renacimiento a la actualidad, in Contreras, J., Medina, X. and Riera, A. (eds.), *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània, 182-187.
/ Poulain, J. P., 2005. Del "régimen mediterráneo" a los modelos alimentarios mediterráneos: herencia plural para hacer un label para el futuro, in Contreras, J., Medina, X. and Riera, A. (eds.), *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània, 198-220.
/ Prats, L., 1996. *La Catalunya rància: les condicions de vida material en la Catalunya de la Restauració segons les topografies mèdiques*. Barcelona: Altafulla.
/ Riera, A., 1996. Jerarquía social y desigualdad alimentaria en el Mediterráneo Occidental en la Baja Edad Media, in *Ata Histórica et Archeologica Medievalia*, 16-17. Barcelona.
/ Soler Sanz, M. M., 1992. Evolución del consumo de alimentos, in *Alimentación, Equipos y Tecnología*. May, 171-178.
/ Serra, L., 2005. La investigació epidemiològica en la Dieta Mediterrània: Avances y retrocesos, in Contreras, J., Medina, X. and RIERA, A. (eds.), *Los sabores del Mediterráneo*. Barcelona: Institut Europeu de la Mediterrània, 232-245.
/ Urteaga, L., 1980. *El higienismo en España durante el siglo XIX y el paradigma de las topografías médicas*. Barcelona: Universitat de Barcelona, (Degree Dissertation).

Nutrition as public policy: still the guarantee or already the restriction of one's rights? [1]

Luísa Neto

Fundamental rights as a form of capability and achievement of equity

The issue that we intend to focus upon may seem paradoxical, or at least provocative; however, it aims to answer this basic question: what are the limits of the State's public policy *quantum* in what concerns diet and/or nutrition?

In order to alleviate any perplexity caused by a jurist speaking about such issues as diets, I would like to propose that we use the Nobel economics laureate Amartya Sen's idea of freedom as one of the elements of justice.[2] For Sen, freedom should be viewed as opportunity and the process of choice, and is related to capability – enhanced by equity.[3]

Another author, Martha Nussbaum,[4] a disciple of this "*capability approach*" of Amartya Sen, identifies primary goods (among others, and for what concerns us here), such as life (including *being able to live to the end of a human life of normal length or not dying prematurely*), bodily health, bodily integrity and practical reason (*id est*, the critical reflection upon an autonomous understanding of good and planning one's own life).

1 Text of lecture given on 13th December, 2012, at the *Calouste Gulbenkian Foundation*, at the final session of the series *Food, Culture and Ethics*.

2 *A ideia de justiça* (The Idea of Justice), Sen, A., 2010. Coimbra: Almedina.

3 Sen (2010), pg. 346 and also pg. 386, 396, 397, 398 and 401.

4 See Nussbaum (2006) and Nussbaum (2007).

In proposing access to real opportunities, Sen and Nussbaum go further than the list of primary goods that John Rawls had proposed,[5] [6] to identify that "the prevention and alleviation of disabilities are fairly central to the promotion of justice".[7]

In the sense proposed by Sen and developed by Nussbaum, the above mentioned "capabilities" should become fundamental rights that the State instigates and implements rather than banal minimum guarantees.[8] One of the consequences of this view is the elimination of the distinction between positive and negative freedom or between the rights of the first and second generation, characteristics of the Liberal State and Social State (that in operational terms, we can identify with the Welfare State, respectively or the ethical State). As such, poverty, for example, can be seen both as capability deprivation but also as the deprivation of freedom (freedom from hunger).

However, it is important to clarify that, within a context of Rawlsian political liberalism (which we could group together with the finding of authors, such as Dworkin, Nagel, Scanlon or James Buchanan for public choice theory), one needs to reject the assimilation between encouraging perfectionism and accepting paternalism.[9] This is where we aim to focus.

The right to food, in particular [10]

Let us consider discussions regarding restrictions on advertising aimed at children or the need to find self-regulating mechanisms that consolidate and clarify the nutritional information created for consumers, or the discussion of legislative proposals (considered by many as fundamentalist) on the amount of salt in bread,[11] or in the measures of the Directorate-General for Health regarding food in school canteens.

As such, and simply for the purposes of example, it demonstrates the existence of a main thread that we wish to underline as a unifying object of analysis. However, the modern definition of public policy cannot ignore the context of how public expenditure is divided and the assessment of

5 Sen (2010), pg. 323.
6 Sen (2010), pg. 325.
7 Sen (2010), pg. 353.
8 Nussbaum (2007), pg. 24.
9 Deneulin (2002), pg. 6 and 7.
10 From this point on, the text adheres, passim, to previously published work by the author, where the issues are examined in greater depth: Neto, L., 2010. *A nutrição como política pública: ainda a garantia ou já a restrição de direitos?*.
11 Stipulated in Law no. 75/2009, 12th August.

constitutional norms that promise social goods[12]. Indeed, choosing the extent of intervention may be merely welfare rooted in the social determinants of hunger/malnutrition (which we would identify with a food policy *stricto sensu*) or could have a more obvious desideratum, from a *nutritional*[13] perspective, as an element of health policy.

In other words, we can (gradually) talk about merely facilitating access to food, of a plus regarding food safety guarantees, of another plus safeguarding healthy dietary alternatives and/or, finally, of a dubious imposition of dietary habits – whether it is justified in terms of protecting individuals, or justified from a solely economic point of view[14].

International constraints

The discussion of the simple advantage and/or desirability of a public policy in this area, however, gives way to the analysis of the constraints and decisions of basic international bodies (multilateral or bilateral, general/universal or sectorial[15]) that oblige States (e.g. the Portuguese State) in accordance with Articles 8 and 16 of our Constitution.

In Articles 55 and 56, the Charter of the United Nations stipulates a joint guarantee of "higher standards of living and solutions of international economic, social, health problems (...)".

More specifically, the provisions regarding food derive from Article 25 of the Universal Declaration of Human Rights (hereinafter UDHR), adopted in 1948: "Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services (...)".

In 1966, this provision was fulfilled and implemented by Article 11 of the International Covenant on Economic, Social and Cultural Rights (hereinafter ICESCR), which determined that States should:

"a) Improve methods of production, conservation and distribution of food by making full use of technical and scientific knowledge, by

12 In this sense, and in terms *pari passu* see Alexandrino, J. M. (2010).

13 Within this context, it is worth reading the objectives and practices of the Brazilian official nutrition policy, the National Programme for Food and Nutrition – PRONAN, during the 1973-79 period, or the Zero Hunger Programme (Programa *Fome Zero*) – public policy and citizenship.

14 Indeed, if it is considered that a healthy and balanced diet is a contributing factor to improvements in health, then preventing mistakes in terms of diet can be viewed as a way of avoiding public expenditure.

15 As a simple example of the sectorial aspect that certain issues merit, it is worth looking at the profusion of World Health Assembly Resolutions (WHA) since the 1980s about breastfeeding and the respective promotion and/nutrition of infants and small children – WHA 27.43, 31.47, 33.32, 34.22, 35.26, 37.30, 39.28, 41.11, 43.3, 45.34, 47.5, 49.15, 53.7. 54.2, 54.7, 55.14, 55.15, 55.25, 58.15, 58.32, 59.13, 59.21, available at www.who.int/nutrition. Other examples of sectorial concerns are, for example, regarding nutrition and HIV/AIDS – e.g. WHA Resolution 59.7, 59.11.

disseminating knowledge of the principles of nutrition and by developing or reforming agrarian systems in such a way as to achieve the most efficient development and utilization of natural resources;

b) Take into account the problems of both food-importing and food-exporting countries, to ensure an equitable distribution of world food supplies in relation to need".[16]

It should be clarified, however, that these merely declaratory proclamations do not effectively bind States to achieving such goals: this can be considered an altogether *capitis diminutio* of international law[17]. As such, one cannot say that these sources indicate clearly specified guidelines of a fundamental right to food (adequate)[18] as a subjective legal position.

However, since 1966, there has been some attempt to clarify the minimum content of the abovementioned right.[19]

Indeed, the adoption of the 1978 Declaration of Alma-Ata, the 1986 Ottawa Charter for Health Promotion or the conclusions of the 1988 Adelaide Conference[20] indelibly linked public policies to the creation of a favourable environment that allows people to live healthy lives.[21]

The attempt to oblige States to implement the standards of the protection of enforceability of economic, social and cultural rights (hereinafter ESCR) would become clear in the Kyoto Protocol, signed in 1988 by Latin American states (*et pour cause*, given the respective shortcomings), which warns of the urgent need to consider ESCR as an indivisible part of human rights, and "part of the basic values of a true democracy." The Kyoto Protocol, which does not impose standard formulas but rather requires the State to provide the means so the minimum needs of the population are met and incremental improvements in living standards of citizens are defined, determines the specification of obligations to be

---

16 It is worth remembering that the same document expressly recognizes (in Part I, Article 2) the indelible impression of ESCR: the so-called clause or proviso of the possible, which we will re-examine *infra*, limiting States' obligations "progressively, by all appropriate means" and "to the maximum of its available resources". However, and as highlighted by the UN Committee for ESCR in its 1999 Comment on this Article 11, in the cases in which the State claims to have insufficient resources as a justification for not being able to guarantee access to food, it will have to demonstrate that "every effort was made to (...) satisfy, in terms of priority, this tiny part of its obligations (...) and that it attempted, unsuccessfully, to obtain international help to ensure the availability and accessibility to the necessary food."

17 We will not address here the delimitation between the concepts of human rights (or the rights of humankind) and fundamental rights.

18 There are other expressions: "right to a correct diet" and/or "fundamental right to not go hungry".

19 See Valente *et al.* (2007)

20 In the sense of a commitment to global public health, the Adelaide Conference defined access to nutritious food and drinking water, amongst other things, as pre-requisites for health and social developments.

21 This globalised perspective of the "environment" and "life quality" also derives from the title and wording of Article 66 of the Portuguese Constitution.

respected, protected and satisfied,[22] to be guaranteed in procedural terms via non-discrimination,[23] the suitability of ordinary legislation, production of public information, promotion of legal measures, and the assumption of progressiveness and prohibition of regression or unreasonable delay in the adoption of measures.

In 1999, the comment by the United Nations Committee on Economic, Social and Cultural Rights (CESCR) stated that "the right to adequate food is indivisibly linked to the inherent dignity of a human being" and also "inseparable from social justice, requiring the adoption of appropriate economic, environmental and social policies, at both the national and international levels, oriented to the eradication of poverty and the fulfilment of all human rights for all." However, the Committee, with respect to Article 11 of the ICESCR, elaborated upon what is meant by "adequate food":

a) The availability of food in a quantity and quality sufficient to satisfy the dietary needs of individuals, free from adverse substances, and acceptable within a given culture;

b) The accessibility of such food (economic, financial and physical, particularly for vulnerable groups).

Finally, nutrition as an aspect of public health was included at the United Nations Millennium Summit in 2000, and, in 2002, the UN Special Rapporteur on the Right to Food redefined the human right to adequate food as the ability to "have regular, permanent and unrestricted access, either directly or by means of financial purchases, to quantitatively and qualitatively adequate and sufficient food corresponding to the cultural traditions of the people to which the consumer belongs, and which ensure a physical and mental, individual and collective".[24]

As such, it becomes clear that this right does not focus solely on the aspect of combating hunger, but covers a broader set of issues.[25]

European constraints

At the regional and European Union level, and until 1996, no efforts seem to have been made to implement a Common Food Policy. Indeed, the issue would arise again as a result of the harmonisation of food quality and

22 This three-way division was later re-employed and made systematic by the UN's Committee on ESCR in the 1999 Comment on Article 11 of the previously-mentioned ICCPR. Originally, in "*Right to adequate food as a human right*, Study Series No.1, 1989, United Nations Publication, Sales No.E.89.XIV, these three levels of obligation were proposed in the following way: *respect*, *protect and assist/fulfill*.

23 In terms that can justify *affirmative actions*.

24 Ziegler (2002)

25 Currently, it is actually interesting to foresee the future developments that lead to a new and distinct degree of protection in the area of nutrition as intangible heritage, for the purposes of the UNESCO Convention, 2003.

safety monitoring and inspection policies[26] due to the advent of the Single European Market in 1993 and food crises that began with BSE in 1996.[27] If some of the planned measures are directly connected to how the internal market works (such as labelling requirements, authorisation regarding health claims and food controls procedures), others are part of more specific frameworks, such as the CAP (via the common organisation of the market in the fruit and vegetables sector), Commission initiatives in the areas of education, regional policy (structural funds) and, last but not least, the policy on audio-visual and media matters.

In this sense, what is fundamentally advocated is that the three aspects of consumer rights (information, security and loyalty) are respected, but not without making it clear that the objectives of State intervention should be to demonstrate health risks and to make the healthy option available. However, it should be noted that the positions of the 2007 White Paper highlight (even regarding what we will see below on the possible restrictions of citizens' rights) that making such an option available does not mean enforcing it, which entails complex checks and balances.

The state of the art in Portugal

Although the sources already analysed supposedly entail obligations for the Portuguese State, at the constitutional level we do not find any direct reference to the issue of food and/or nutrition, although one can consider its application to the principle of the dignity of the human being (Article 1)[28] and even the provisions of Articles 64 (right to health) and 66 (environment and quality of life), which is always the State's responsibility, in terms of real equality – as stipulated in paragraph d) of Article 9 of the Portuguese Constitution. From another sectorial perspective, there is also the reference to consumer rights (Article 60, and alluded to in other legal provisions), which arise in the abovementioned rights to information, loyalty and security.[29]

26 It is important to make clear that even when we talk about food safety, the idea has nothing to do with what was meant by food safety in the 1970s. Nowadays, the issue has shifted to new debates, since the advent of other fears about food or health crises, such as genetically-modified organisms or banned food additives.

27 See Helsing (1997) for a thorough analysis.

28 In specific reference to the right to health, Article 12 of the ICESCR (International Covenant on Economic, Social and Cultural Rights) recognises everybody's right to the highest level of physical and mental health, with number 1 of General Recommendation 14 of 2000 of the Committee on ESCR establishing the link between health and dignity: "Every human being should have the right to enjoy the highest level of health that leads to a dignified life". Furthermore, the Committee states that the right to health involves aspects such as availability, accessibility, tolerance and quality.

29 Not forgetting to highlight the creation of the Autoridade de Segurança Alimentar e Económica (Food and Economic Safety Authority), it is worth recalling that ordinary legislative intervention for the integration of international instruments (essentially of European origin) within the Portuguese legal system has been multiple and with global ambitions in relation to these three aspects.

In addition to this, and in the sense that, in relation to the limitations of the State's power to intervene, the opposite outcome may be true, it is worth remembering that, alongside the right to be let alone that always defines a sphere of self-determination (free from outside interference),[30] the Portuguese Constitution has guaranteed the right to free development of personality since 1997. These rights, both stipulated in Article 26 as a corollary of the right to freedom, may well impose limits on the State determination of diets.[31]

The limits on diet imposition

Whether directly found in a constitutional provision or in a source of legitimacy in international mechanisms, it is clear that the rights underlying food and/or nutrition policies – a right to adequate/proper food or a subjective legal position generically covered by the right to health, the right to quality of life or, even more generically, the principle of human dignity (and specific rights to dignity and equality arising from them) – are always qualified as ESCR (and, therefore, enshrined in section III of Part I of the Portuguese Constitution).[32]

Currently, traditional doctrine dictates a specific regime for these ESCR,[33] highlighting a quantitative perspective that focuses on the State's degree of achievement; therefore, it is necessary to mention the "condition of the (financial) possibilities" – with the obvious overlap of the "cost of rights", dealt with superbly by Holmes and Sunstein –, which finds its other extreme in the principle of the prohibition of regression.[34]

However, and as the Committee on ESCR emphasised in its General Recommendation no. 3[35] regarding the nature of state obligations, there is a minimum core obligation concerning the ESCR to be implemented by the States, to the extent which they must ensure the essential core of these rights (...) particularly for the most disadvantaged and vulnerable segments of the population.

30 The "right to be let alone", as described by Louis Brandeis in 1890.

31 And although not everyone agrees with a basic right to decide about one's own body – for all of these aspects, see Neto, L., 2004. *O direito fundamental à disposição sobre o próprio corpo*.

32 For the benefit of clarity and more direct expression, we focus neither on extreme situations of the possible violation of the right to life due to a lack of access to food nor physical well-being stipulated in Article 25 of the Portuguese Constitution, because it is strictly understood that, and regardless of any competitive situation, it must adhere to the provisions of Article 64. In this area, for precisely the same reasons, the preferred term is 'personal injury' or damage to health (or *danno alla salute*, incorrectly termed biological damage). As guardian of the whole person (and not solely their right to health or physical well-being) it is also worth mentioning the concepts "personal harm", of *danno alla vita di relazione* or existential harm – see Frada (2008).

33 As this is not the time for such explanation, we will leave the (increasingly more accepted) consideration of a unifying dogma of fundamental rights aside.

34 For more on this matter, see Queiroz (2006) and Novais (2010).

35 Committee on ESCR, General Comment n.3, UN doc. E/1991/23, 1990.

The theoretical debate regarding the minimum content of ESCR, as well as the intangible essence of each right and respective enforcement mechanisms, is thus not divorced from the idea of activism in the definition of a general public policy and/or sectorial policies.

However, beyond the basic limit resulting from the "condition of (financial) possibilities", there are other factors that must be taken into account (axiologically speaking) when we are faced with the objective of moving from a public policy on access to food/food security (formal) to a public policy of nutrition and combating obesity (material) .

Indeed, when discussing the boundaries of this public policy, we obviously do not question the levels we have already identified as basic – non-discriminatory access or the regulation of aspects strictly linked to health and/or safety that essentially overlap with consumer rights (information, security and loyalty) protected by Article 60 of the Portuguese Constitution. In fact, this right to information clearly covers the provision of data and information about healthy and alternative dietary options. In relation to these aspects, which are not only legitimate but also enforced within a democratic state, it is the responsibility of political power to create mechanisms – some emergency, others permanent – that ensure access to food as a basic inalienable right of every human being.

However, the State cannot overstep an extremely important threshold in the field of legal social sciences: where the law aims at voluntary and lawful acts that are legally pertinent, the State must allow the exercise of the power of self-determination in human and behavioural decisions.[36]

Furthermore, under the terms provided for in the Portuguese Constitution, the State can only restrict rights – which we have tentatively identified as the rights to the free development of personality (and/or the basic right to decide about our own body)[37] – if (abiding by a triple dimension of the principle of proportionality) such a restriction is necessary to safeguard other constitutionally protected rights or interests, if the same restriction is appropriate to the creation of such a case-by-case assessment and if, in addition to this, it is not excessive nor affects the essential core of rights.[38]

---

36 For the sake of simplicity we also do not focus on the issue of eating disorders, such as anorexia and/or bulimia, on the basis that they are illnesses and not (only) the result of people's expression of will.

37 These are stipulated in the Portuguese Constitution as rights, freedoms and guarantees and enjoy a specific protection regime. Furthermore, there is the aspect of the right to religious freedom and worship and conscientious objection laid out in Article 41 of the Portuguese Constitution, in the cases where a particular dietary choice is dictated by a religious or ethical belief – *e.g.* in the case of the option of vegetarian diets.

38 For the sake of simplicity, we consider the determination of a diet as a form of restriction and not just conditioning or conformity, although the basic precepts are essentially the same.

Some people will surely say that any imposition by the State of particular diets would be legitimised by practical agreement that would justify the restriction of the individual's freedom to safeguard another right or interest – health, *brevitatis causae*. However, remember John Stuart Mill, the 19th-century philosopher who posited that the value of autonomy neither derives from, nor is even compatible with, an external and paternalistic view of preferences, implying a conscious decision. There are indeed limits to the imposition of lifestyles, as, in the field of human relations, it is each individual's responsibility to trace a path in which they recognize themselves.

In fact, physical well-being can be used as a means of pressuring a particular body, such as the State authorities, by creating public opinion from sympathy and solidarity, or from simple interest – typically in the case of hunger strikes.[39]

A different and controversial issue is knowing whether a person's right to decide about their own body means they can demand that others take risks or are accountable for such causes. Here, this would relate to whether, as a result of that choice (consciously taken based on the information that the state is obliged to provide and having consciously refused other dietary alternatives[40]), the individual may be held responsible or not merit the same treatment by the health authorities.

In other words, will there still be responsibility when the individual is the person that causes the damage[41], almost generating informed consent? It would therefore constitute self-endangerment[42], where the victim himself consciously contributes to the result through his own conduct, thus distinguishing it from endangering others. Some will say that this self-endangerment is never acceptable because unavailable goods in relation to consent/self-restraint/abstinence are at stake. Others, who are more

39 An obvious example, although this is not the place for an in-depth analysis, is the case of hunger strikes and eventual force-feeding by prison authorities.

40 Within this context, it is worth stressing the overriding importance of the responsibility of education/training for healthy lifestyles in line with the guidelines from the WHO, Educação Alimentar em Meio Escolar (Food Education at School), Referencial para uma oferta alimentar saudável (Framework for Providing a Healthy Diet) Direção-Geral de Inovação e de Desenvolvimento Curricular, Coordenadora do Núcleo de Educação para a Saúde (NES), (DGIDC – NES), (FCNAUP), October 2006, in accordance with WHO guidelines and the conclusions of the European Forum (Eating at school making healthy choices) organised by the Council of Europe in 2003, and which led to the adoption by the Committee of Ministers of the Council of Europe's Resolution ResAP (2005) 3 on 14/9/2005 in which recommendations are made regarding food in schools.

41 For the sake of simplification, let us not focus on self-endangerment as the result of hetero-determination, *id est*, dictated by another, via order, advice, recommendation (e.g. from a nutritionist) or the mere expression of a desire (for example, the husband that puts pressure on his wife to go on various diets). Worthy of independent study would be that of minors, in relation to parents' powers and educational duties.

42 Some here use the concept of increased risk for voluntary assumption of risks from certain diets.

open to new paradigms of freewill[43], will say that there can be no negative discrimination regarding access to (albeit scarce) health resources, due to the intervention of other factors (e.g. genetic predisposition)[44] beyond the control of the individual.[45]

If the authority of the State must necessarily be legitimised and tested by participative bodies and those of democratic debate, let us return to the beginning: nowadays, what should the goal of State public policy be regarding food? If we want to use a broad definition of food safety, four aspects may be involved: the dimension of the quantity and minimum consumption of calories, proteins and vitamins for a healthy and active life; the dimension of quality; the dimension of regularity and the dimension of dignity.[46] This dimension of dignity involves the idea of justice that Amartya Sen proposes as a true condition of development and one that all of us should be aware of.

43 Here, we will not focus on the influence of guilt on a person's will.

44 See recently-published studies on the link between overeating and certain variations of the FTO gene, known to be linked to body mass.

45 These figures may be relevant in relation to health problems associated with diet, may also have implications for loss of chance for the purpose of distinguishing between cases of plastic and reconstructive surgery in the case of the use of gastric bands (and respective health insurance coverage above a certain body mass index).

46 As a result of the Portuguese Constitutional Court Rulings 177/2002 and 509/2002, there is an attempt nowadays to define a minimum core of social rights, linking this with the principle of human dignity as a veto, imposed on the legislator, on the arbitrary reduction of the level of legislative implementation of a fundamental social right.

Bibliography

/ Alexandrino, J. M., 2010. Controlo Jurisdicional das políticas públicas: regra ou exceção?, *Revista da Faculdade de Direito da Universidade do Porto*, Ano VII. Coimbra: Coimbra Editora, 147 – 169.

/ Deneulin, S., 2002. Perfectionism, Liberalism and Paternalism in Sen and Nussbaum's Capability Approach. *Review of Political Economy*, 4 (4).

/ Frada, M. A. C., 2008. Nos 40 anos do Código Civil Português, Tutela da personalidade e dano existencial, Themis, *Revista da Faculdade de Direito da UNL* (Código Civil Português – Evolução e Perspetivas Atuais), Special Edition, 47-68.

/ Helsing, E., 1997. The history of nutrition policy. *Nutrition Reviews*, 55 (11), S1 SS, NOV 1997, S1-S3.

/ Neto, L., 2004. *O Direito Fundamental à disposição sobre o próprio corpo*. Coimbra: Coimbra Editora.

/ Neto, L., 2010. A nutrição como política pública: ainda a garantia ou já a restrição de direitos?, *Revista da Faculdade de Direito da Universidade do Porto*, Year VII. Coimbra: Coimbra Editora, 391-412.

/ Novais, J. R., 2010. Teoria jurídica dos direitos sociais enquanto direitos fundamentais. Coimbra: Coimbra Editora.

/ Nussbaum, M. C., 2006. *Frontiers of Justice: Disability, Nationality, and Species Membership*, Harvard University Press.

/ Nussbaum, M. C., 2007. The Supreme Court 2006 Term. Foreword: Constitutions and Capabilities: 'Perception' against lofty Formalism. *Harvard LR*, 121 (4).

/ Queiroz, C., 2006. *O princípio da não reversibilidade dos direitos fundamentais sociais, princípios dogmáticos e prática jurisprudencial*. Coimbra: Coimbra Editora.

/ Sen, A., 1999. *Development as Freedom*. Oxford University Press.

/ Sen, A., 2010. *A ideia de justiça*. Coimbra: Almedina.

/ Valente, F. *et al.*, 2007. *A Exigibilidade do Direito Humano à Alimentação Adequada Brasília* (DF), Brazil, December 2007. Available at www.abrandh.org.br.

/ Ziegler, J., 2002. *Report by the Special Rapporteur on the right to food* (Commission on Human Rights, 23rd January 2002, E/CN.4/2002/58/Add.1)

Biographies

Arlindo Cunha

Graduated in economics in 1975 at the University of Porto and gained a Master's (MPhil) and doctorate (PhD) in agricultural economics from the University of Reading (UK). He was a member and head of the coordinating committee of the Comissão de Coordenação e Desenvolvimento do Norte – CCDRN (1976-1986), Secretary of State (1986-1990) and Minister of Agriculture (1990-1994), member of the European Parliament (1994-2003), President of the CCDRN (2003-2004), Minister of Cities, Spatial Planning and Environment (2004) and President of Porto Vivo, Sociedade de Reabilitação Urbana do Porto (2004-2010). While minister, he chaired the Council of EU Ministers of Agriculture that negotiated and discussed the 1992 CAP reform and, as European MP, acted as parliament rapporteur for the CAP Reforms of 1999 and 2003, as well as rapporteur for the Agricultural Negotiations of the Doha Round of the World Trade Organisation (WTO). He is a Visiting Professor at the Economics and Management Faculty of the Universidade Católica Portuguesa-Porto, President of the Comissão Vitivinícola Regional do Dão (Dão Regional Winegrowing Commission), winegrower and producer in the Dão region, member of the Associação Portuguesa de Economia Agrária (Portuguese Agricultural Economics Association), the European Association of Agricultural Economists and member of the editorial board of the Spanish magazine *Economia Agraria y Recursos Naturales*.
He has been decorated with the Commandeur de l'Ordre du Mérite Agricole from the French government (2003) and the Ordem de Grande Oficial do Infante D. Henrique (2009).

Armando Sevinate Pinto

Gained a degree in agronomy at the Instituto Superior de Agronomia. He was Director-General of the Ministry of Agriculture (1985-1987), Director of the European Commission in Brussels, between 1987 and 1993 (EAGGF/guidance, and Rural Development), and Minister of Agriculture, Rural Development and Fisheries (from 2002 to 2004). He is Vice-President of the General Board of the University of Évora, technical coordinator of the agricultural studies firm Agroges, and consultant for the Portuguese President for agricultural and rural issues.

Augusto Manuel Correia

Studied for an agronomy degree at the Instituto Superior de Agronomia, Universidade Técnica de Lisboa, later gaining a PhD in 1991 from the same institution, where he is an Associate Professor, teaching tropical agronomy. His main research and teaching focusses include sustainable development of rural African communities, tropical agricultural production and tropical agricultural systems and their development. He was Vice-President (2001-2003) and President of Portuguese Cooperation (2005-2012) at the Ministry of Foreign Affairs, where he was responsible for the planning and implementation of Portugal's cooperation programmes with its main bilateral partners (essentially Portuguese-speaking countries in Africa and East Timor), as well as multilateral partners (United Nations organisations, the Community of Portuguese Language Countries, the Ibero-American Summit). Between 1994 and 2002, he was an international consultant in the fields of pedagogy, rural development, commercial crops and food safety in Portuguese-speaking African countries and Brazil; a national delegate at the Consultative Group for International Agricultural Research meetings; a member of the European Forum for Agricultural Research Steering Committee; a member of the Advisory Committee of the CTA/ACP and a national expert for the EU's 5th Development Aid Framework. He has published a number of books and articles on rural development, agricultural production systems and natural resources in developing countries.

Benoît Miribel

Concluded his post-graduate course (Diplôme d'études Approfondies, D.E.A.) in international relations from the University of Paris I – Panthéon-Sorbonne. Since January 2007, he has been Director General of the Fondation Mérieux in Lyon (France). He is also President of Action Contre la Faim, having been responsible for this organisation's programmes in Angola, Burma, Bosnia, Cambodia, Laos and Mozambique. Between 1997 and 2002, he was Executive Director of the Institut Bioforce Développement. He chairs the Groupe de Réflexion Urgence et Post-crise, as well as being a member of the (Re)-Sources reflection group , which is devoted to issues of sustainable development and access to water and essential services in developing countries. In 2010, along with Alain Boinet, he co-wrote a report commissioned by the French Minister of Foreign Affairs (B. Kouchner) on the evolution of humanitarian aid and its developments. He was a member of the Haut Conseil de la Coopération Internationale, an advisory body for the French Prime Minister; a member of the Nationale des Droits de l'Homme Commission, and a member of the Commission du Livre Blanc (French Ministry of Foreign Affairs). He is currently part of the Conseil Stratégique de la Coopération Non Gouvernementale, which is chaired by the French Minister of Foreign Affairs. He is father to three children and has been decorated with the Chevalier da Légion d'Honneur.

Carlos Cardoso

Studied chemical engineering (biotechnology) at Instituto Superior Técnico, Universidade Técnica de Lisboa and gained his doctorate in animal science, specialising in animal product technologies from the Instituto de Ciências Biomédicas Abel Salazar, University of Porto. Researcher at the Instituto Português do Mar e da Atmosfera – IPMA (Portuguese Sea and Atmosphere Institute). Member of the scientific council of the IPMA and involved in a number of research projects for Europe (SEQUID, ETIV, QALIBRA, SECUREFISH) and Portugal (CSF III MARE-FEDER, GOODFISH). A reviewer of scientific articles in indexed journals, he also writes them in a number of areas, ranging from technology to food toxicology. He is also involved in international studies on the risk and benefit analysis associated with fishery products consumption.

Carlos Sousa Reis

A biology graduate (scientific area), researcher, university professor and manager. The main focuses of his work are coastal development, spatial planning, living marine resources and fisheries, which has been mainly undertaken at the Science Faculty of the University of Lisbon. He has published over 50 pieces that include scientific and research dissemination articles, books and book chapters, either individually or in conjunction with other authors. As a public manager of RDT, he has occupied positions such as the President of Instituto de Investigação das Pescas (Fisheries Research Institute) and of the Instituto Português de Investigação do Mar (Portuguese Sea Research Institute) , Vice-President of the Standing Committee for Património Cultural Subaquático (Underwater Cultural Heritage), President of the Supervisory Board of DOCAPESCA- Portos e Lotas, SA, Managing Director of the Instituto de Ciência Aplicada e Tecnologia (Institute of Applied Science and Technology), as well as the Agência Cascais Atlântico, coordinator of the Finisterra programme and member of the EU's Scientific Technical Economic Committee for Fisheries. Expert assessor of RTD projects in the areas of fisheries and aquafarming for the EU, FCT (Portuguese Science and Technology Foundation) and the Junta Nacional de Investigação Científica e Tecnológica (National Scientific and Technological Research Board). Member of the Advisory Council for Fishery Management and of the Ocean Strategy Committee. In the private sector, he has worked as a company director in the agro-food, fisheries and services sectors. He currently works as a university professor, as well as a member of the Conselho Nacional da Água (National Water Board), an elected member of the Direção do Fórum Permanente dos Assuntos do Mar (Permanent Forum for Sea Affairs Board) and member of the Conselho Estratégico do Cluster do Mar da Associação Oceano XXI (Strategic Committee of the Oceano XXI Association Sea Cluster) and is a company director of different firms. He has received six public commendations: two for military office and four for public office. He has also received the Prémio do Mar – Rei D. Carlos award.

Charles Godfray

Hope Professor at Oxford University and Director of the Oxford Martin Programme on the Future of Food. Charles Godfray is a Fellow of the Royal Society and a Foreign Member of the American Academy of Arts and Sciences. He has been at Oxford since 2006 and was previously Head of Biology and Director of the NERC Centre for Population Biology at Imperial College London, where he remains a Visiting Professor. He is a population biologist with broad interests in the environmental sciences and has published in fundamental and applied areas of ecology, evolution and epidemiology. He chaired the Lead Expert Group of the UK Government's Foresight Project on the Future of Food and Farming and is a member of the strategy advisory board of the UK Global Food Security Programme and the steering group of the UK Government Green Food Project.

David Baldock

Graduated in economics and philosophy at Cambridge and has had a career in independent policy institutes. He joined the Institute for European Environmental Policy (IEEP) in 1984 and has been Director since 1998. He has been responsible for a wide range of studies on European environmental, agricultural and related policies and is an experienced observer of EU affairs. As well as independent work, he has led policy research studies for the European Commission, OECD, governments, academic funders and NGOs. He has been published widely and regularly gives evidence to parliamentary committees and government agencies. He established the Institute's agricultural policy work in the mid-1980s. Since then he has been responsible for a series of research projects on agriculture, rural development and nature conservation policy in Europe, as well as wider topics, such as climate policy. He led the Institute's work on the integration of agricultural and environmental policy within the CAP and the development of agri-environment measures. Recent work in this area includes studies on the future of the CAP, the delivery of public goods in rural areas and specific policies, such as modulation and cross-compliance.

Filomena Duarte

Graduated in engineering, specialising in agricultural economics and rural sociology in 1979, and gained a doctorate (1992) and agregação (academic title) in 2010, in agricultural economics from Universidade Técnica de Lisboa (UTL). She has been a Professor at the Instituto Superior de Agronomia (UTL) since 1979 and is currently Assistant Professor with agregação, having taught a range of subjects, such as agricultural and agro-food economics and food product marketing. She is a member of the Centro de Engenharia dos Biossistemas (Biosystems Engineering Centre), where her main research focus is on food consumption behaviour and the marketing of agricultural products and food.

Francisco Avillez

Graduated in agricultural engineering in 1970 at the Instituto Superior de Agronomia, Unioversidade Técnica de Lisboa. He gained a post-graduate qualification in rural development economics from the Institut Agronomique Méditerranéan, Centre de Hautes Études Agronomiques Méditerranéannes de Montpellier, France, in 1971 and a doctorate in agricultural economics from Instituto Superior de Agronomia, Universidade Técnica de Lisboa, in 1982. He was made a Full Professor of agricultural policy and economics at Instituto Superior de Agronomia, Universidade Técnica de Lisboa in 1993, from which he retired in March 2008. He has been an Emeritus Professor at Instituto Superior de Agronomia, Universidade Técnica de Lisboa, since December, 2008.
Founding partner and scientific coordinator of Agroges, Sociedade de Estudos e Projetos, where he began working in 1989. Coordinator of the group of experts for the post-2013 CAP Reform. Guest member of the Conselho Nacional da Água (National Water Board). Guest member of the Conselho da Região Hidrográfica do Alentejo (Alentejo Hydrographical Region Board). Member of the Conselho Geral (General Board) of the Universidade Técnica de Lisboa. Member of the Conselho das Ordens Honoríficas de Mérito Civil (Council of Civil Honours). He has participated at seminars and been involved in books and articles published in Portugal and abroad that focus primarily on the analysis and planning of investment and agricultural development projects in general and the common agricultural policy in particular.

Henrique Barros

Graduated in medicine in 1981 and has taught at the Faculdade de Medicina do Porto (Porto School of Medicine) since 1979. In 1991, he became Hospital Assistant for Gastroenterology and gained a doctorate for his research into viral hepatitis. He has been a Full Professor of Epidemiology since 1999. He oversees the Master's degree programmes in public health and sociology and health, as well as the public health doctorate programme at University of Porto. He has undertaken research on Portuguese and international projects in areas such as clinical and perinatal epidemiology, cardiovascular and infectious diseases and cancer in over 200 publications in international scientific journals. He is the Editor-in-Chief of the journal *Arquivos de Medicina*, associate-editor of the *European Journal of Epidemiology* and member of the editorial board of the journals *BMC, Public Health* and *Cadernos de Saúde Pública*. He is a member of the scientific council for health sciences for the Fundação para a Ciência e a Tecnologia (Science and Technology Foundation). He was national coordinator for HIV Infection/AIDS (2005-2012), and is currently the President of the Instituto de Saúde Pública (Public Health Institute) of the University of Porto. He was recently nominated a member of the Medical Sciences (MED) Scientific Committee of Science Europe.

Isabel do Carmo

Holds a first degree and doctorate from Lisbon's Faculdade de Medicina (Faculty of Medicine). Associate Professor with *agregação* at the same faculty. Coordinator for the Master's programme in metabolic diseases and dietary behaviour. Specialist in endocrinology.
Head of endocrinology at Hospital de Santa Maria. President of the scientific council of the DGS Platform against Obesity. Founder of the Sociedade Portuguesa para o Estudo da Obesidade (Portuguese Society for the Study of Obesity) and the Núcleo de Doenças do Comportamento Alimentar (Centre for Eating Disorders – Scientific Society). Author of scientific articles and books for the public at large.

Isabel Ribeiro

Graduated in agronomy in 2002 at the Instituto Superior de Agronomia, in 2002, after specialising in agricultural economics and rural sociology. Inspired by her curiosity, in recent years she has visited over 20 countries on four continents, where she has seen, heard and experienced other cultures and ways of life. In 2006, she decided to combine her interest in food production and respect for the environment by taking a Master's in environment and international development, where she explored the links between agriculture, environment and economic and social development in Mozambique: first analysing the country's sugar industry before going there to live and work. In recent years, she has focused her professional life on developing her knowledge of the links between food production, consumption and its impact on natural resources in Europe, and Portugal in particular. Since February 2013, she has been Assistant to the Secretary of State for Forestry and Rural Development, which is part of the Portuguese Ministry of Agriculture, Sea, Environment and Spatial Planning.

Jesús Contreras

Holds a doctorate in philosophy and literature and is a Professor of social anthropology at the University of Barcelona, specialising in economic anthropology and food anthropology. He is currently the Director of the Food Observatory in Barcelona. He has done considerable fieldwork in the Peruvian Andes, as well as in different areas of Spain. He has also been an associate researcher for the Centre National de la Recherche Scientifique (1986) and a Visiting Scholar at Cambridge University (1991-1992). He holds the Chair of Excellence, Le Studium (CNRS-Région centre, France, 2007), and is a Visiting Professor at Université paul Valéry (Montpellier, France, 2010) and a member of the Advisory Group on Risk Communications of the European Food Safety Authority. He has written around 20 books and 200 articles on his specialist areas.

José Lima Santos

Graduated in agronomy in 1987 at the Higher Institute of Agronomy (ISA) in Lisbon, in 1987, and gained his PhD from the Faculty of Law, Environment and Social Sciences of University of Newcastle upon Tyne, United Kingdom, in 1997. Employed as trainee assistant at the Department of Agricultural Economics and Rural Sociology (DAERS) of the ISA in 1987 (Associate Professor since 2005). Between 1999 and 2000, he worked for the OECD as an external expert on the economic assessment of biodiversity and on the multifunctional nature of agriculture. He worked as Director-General of the Office of Planning and Agro-food Policy at the Ministry of Agriculture between 2000 and 2003. Since 2006, he has been a member of Conselho Nacional do Ambiente e do Desenvolvimento Sustentável (National Council for the Environment and Sustainable Development), which advises the government on these issues. He has been President of DAERS since 2007. He has undertaken research focused on issues of agriculture and environment, particularly the preservation of nature and biodiversity. He developed an economic approach for conservation policies geared towards multiple environmental attributes, especially in the book *The Economic Valuation of Landscape Change: Theory and Policies for Land Use and Conservation* (1998; Edward Elgar publ.), which includes the methodological framework for the economic valuation and cost/benefit analysis of those policies, as well as a range of empirical applications.
He has taught first degree and post-graduate courses in the areas of economic and social sciences applied to agricultural, rural and environmental issues.

José Luís Domingo

Professor of toxicology and environmental health (1991) at the School of Medicine at Reus, "Rovira i Virgili" University, Catalonia, Spain. He is a founder and Director of the Laboratory of Toxicology and Environmental Health and also Director of TECNATOX. He is an Associate Professor at the Johns Hopkins University (1987), Baltimore, MD, USA. Sabbatical periods: Vanderbilt University-1985 (Nashville, TN), The University of Arizona-1986 (Tucson, AZ), and the University of California (Davis, CA): 1989, 1991 and 1993. He has had 464 peer-reviewed articles indexed in SCOPUS and 405 articles in PUBMED (September 2012). He has also published 15 chapters of books, and given more than 400 presentations at international meetings, symposia and conferences. He has supervised 23 doctoral theses (PhD).
The group he heads has been/is involved in a number of scientific projects, including current EU projects. He is Editor-in-Chief of *Human and Ecological Risk Assessment*, Managing Editor for Europe and India of *Food and Chemical Toxicology*, Associate Editor of *Environment International*, and member of the editorial board of various international journals.

Luísa Neto

Graduated in 1994, she obtained her PHD degree from the University of Porto – FDUP (2003, dissertation published as *O direito fundamental à disposição sobre o próprio corpo – a relevância da vontade na configuração do regime*, Coimbra Editora, 2004). Associated Phd Professor (with tenure) at the Faculty of Law of the University of Porto. Director of the 3rd cycle of Law Studies at FDUP. Executive Director of the post-graduate qualification in local authority and urbanism law at University of Porto's Law Faculty. She works with other scientific institutions and universities teaching degree and non-degree courses. She is a member of the pedagogical council of the Centro de Estudos Judiciários (Legal Studies Centre), elected by the Portuguese parliament. Member of the Instituto Jurídico Interdisciplinar da Faculdade de Direito da Universidade do Porto (Interdisciplinary Legal Institute of the Law Faculty, University of Porto). Member of the Centro de Investigação em Ciências Forenses (Forensic Sciences Research Centre), University of Porto. Lawyer registered (voluntarily suspended since November 2006) with the Ordem dos Advogados (Portuguese Bar Association). Main scientific research/teaching areas: constitutional law, fundamental rights, medical law and bioethics. Other research/teaching areas: administrative law and social media law.

Maria Hermínia Cabral

Director of the Gulbenkian Partnerships for Development Program since 2012, she was deputy director of the Health and Human Development Department of the Gulbenkian Foundation and, subsequently, coordinator of Health issues at the Gulbenkian Development Aid Program. From 2007 until 2011 she was executive coordinator of the Gulbenkian Environment Program and, between 2008 and 2009, of the Advanced Medical Program.
Graduated in economics from the University of Porto's Economics Faculty in 1985, gaining her Master's in cooperation and international development from the Instituto Superior de Economia e Gestão, Universidade Técnica de Lisboa in 1997.
She began working in 1985 on the Comissão de Coordenação da Região Norte (Coordinating Committee of the Northern Region), in the Studies and Planning Division (fisheries sector), working on the Integrated Management of Water Resources of the North project team.
She taught at the University of Minho (industrial costs analysis) and the Economics Faculty of University of Porto (costs accounting) between 1985 and 1988.

Maria Leonor Nunes

Head researcher at the Instituto Português do Mar e da Atmosfera (Portuguese Sea and Atmosphere Institute), Research Coordinator of the Divisão de Aquacultura e Valorização de Produtos da Pesca e Aquacultura (Division of Aquafarming and the Enhancement of Fisheries and Aquafarming Products) and national representative at the 7th Framework Programme (KBBE). Coordinator and participant in a variety of European and Portuguese research programmes in the areas of development and classification of fisheries and aquaculture products. Reviewer of scientific articles for indexed journals. Author/co-author of 22 books/chapters and over 120 scientific articles in a number of areas, ranging from technology to food toxicology. Supervisor of a number of doctorate theses and Master's dissertations and organiser of various scientific events, both in Portugal and abroad.

Pedro Graça

Associate Professor at Faculty of Nutrition and Food Sciences of the University of Porto, where he teaches nutrition policy on graduate and post-graduate courses. Director of the National Programme for the Promotion of Healthy Eating (Directorate General of Health/Portuguese Ministry of Health). Portuguese Representative at the High Level Group on Nutrition and Physical Activity – DG SANCO – European Commission. He is President of the Specialised Technical Commission of ASAE – Dietetic Products, Nutrition and Allergies. Since 1996, he has been involved with a variety of scientific research projects, publishing both in Portugal and abroad.

Tim Lang

Professor of Food Policy at City University London's Centre for Food Policy since 2002. After a PhD in social psychology at Leeds University, he became a hill farmer in the 1970s, which shifted his attention to food policy. For over 35 years, he has been engaged in academic and public research and debate about its direction, locally to globally. His abiding interest is how policy addresses the environment, health, social justice, and citizens. He has been a consultant to a number of international and British organisations in the food industry, in terms of environment and health, food related to dietary habits, globalisation and health, as well as food security and sustainability. He has been a Vice-President of the Chartered Institute of Environmental Health (since 1999) and President of Garden Organic (since 2008). He has written and co-written many articles, reports, chapters and books, the most recent being *Food Policy* (with D. Barling and M. Caraher, Oxford University Press, 2009), *Food Wars* (with M. Heasman, Earthscan 2004), *Atlas of Food* (with E. Millstone, Earthscan 2003/2008), *Unmanageable Consumer* (with Y. Gabriel, Sage 1996/2007). *Ecological Public Health* (with G. Rayner, Earthscan/Routledge) was published in May 2012. He writes frequently in the media and has written a monthly column in *The Grocer* since 2000. He rides a bicycle to work, does not own a car and grows vegetables and fruit in his London garden. His current research interests include: the definition, articulation and governance of sustainable diets; food security; how institutional structures help and hinder moves towards integrated food policies; food democracy and the growth of democratic experimentalism.